



International
Labour
Organization

Employment-intensive
Investment Programme



20th ILO Regional Conference for Labour-based Practitioners

Resilient communities and healthy environment: The Employment Intensive Investment (EIIP) approach

Technical Papers

► Addis Ababa, Ethiopia
19 - 23 May 2025



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► Impact of voluntary sustainability standards on decent rural employment

Evidence from smallholder coffee farms and cooperatives

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Abstract

Voluntary Sustainability Standards (VSS) have gained prominence in global sustainability discussions, aligning with the United Nations Sustainable Development Goals (SDGs), particularly those related to decent work and economic growth. This study examines the impact of Fairtrade and organic certification on decent rural employment among wage workers in Ethiopia's smallholder coffee sector, focusing on key employment indicators, including wages, contracts, working conditions, training, and job satisfaction. Data were collected from 560 wage workers across six woredas using a multi-stage sampling approach. To address potential endogeneity, the analysis employs Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and IV Probit models. The findings reveal differentiated effects of certification across organizational contexts. Certification significantly increases access to formal contracts for both cooperative and farm-based workers. However, cooperative workers benefit more from certification, particularly in training and capacity-building in areas such as gender, child labor, occupational health, and coffee processing. Conversely, household/farm workers experience limited improvements, facing structural barriers that restrict certification benefits. Certification enhances working conditions and provides in-kind benefits (e.g., housing, food, and healthcare), but social integration remains largely unchanged. Job satisfaction improves moderately among cooperative workers, whereas no significant changes are observed for household/farm workers. The Decent Work Index (DWI) confirms that certification improves cooperative workers' labor conditions but has no measurable effect on household/farm workers. These findings highlight the need for tailored certification frameworks, stronger enforcement, and targeted training programs to ensure VSS more equitably support rural employment in developing economies.

Key words: Voluntary Sustainability Standards; Decent Rural Employment; coffee; smallholders; Cooperative; Ethiopia

Introduction

Agricultural labor constitutes a significant portion of the global workforce, with approximately 940 million individuals, or 28% of the labor force, engaged in agriculture, primarily as small-scale farmers or rural laborers (ILO, 2020). Despite its critical role in employment and economic output, the rural economy is still marked by informal employment, poor working conditions, and widespread poverty, with rural populations accounting for nearly 80% of the global poor. Many agricultural workers endure low wages, lack social protection, and face hazardous working environments with limited access to essential services such as healthcare and education (FAO, 2017). A 2020 ILO study reported that 73% of rural workers in developing regions lacked access to social protection, including health insurance, pensions, or unemployment benefits (ILO, 2020; Krumbiegel et al., 2018). Structural challenges such as seasonal employment patterns, exposure to hazardous agrochemicals, and weak enforcement of labor regulations exacerbate these conditions (Meemken et al., 2019). Rural women, in particular, experience precarious employment with minimal social security and limited advancement opportunities (UN Women, 2019), underscoring the urgent need for policies aimed at improving rural labor conditions.

Voluntary Sustainability Standards (VSS) have emerged as a market-based instrument to address these challenges by promoting decent work in global agricultural value chains. These standards align with the Sustainable Development Goals (SDGs), particularly SDG 8 on decent work and economic growth (Blankenbach, 2020; Bissinger et al., 2020), and are designed to enhance fair wages, safe working conditions, and labor protections in agricultural production (Bennett, 2018). As agrifood systems globalize, VSS are increasingly viewed as mechanisms to improve labor conditions and reduce rural poverty (Meemken et al., 2019; Krumbiegel et al., 2018). Many VSS integrate core International Labour Organization (ILO) principles, offering an opportunity to elevate labor standards in contexts where regulatory oversight is weak (Meemken et al., 2019). Empirical evidence suggests that the expansion of global agricultural value chains and stringent sustainability standards can foster the formalization of rural employment, displacing informal and family labor in smallholder settings and reshaping rural labor markets (Fabry et al., 2022; Maertens et al., 2018; Rao & Qaim, 2013).

Fairtrade, one of the most recognized VSS, enforces rigorous labor standards, including provisions on wages, child and forced labor, occupational health and safety, social protection, collective bargaining, non-discrimination, and formal employment arrangements. However, concerns persist that stringent labor requirements may undermine the competitiveness of countries with lower labor standards, particularly those reliant on low labor costs (IMF, 2017).

Despite increasing research on VSS, empirical studies on their impact on rural employment and job quality remain limited, particularly regarding workers in smallholder farms and cooperatives within the coffee sector. Existing literature predominantly examines the economic and environmental dimensions of VSS, while the social dimension—especially decent rural employment—has received comparatively less attention (Barham & Weber, 2012). While studies highlight VSS-related benefits such as improved farm gate prices and market access (Minten et al., 2018; Mitiku et al., 2018; Chiputwa et al., 2015), their effects on employment conditions, including wages, working hours, and social protection, remain underexplored (Oya et al., 2018; Terstappen et al., 2013). Existing research studies often focuses on wage laborers in plantation or agro-industrial settings (Van Rijn et al., 2020; Krumbiegel et al., 2018; Said-Allsopp & Tallontire, 2014), neglecting smallholder farm and cooperative workers, who constitute the majority of the rural workforce (Maertens & Fabry, 2019; Meemken et al., 2019).

Additionally, methodological limitations—such as small sample sizes, lack of representative data, and absence of credible noncertified counterfactuals—challenge the robustness of existing findings (Van Rijn et al., 2020). Consequently, evidence on the effects of VSS on rural employment remains fragmented and sometimes contradictory, influenced by variations in certification schemes, implementation practices, and broader socioeconomic contexts. Addressing these gaps is critical to understanding the long-term implications of VSS on rural labor markets and to designing interventions that maximize their benefits while mitigating potential adverse effects. Strengthening decent rural employment is vital for reducing poverty and fostering sustainable rural development by ensuring stable incomes and improved working conditions for agricultural workers (ILO, 2020).

This study is significant for three key reasons. First, it addresses a critical gap in the literature by examining the working conditions of wage laborers in smallholder farms and cooperatives, a group often overlooked in favor of plantation and agro-industry workers. Second, it systematically integrates wage worker data with household and cooperative organizational data, facilitating a comprehensive analysis that considers multiple influencing factors. The use of both farm and cooperative worker data enables a comparative analysis within the context of sustainability standards, strengthening the robustness of findings. Thirdly, while efforts are made to ensure living wages for workers to cover basic living expenses in recent studies (Anker & Anker, 2017), there is a notable lack of focus on other working conditions that significantly affect worker well-being (Van Rijn et al., 2020). To address this gap, this study develops a composite decent work index, offering a multidimensional assessment of employment quality, including wages, working conditions, social protection, and employment security. This holistic approach provides critical insights into the impact of VSS on employment conditions in smallholder coffee farms and cooperatives, contributing to the broader dialogue on sustainable rural livelihoods.

The study examines two key research questions: (1) Do Voluntary Sustainability Standards enhance wage earnings on small farms and cooperatives, as measured by hourly wages and working hours per day, week, and month? (2) How do VSS influence working conditions for waged workers on small farms and cooperatives, as measured by a composite decent work index incorporating other non-wage aspects of employment conditions?

Literature review

Decent work, as defined by the International Labour Organization (ILO), refers to "productive work for women and men in conditions of freedom, equity, security, and human dignity" (International Labour Organization, 1999). It is a central pillar of global frameworks such as the Sustainable Development Goals (SDGs) and the ILO Decent Work Agenda, emphasizing job quality as a driver of poverty reduction, social inclusion, and sustainable development (ILO, 2018; Katila et al., 2019). Over time, development frameworks have expanded to incorporate key employment dimensions, including wages, working conditions, social protection, and labor rights (Maertens & Fabry, 2019).

Voluntary Sustainability Standards (VSS) are increasingly recognized for their role in shaping decent work conditions in agricultural value chains. The United Nations Forum on Sustainability Standards defines VSS as requirements for producers, traders, manufacturers, and service providers to uphold environmental, social, and economic sustainability criteria (De Cordoba et al., 2018). While numerous studies have examined VSS in agriculture, their direct impact on decent work remains underexplored. Most research considers decent work within broader social impacts, such as labor conditions, education, health, nutrition, gender equality, and community well-being (Chiputwa et al., 2015; Van Rijsbergen et al., 2016; Meemken et al., 2017). Although VSS can enhance economic opportunities, including job creation, wage improvements, and better working conditions, challenges persist in ensuring widespread benefits.

Evidence suggests that VSS adherence can increase labor demand and wages, primarily due to the intensive management practices required for certification (Meemken et al., 2019; Krumbiegel et al., 2018; Kilian et al., 2016). Fairtrade certification, in particular, has been associated with higher wages and improved social benefits (Meemken et al., 2019). In Ghana, Fairtrade-certified pineapple plantation workers earned significantly higher wages than their counterparts on noncertified farms (Krumbiegel et al., 2018). Similarly, Schuster and Maertens (2016) observed that Peruvian horticultural export workers in certified firms had a higher probability of earning at least the minimum wage. Organic certification is also linked to increased labor demand due to its labor-intensive nature (Organic Trade Association, 2010), and Rainforest Alliance certification has been associated with improved rural labor conditions (Minten et al., 2018).

However, some studies challenge the assumption that certification consistently leads to better wages. Cramer et al. (2014) found no significant wage benefits of Fairtrade certification in the tea, coffee, and flower sectors in Uganda and Ethiopia. Similarly, Riisgaard and Gibbon (2014) highlighted the inconsistency of Fairtrade wage improvements. The variability in outcomes suggests that while VSS can increase labor demand, the effects on employment are highly context-dependent (Oya et al., 2017). In some cases, certification adoption may even reduce labor needs due to mechanization or farm consolidation (Loconto & Dankers, 2014; Dragusanu & Nunn, 2014). Although VSS can facilitate market access, they may also create dependency on niche markets, leading to job losses when demand fluctuates or certification criteria are not met (DeFries et al., 2017; Bemelmans et al., 2023).

VSS frequently include labor rights protections and occupational safety regulations, potentially improving working conditions (Meemken et al., 2019; Van Rijn et al., 2020; Ruben & Fort, 2012). For instance, Fairtrade certification has been associated with enhanced labor conditions on Kenyan tea plantations (Said-Allsopp & Tallontire, 2014). However, enforcement challenges, particularly in informal labor markets, limit the realization of these benefits (Loconto, 2015; Bitzer & Glasbergen, 2015). While VSS aim to mitigate issues such as child labor and worker exploitation, their effectiveness varies due to persistent enforcement gaps (Berthet et al., 2018; Oya et al., 2018). Some studies also indicate that despite wage and condition improvements, excessive working hours and precarious contracts remain issues (Krumbiegel et al., 2018).

Overall, the effectiveness of VSS in promoting decent work is highly variable. While some studies indicate benefits in terms of wages and working conditions, others reveal persistent challenges, including weak enforcement and continued exploitative practices, particularly in developing countries (Elliott, 2018; Loconto, 2015; Raynolds, 2017). The impact of VSS depends on local contexts, the specific certification scheme, and the extent of compliance oversight.

Participation in VSS often involves substantial training and capacity-building initiatives (Meemken et al., 2019; Krumbiegel et al., 2018; Schuster & Maertens, 2016). Organizations that promote VSS frequently implement training programs to improve rural workers' skills (Nelson & Phillips, 2017), facilitating the adoption of sustainable agricultural practices and increasing overall productivity. This is crucial for generating decent employment opportunities, particularly in regions where agricultural knowledge gaps exist.

VSS can promote the inclusion of marginalized groups, including women, migrants, and youth (Krumbiegel et al., 2018; Van den Broeck & Maertens, 2016). However, challenges persist, particularly in Sub-Saharan Africa, where women and young workers often face poor labor conditions (Rubin et al., 2019). Women's participation in global value chains can yield developmental benefits, increasing their income opportunities and roles in agricultural systems (Krumbiegel et al., 2018; Van den Broeck & Maertens, 2016). Nonetheless, barriers such as limited decision-making power and unequal certification benefits persist (Nelson & Martin, 2015; Lyon et al., 2010).

The impact of VSS on cooperative workers remains underexplored, yet cooperatives play a crucial role in promoting decent work and improving farmer livelihoods (Majee & Hoyt, 2011). Research suggests that VSS-aligned cooperatives experience greater member engagement and social capital, leading to better employment outcomes (Majee & Hoyt, 2011). For instance, Fairtrade certification in Côte d'Ivoire's cocoa sector was found to improve wages and reduce poverty among cooperative workers but not among farm workers (Meemken et al., 2019; Oya et al., 2018; Cramer et al., 2014).

The effects of VSS on rural employment in coffee farming are mixed. Some studies suggest that certification fosters more stable and well-paid jobs, improved labor conditions, and enhanced worker rights (Bacon, 2005; Beuchelt & Zeller, 2011). Beuchelt and Zeller (2011) found that Fairtrade certification was associated with higher wages and improved conditions for cooperative coffee workers. However, other studies report limited or even negative impacts, citing concerns about producer exclusion and increased workloads without adequate compensation (Cramer et al., 2014; Chiputwa et al., 2015).

Overall the existing literature indicates that while VSS have the potential to enhance wages, working conditions, and labor rights, their overall impact on decent rural employment is context-dependent, shaped by certification schemes, crop types, and local labor market dynamics.

Methodology

This section outlines the methodology employed in the study, organized into three subsections. The *study area and sampling procedure* describes the geographic scope and the multi-stage sampling approach used to select participants. The *survey design and data collection* subsection details the tools and processes for gathering data on employer and worker characteristics, employment conditions, and related outcomes. Finally, the *analytical framework* introduces the variables and explains the econometric models used in the analysis.

Study area and sampling procedure

The study evaluates the impact of VSS on decent rural employment, focusing on smallholder coffee farms and cooperatives in Ethiopia's Sidama region. Sidama was chosen due to its status as the leading coffee-producing area in the country, which is particularly noted for its washed coffee and its long history of cooperative participation in VSS certifications. The region covers 10,000 km², with approximately 48.7% of the land used for farming. It also includes varying land types, such as forests (2.29%), shrubland (5.04%), grazing land (17.47%), uncultivated land (18.02%), and unproductive land (6.38%). Sidama's climate is categorized into three zones: *cool* (16% of the area, 2500–3500 meters above sea level), *warm* (54%, 1500–2500 meters), and *hot* (30%, 500–1500 meters), and The region receives annual rainfall ranging from 1600 mm to 1999 mm. Sidama's economy is predominantly agrarian, with coffee being the main income source for many rural households.

To gather preliminary data, visits were conducted to various pertinent offices, including federal and regional Agriculture and Rural Development Offices, the Coffee and Tea Authority, the Cooperatives Agency, and Sidama coffee farmers' cooperative unions, and these visits helped identify key coffee-producing areas (woredas) and compile a list of coffee cooperatives, their VSS certifications, and household data from official registries.

The Sidama region is home to about 57 primary coffee cooperatives involving around 85,000 smallholder farmers cultivating 8,000 hectares of Arabica coffee. VSS participation is widespread in the region; according to Minten et al. (2018), the cooperatives certification percentage by the time was Fairtrade (87.2%), Organic (83%), Rainforest (6.4%), and UTZ (10.6%). However, during the survey, Rainforest Alliance and UTZ certifications were found to be inactive. Currently, 41 cooperatives are Fairtrade-certified, and 32 are Organic-certified, with all Organic-certified cooperatives also holding Fairtrade certification. Double certification is common in Ethiopia, which is Africa's largest exporter of organic and Fairtrade coffee (Winter et al., 2020). Thus, this study specifically focuses on the impact of the Fairtrade-Organic double certification, henceforth referred to as "VSS certification."

The study employed a rigorous multi-stage sampling methodology focused on coffee wage workers across six coffee-producing woredas: Dale, Wonsho, Aleta Wondo, Bursa, Shebedino, and Lokabaya. These woredas were selected due to their substantial coffee production capacity. The sample included all 12 Fairtrade-Organic double-certified and eight noncertified cooperatives, establishing treatment and control groups respectively. Two categories of wage workers were targeted: those employed by coffee-producing households affiliated with the cooperatives and those employed by cooperative organizations engaged in coffee processing.

The sample size was determined using Cochran's formula, which assumes a confidence level of 95%, a margin of error of 5%, and an estimated proportion of 0.5 to account for maximum variability. This size was subsequently adjusted using Finite Population Correction (FPC) to accommodate the limited population sizes. The total population of households comprised 46,248 individuals who were members of both certified and noncertified cooperatives, with at least one employed wage worker. Although the FPC-adjusted sample size recommendation was 380, the final sample was set at 340 wage workers due to logistical constraints and the necessity to ensure proportional representation across treatment and control groups. The distribution of the sample was conducted randomly, proportional to group size, resulting in 200 wage workers from certified households and 140 from noncertified households. From a total of 515 wage workers in both certified and noncertified cooperatives, 220 samples were randomly selected (120 from certified and 100 from noncertified cooperatives, proportional to their sizes). The final sample comprised 560 wage workers: 200 household workers from certified households, 140 from noncertified households, 120 cooperative workers from certified cooperatives, and 100 from noncertified

cooperatives. Power analysis indicated that the sample sizes for both household and cooperative workers were adequate to detect a minimum effect size of 0.2, with power exceeding the desired threshold of 0.80 at a 95% confidence level. This ensures robust statistical validity of the findings.

Survey design and data collection

Given the lack of comprehensive labor quality data in many low-income countries, particularly regarding returns to labor and working conditions in the rural agricultural sector, this study required a tailored survey instrument to assess the impact of Voluntary Sustainability Standards (VSS) on decent rural employment in the coffee sector. The instrument was designed to capture relevant metrics on rural employment, labor returns (wages), and non-wage indicators of decent work, such as metrics on working time (weekly hours, unsocial hours, and work intensity), job stability (contract type, employment status, and tenure), and safety (availability of health facilities, incidence of work-related accidents, and exposure to hazardous materials).

In order to improve the validity of the analysis, both internal and external, the survey design was specifically structured to address potential measurement errors and coverage gaps. A unique questionnaire was developed to effectively differentiate between wage employment and self-employment, a common challenge in household surveys that can lead to misleading representations of rural labor dynamics. The survey design also tackled the debate over the appropriate unit of observation—whether to focus on the household or the individual laborer employed by the household. By employing a dual data collection approach, the instrument gathered responses from both household representatives (proxy respondents) and the wage workers themselves. This approach aligns with the perspective advocated by Oya et al. (2018), emphasizing the individual laborer as the primary observation unit while linking this information back to household data through identification codes. For workers directly employed by the cooperative, distinct questionnaires tailored to capture the workers' returns and working conditions in the cooperatives are used.

The survey was conducted during the main coffee harvesting season to ensure the inclusion of all potential workforces, including local migrant workers. In the data collection phase, a strong emphasis was placed on minimizing interviewer-related errors. Skilled enumerators were selected based on their educational background, language proficiency, and motivation. They underwent extensive training to ensure a deep understanding of the questionnaire and its conceptual framework, particularly regarding the notion of "Decent Work." The survey instrument was pre-tested on a sample of households to ensure the indicators were understood accurately in the local context. Throughout the data collection process, close supervision was maintained, and a brief explanation was provided to respondents to encourage accurate and honest responses. Finally, each completed questionnaire was thoroughly checked for completeness, and any identified gaps or inaccuracies were verified and corrected as necessary.

Analytical framework

This section presents the analytical framework adopted to evaluate the impact of Voluntary Sustainability Standards (VSS) certification on decent rural employment. The analysis utilizes a combination of econometric models, including Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and Instrumental Variable (IV) Probit models, to estimate the causal effects of certification. The 2SLS and IV probit models isolate exogenous variation in certification adoption and address unobserved confounders and reverse causality using instrumental variables (IV). Similar approaches have been applied in the literature to estimate the impact of sustainability certifications. For example, Krumbiegel et al. (2018) used IV methods to investigate Fairtrade certification's effects on wages and job satisfaction among plantation workers in Ghana. Similarly, Meemken et al. (2019) applied the IV method to analyze Fairtrade's impact on the livelihoods of poor rural workers in Côte d'Ivoire.

Description of variables

Dependent variables

The study assesses nine composite dependent variables as indicators of decent work based on the ILO's concepts and definitions, as well as the VSS's social and economic impact pathways, as described by Fabry et al. (2022) and Van Rijn et al. (2020). These variables reflect VSS's aim to improve worker conditions through fair wages, formal employment, social inclusion, training, and safety, supported by relevant theoretical frameworks and empirical evidence:

- *Wage*: Measures wage improvements driven by the Fairtrade Minimum Price and Premium, enhancing producers' capacity to pay fair and stable wages. Rooted in marginal productivity theory and distributive justice, this reflects how VSS promote equitable income distribution (Borjas, 2016).
- *Employment Contract*: Captures the formalization of employment relationships to reduce informality and enhance job security. Institutional theory explains how VSS acts as a governance mechanism to improve labor practices (Ponte, 2020).
- *Social Integration*: Assesses participation in decision-making, gender equity, and community involvement. Social capital theory supports the role of VSS in fostering bonding and bridging social ties (Putnam, 2000).
- *Public Education and Health Services*: Tracks community investments funded by the Fairtrade Premium, including education and healthcare access. Grounded in public goods theory and the capability approach, these investments enhance human development and well-being (Sen, 1999).
- *Job Satisfaction*: Evaluates satisfaction with wages, job security, working conditions, and recognition. Supported by Herzberg's Two-Factor Theory and Job Characteristics Model, VSS improve workplace experiences (Herzberg, 1966).
- *Training on Social Issues*: Reflects capacity building in gender equality, child labor prevention, health, and nutrition. Human capital theory and transformative learning theory explain how VSS improve knowledge, productivity, and social awareness (Mezirow, 2008).
- *Training on Coffee Production*: Examines skill development in sustainable farming, processing, and quality control. Human capital theory supports the link between training, productivity, and increased incomes (Becker, 2009).
- *Working Conditions and Benefits*: Evaluates compliance with occupational health and safety (OHS) standards, including the use of protective equipment and benefits like leave and transportation. This aligns with OHS frameworks and labor rights principles (ILO, 2018).
- *Healthcare and Work-Related Accidents*: Measures healthcare access and the incidence of workplace hazards. Rooted in the OHS hierarchy of controls, VSS aim to minimize risks and ensure worker well-being (Gunningham, 2007).

To construct the Decent Work Index (DWI), we employed Principal Component Analysis (PCA), a statistical method that reduces dimensionality while retaining the maximum variance in the data. We used the above nine key indicators of decent work to comprehensively capture its multi-dimensional nature.

Before conducting PCA, we standardized all variables using Z-score standardization, ensuring comparability by transforming them to have a mean of zero and a standard deviation of one. We then assessed the suitability of the data for PCA using Bartlett's test of sphericity, confirming intercorrelations among the selected indicators. Given the structural differences between employment types, we conducted separate PCA analyses for household wage workers and cooperative wage workers. The results indicated that the first principal component (PC1) had an eigenvalue of 1.815 for household workers and 1.87 for cooperative workers, explaining 20.17% and 20.79% of the total variance, respectively. This justified the use of PC1 as a composite measure of decent work conditions.

The scree plots further validated PC1 as the dominant dimension of decent work, while factor loadings confirmed that multiple indicators significantly contributed to this construct. Based on these findings, we extracted PC1 and used it as the Decent Work Index, where higher values indicate improved working conditions. This data-driven approach provides an objective and robust measure of decent work outcomes among smallholder coffee farm and cooperative wage workers, facilitating rigorous empirical analysis.

Independent Variables

The independent variables include the characteristics of both wage workers and their employers. Wage worker variables include age, gender, marital status, education level, household size, and employment status. Employer variables encompass age, gender, education, non-farm participation, coffee farming experience, land ownership, and farm size. For cooperatives, additional variables include worker characteristics, cooperative membership, managerial structures, and financial performance indicators (e.g., liquidity, leverage, efficiency, and profitability). These variables provide context for analyzing the impacts of VSS and the mechanisms through which they operate.

Model specification

We began our analysis using an Ordinary Least Squares (OLS) Model to estimate the impact of certification status on various decent work outcome indicators. Separate regressions are performed for wage workers at both the household and cooperative levels, and distinct models are estimated for each decent work indicator. These indicators include hourly wage, contract type, and composite indexes - the arithmetic mean used to combine multiple indicators into a single representative measure for a particular dimension of decent work, as specified in the variable list. To comprehensively capture decent work as an outcome, we compute the arithmetic mean of indicators within each decent work category.

We estimate the outcome indicators (Y) as a function of wageworker characteristics (X), certification status (C), and contextual characteristics (Z). Specifically:

General model

$$Y_i = f(C, X_i, Z) \quad (1)$$

Here:

- Y_i : Outcome indicator for wage workers, either at the household or cooperative level.
- C : Certification status (1 if certified, 0 otherwise). For households, this is the certification status of the household through its cooperative; for cooperatives, this is the certification status of the cooperative.
- X_i : Wageworker characteristics (e.g., gender, education, age, type of job, work experience).
- Z : Contextual characteristics. For households, this includes household-level covariates (e.g., demographics, education, assets, work experience). For cooperatives, this includes cooperative-level covariates (e.g., efficiency and productivity factors).
- ε_i : Random error term.

We operationalize the functional relationship as a linear regression model similar to Fabry et al. (2022) and Meemken et al. (2019):

$$y_i = \alpha_0 + \alpha_1 C + \alpha_2 Z + \alpha_3 X_i + \varepsilon_i \quad (2)$$

Here:

- y_i : Decent work outcome indicator (e.g., hourly wage, contract type, composite indexes).
- α_0 : Intercept.
- α_1 : Coefficient for certification status (C).
- α_2 : Coefficients for contextual characteristics (Household and Cooperative) (Z).
- α_3 : Coefficients for worker characteristics (X_i).
- ε_i : Random error term clustered appropriately at the household or cooperative level.

Addressing potential bias with robustness checks

Although we control for observed characteristics in the covariates, the OLS model may not fully address unobserved heterogeneity that could be correlated with both certification and decent work outcomes. To address this, we implement instrumental variable methods, specifically Two-Stage Least Squares (2SLS) and IV Probit models. The use of 2SLS and IV Probit models is essential to address potential endogeneity in the certification status variable (C), which may arise due to unobserved factors that influence both certification and decent work outcomes. For instance, factors such as cooperative management quality or worker motivation could simultaneously affect the likelihood of certification and employment conditions, leading to biased OLS estimates. 2SLS and IV Probit provide unbiased and consistent estimates of certification's impact by using an instrumental variable that is correlated with certification but not with the error term in the outcome equation. IV Probit is particularly used for binary outcomes such as contract type as it accounts for the nonlinear nature of these variables, unlike linear models. We cluster errors at the cooperative level to further ensure that the standard errors are robust to within-group correlations, which is crucial for cooperative workers. These models complement OLS by addressing unobserved heterogeneity and ensuring robustness for different types of outcome variables.

We used two instrumental variables (IV): "years of cooperative membership" and "Years since cooperative establishment" for farm/household workers and cooperative workers, respectively. Using "years of cooperative membership" as an instrumental variable (IV) for farm workers is appropriate because it strongly correlates with the likelihood of certification without directly influencing decent work outcomes, except through certification. Certification is often granted to cooperatives rather than individual workers or households, and longer membership durations are associated with greater exposure to certification initiatives, training, and compliance processes. This aligns with previous research showing that cooperative membership facilitates access to collective benefits such as certification (van Rijsbergen et al., 2016; Ruben & Fort, 2012). Moreover, membership duration is unlikely to independently affect individual employment outcomes like wages or contract types, provided we control for relevant worker and cooperative characteristics. This exclusion restriction strengthens its validity as an instrument. Thus, "years of cooperative membership" effectively captures selection into certification while addressing endogeneity concerns in assessing the impact of Voluntary Sustainability Standards on decent work outcomes.

"Years since cooperative establishment" is used as an instrumental variable (IV) for cooperative workers as it measures the length of time a cooperative has been operational, serving as a proxy for its experience, capacity, and likelihood of achieving certification. Older cooperatives are generally more established, often possessing the organizational infrastructure, financial resources, and market linkages needed to adopt VSS certification (Fairtrade International, 2021). Importantly, while this variable strongly influences the probability of a cooperative attaining certification (relevance criterion), it is unlikely to directly affect the working conditions of cooperative employees, apart from its indirect effect through certification (exogeneity criterion). For instance, the age of the cooperative does not inherently determine whether workers receive formal contracts, training on social issues, or improved working conditions—all outcomes tied directly to VSS requirements. Therefore, "Years since cooperative establishment" satisfies the necessary conditions for a valid IV and can be effectively utilized in econometric models like 2SLS and IV probit to address potential endogeneity bias when estimating the causal effects of VSS certification on employment outcomes.

The F-statistics were computed for the instruments "Years of Cooperative Membership" (for farm/household workers) and "Years since Cooperative Establishment" (for cooperative workers) to assess instrument strength. In both cases, the F-statistics is greater than 10 (the threshold value), indicating that the instruments are sufficiently strong and satisfy the relevance criterion for instrumental variable analysis.

The following is the 2SLS and IV Probit models specifications. The models are specified for both household and cooperative workers, taking into account clustering for cooperative workers.

Two-stage least squares (2SLS) model

The 2SLS model is appropriate when there is concern about endogeneity in the certification status (C) due to unobserved factors influencing both certification and decent work outcomes. It involves two stages:

First Stage: Predicting Certification Status

The first stage estimates the relationship between certification status and the instrumental variable (IV), controlling for relevant covariates. The equation is as follows:

$$C_{ij} = \pi_0 + \pi_1 IV_{ij} + \pi_2 Z_j + \pi_3 X_{ij} + v_{ij} \quad (3)$$

Where:

- C_{ij} : Certification status (1 if the cooperative/household is certified, 0 otherwise) for worker i in cooperative/household j .
- IV_{ij} : Instrumental variable (e.g., years of cooperative membership).
- Z_j : Cooperative or household-level covariates (e.g., efficiency, productivity, demographics, assets).
- X_{ij} : Worker-level covariates (e.g., age, education, gender, work experience, type of job).
- v_{ij} : Error term.

For cooperative workers, clustering is applied at the cooperative level to account for correlated observations within the same cooperative.

Second Stage: Outcome Equation

The second stage uses the predicted certification status C_{ij} from the first stage to estimate its impact on the decent work outcome y_{ij} :

$$y_{ij} = \beta_0 + \beta_1 C_{ij} + \beta_2 Z_j + \beta_3 X_{ij} + \varepsilon_{ij} \quad (4)$$

Where:

- y_{ij} : Decent work outcome indicator (e.g., hourly wage, contract type, composite indexes).
- C_{ij} : Predicted certification status from the first stage.
- Z_j : Cooperative or household-level covariates.
- X_{ij} : Worker-level covariates.
- ε_{ij} : Error term (clustered at the cooperative level for cooperative workers).

IV probit model

The IV Probit model is used for binary or ordinal outcome variables. It explicitly accounts for the nonlinear nature of these outcomes and potential endogeneity in certification status.

First Stage: Predicting Certification Status

For the IV Probit model, the first stage estimates a latent variable for certification status:

$$C_{ij}^* = \gamma_0 + \gamma_1 IV_{ij} + \gamma_2 Z_j + \gamma_3 X_{ij} + \eta_{ij} \quad (5)$$

Where:

- C_{ij}^* : Latent variable for certification status.
- $C_{ij} = 1$ if $C_{ij}^* > 0$; otherwise, $C_{ij} = 0$.
- Remaining terms are as defined earlier.

Second Stage: Outcome Equation

The second stage models the latent decent work outcome variable (y_{ij}^*) as a function of the predicted certification status (C_{ij}):

$$y_{ij}^* = \delta_0 + \delta_1 C_{ij} + \delta_2 Z_j + \delta_3 X_{ij} + \epsilon_{ij} \quad (6)$$

Where:

- y_{ij}^* : Latent variable for the outcome (e.g., likelihood of having a formal contract, satisfaction with working conditions).
- For binary outcomes: $y_{ij} = 1$ if $y_{ij}^* > 0$; otherwise, $y_{ij} = 0$.
- For ordinal outcomes: The latent variable is categorized based on thresholds.

Clustering is applied at the cooperative level for cooperative workers to account for within-cooperative correlations.

Results

This section presents the findings of the study, integrating descriptive and econometric analyses. The descriptive analysis characterizes employer households, cooperative structures, wage workers' demographic and socioeconomic attributes, employment patterns, wages, working conditions, and training opportunities. It also examines job satisfaction and related work outcomes. The econometric analysis estimates the causal impact of Voluntary Sustainability Standards (VSS) on key decent work indicators.

Rural employment and working conditions: a descriptive analysis

The coffee sector in Ethiopia is a vital pillar of the nation's economy, supporting the livelihoods of millions, predominantly smallholder farmers. Over 95% of coffee production comes from farms smaller than one hectare, impacting approximately 30 million people, and it provides direct and indirect employment to around 15 million individuals (USDA, 2024). Ethiopian coffee farming typically involves a mix of permanent and seasonal labor. Seasonal workers are primarily employed during the harvest season, which spans from October to January, and constitute 78% of household employees, with each household employing an average of six workers for three to five months, mainly for harvesting ripe cherries and processing coffee. Larger smallholder farms may hire 20 to 30 seasonal workers during peak harvest times. In contrast, permanent workers are engaged year-round in activities such as weeding, pruning, nursery maintenance, and coffee processing. Most smallholder farms, however, rely on family labor and rarely employ permanent workers, depending on the size of their operations.

Cooperatives similarly depend on seasonal labor, employing 20–100 workers during peak processing periods for sorting, drying, and milling coffee. Cooperatives also employ 7–20 permanent workers responsible for administrative tasks, equipment maintenance, and community engagement. The following analysis distinguishes employer households and cooperatives based on certification status.

Employer households and cooperative characteristics

Table 1 summarizes key characteristics of employer households. The sample is predominantly male-headed (98%), with an average household head age of 49.4 years. Educational attainment is generally low, though certified farmers exhibit slightly higher education levels. Certified households have larger families (6.5 members) and employ more family labor (4.94) compared to noncertified households. Seasonal labor utilization is significantly higher among certified farmers, who hire an average of 6.48 workers compared to noncertified counterparts. Certified farmers also have greater farming experience (29.9 years) and longer cooperative membership durations. Noncertified households demonstrate higher engagement in nonfarm activities (50% participation). Land ownership averages 1.93 hectares per household, with certified farmers allocating a larger proportion (0.69) to coffee cultivation.

Cooperatives exhibit institutional heterogeneity. Performance metrics—including profitability, leverage, liquidity, and efficiency ratios—indicate superior outcomes for certified cooperatives (Table 1). Certified cooperatives also have a larger average membership (3,235 vs. 1,110 members) and employ professional managers, a feature absent in noncertified cooperatives. These differences suggest enhanced institutional capacity among certified cooperatives, potentially influencing labor conditions and benefits distribution.

► **TABLE 1. Summary statistics of employers' characteristics by their VSS certification status**

Household/Farm Characteristics				¹ Cooperative Characteristics			
Variable	Total (N=340)	Noncertified (N=140)	Certified (N=200)	Variable	Total (N=220)	Noncertified (N=100)	Certified (N=120)
Employer HH size	6.10 (2.09)	5.49 (2.10)	6.53*** (1.97)	Cooperative Member	2269.32 (1430.99)	1109.96 (519.54)	3235.45*** (1213.76)
Employer Age	49.39 (12.44)	48.79 (11.59)	49.80 (13.01)	Cooperative Employed Manager	0.50 (0.50)	0.00 (0.00)	0.92*** (0.28)
Employer Gender (Male=1)	0.98 (0.14)	0.98 (0.15)	0.98 (0.14)	Liquidity Ratios-Current Ratio	1.44 (0.49)	1.06 (0.23)	1.76*** (0.40)
Employer Education	3.66 (2.68)	3.21 (1.98)	3.98*** (3.04)	Leverage Ratios-Debt to Equity	1.20 (0.19)	1.22 (0.20)	1.18 (0.17)
Employer Non-farm Participation	0.34 (0.49)	0.50 (0.54)	0.24*** (0.43)	Efficiency Ratio-Asset Turnover	1.99 (0.65)	1.60 (0.41)	2.31*** (0.64)
Employer Coffee Farming Years	26.92 (10.97)	22.54 (10.63)	29.99*** (10.16)	Profitability Ratios-Gross Profit Margin %	12.24 (2.16)	10.84 (1.33)	13.40*** (2.03)
Employer Total land owned	1.93 (0.99)	2.03 (0.85)	1.87 (1.08)				
Employer Area under coffee	0.56 (0.36)	0.37 (0.25)	0.69*** (0.36)				
Year Coop Membership	19.96 (11.12)	10.89 (3.55)	26.35*** (10.16)				
No. of Family Labor	4.62 (1.44)	4.16 (1.29)	4.94*** (1.45)				
No. of Wage Workers	5.70 (3.33)	4.59 (2.17)	6.48*** (3.76)				

Notes: Mean values are shown with standard deviations in parentheses. Mean values are tested for statistically significant differences; *p < 0.1, **p < 0.05, ***p < 0.01

¹Cooperatives' performance indicators are used as proxy indicators of cooperatives' characteristics. *Binary responses are presented in percent

Wage workers' characteristics

Table 2 presents demographic and socioeconomic characteristics of household and cooperative wage workers, highlighting differences between certified and noncertified groups. Certified household workers are older (36.88 years) than noncertified workers (29.25 years), while cooperative workers are generally older than farm/household workers, with certified cooperative workers averaging 41.80 years. These may be due to certification leading to more stable work, attracting older workers who value job security. Certified cooperatives may also prefer experienced, skilled workers for consistent employment. Gender distribution is balanced, though household workers exhibit a higher male predominance. Certified workers are more likely to be household heads and have larger households, with certified household workers averaging 2.59 members versus 1.16 for noncertified, while certified cooperative workers have 3.53 members on average.

Educational attainment follows a similar pattern, with certified household workers attaining higher education levels than noncertified workers. Cooperative workers, irrespective of certification, exhibit higher education levels than household workers, with certified cooperative workers outperforming noncertified counterparts. Awareness of VSS certification is significantly higher among certified workers, with 58% of certified household workers and 81% of certified cooperative workers aware of certification, compared to 5% and 46% for noncertified workers, respectively.

Socioeconomic factors reveal variations in commuting times, with cooperative workers spending more time traveling (40.45 minutes) compared to household workers (21.80 minutes). Income levels are comparable, with cooperative workers earning slightly more. Certified workers report better housing conditions, owning more rooms, though electricity access remains low across groups. Health status differences due to certification standards are not significant. Community engagement is generally limited across all groups. However, certified cooperative workers demonstrate slightly higher integration in social networks. Media consumption patterns are similar, though certified cooperative workers exhibit slightly higher mobile phone ownership (86%) compared to noncertified counterparts (78%).

► **TABLE 2. Summary statistics of wagedworkers characteristics by household/farm workers and cooperative workers and by their VSS certification status**

	Household/Farm Workers			Cooperative Workers		
	Total (N=340)	Noncertified (N=140)	Certified (N=200)	Total (N=220)	Noncertified (N=100)	Certified (N=120)
<i>General Information</i>						
Age of respondents	33.43 (9.01)	29.25 (8.38)	36.36*** (8.28)	39.56 (11.12)	36.88 (12.30)	41.80*** (9.52)
Gender of respondents (Dummy, Male=1)	0.73 (0.45)	0.76 (0.43)	0.70 (0.47)	0.56 (0.50)	0.56 (0.50)	0.56 (0.50)
Are you a household head (Dummy, Male=1)	0.56 (0.50)	0.40 (0.49)	0.68*** (0.47)	0.73 (0.45)	0.65 (0.48)	0.79** (0.41)
Total Household Members	2.00 (2.02)	1.16 (1.76)	2.59*** (1.98)	3.45 (2.94)	3.37 (3.37)	3.53 (2.53)
Marital Status (Dummy, Married=1)	1.58 (0.65)	1.44 (0.50)	1.68*** (0.72)	1.78 (0.56)	1.70 (0.72)	1.85** (0.38)
Level of Education (Level)	2.11 (1.67)	2.59 (2.07)	1.77*** (1.21)	4.56 (2.80)	5.18 (2.98)	4.05*** (2.55)
Familiarity with VSS certification	0.36 (0.48)	0.05 (0.22)	0.58*** (0.49)	0.65 (0.48)	0.46 (0.50)	0.81*** (0.40)
Awareness of Employer's Certification Standards	0.46 (0.60)	0.04 (0.20)	0.76*** (0.61)	0.58 (0.50)	0.35 (0.48)	0.77*** (0.44)
Travelling time to work place	22.61 (16.68)	21.80 (21.51)	23.18 (12.24)	38.93 (23.32)	40.45 (28.71)	37.67 (17.64)
Previous Income Source Before Current Employment (Code)	1.84 (1.05)	1.95 (1.04)	1.76 (1.05)	2.14 (1.09)	2.51 (0.89)	1.83*** (1.14)
<i>Social Integration</i>						
Duration of residence in the community	24.01 (12.63)	23.51 (11.77)	24.36 (13.21)	33.88 (14.92)	36.29 (12.44)	31.87** (16.49)
Reason for leaving place of origin	2.15 (1.05)	2.07 (1.08)	2.21 (1.02)	1.95 (1.17)	1.96 (1.03)	1.94 (1.27)
Do you watch/read/listen to news?	0.55 (0.50)	0.54 (0.50)	0.55 (0.50)	0.70 (0.50)	0.70 (0.50)	0.70 (0.50)
Do you own a mobile phone?	0.54 (0.50)	0.55 (0.50)	0.56 (0.50)	0.82 (0.39)	0.78 (0.41)	0.86 (0.35)
Involvement in community activities	0.50 (0.50)	0.50 (0.50)	0.50 (0.50)	0.74 (0.44)	0.80 (0.40)	0.71 (0.46)
Community integration status	0.56 (0.50)	0.56 (0.50)	0.57 (0.50)	0.69 (0.46)	0.68 (0.47)	0.70 (0.46)

<i>Housing conditions and health status</i>						
Total number of rooms owned	1.51 (0.63)	1.37 (0.63)	1.61*** (0.61)	1.59 (0.72)	1.55 (0.72)	1.62 (0.72)
Main source of drinking water	2.55 (0.63)	2.64 (0.59)	2.49* (0.66)	2.35 (0.66)	2.35 (0.67)	2.34 (0.65)
Is there electricity in your home?	0.14 (0.35)	0.17 (0.38)	0.12 (0.32)	0.28 (0.45)	0.30 (0.46)	0.27 (0.44)
Have you experienced any illnesses in the past year?	0.21 (0.41)	0.19 (0.40)	0.22 (0.42)	0.15 (0.36)	0.16 (0.37)	0.15 (0.36)

Notes: Mean values are shown with standard deviations in parentheses. Mean values are tested for statistically significant differences; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$ Binary responses are presented in percent

Employment, wages, and working conditions

The employment conditions, wages, and working conditions of wage workers in Ethiopia's coffee sector exhibit notable differences between certified and noncertified workers in both farm and cooperative settings. As shown in Table 3, certified workers tend to have longer job tenures. Certified farm workers report an average of 9.41 years of experience compared to 7.24 years for noncertified counterparts, while certified cooperative workers average 8.41 years versus 5.95 years for noncertified workers. These findings suggest that Voluntary Sustainability Standards (VSS) certification may contribute to labor retention.

Formal employment contracts are more prevalent among certified workers, enhancing job security and reducing vulnerability to exploitation. Among farm workers, 30% of certified individuals hold formal contracts, compared to 4% of noncertified workers. Similarly, 72% of certified cooperative workers have formal agreements, compared to 52% of noncertified counterparts. While farm workers are predominantly employed seasonally, certified cooperative workers experience greater employment stability.

Working hours differ across certification status. Certified farm workers report shorter daily hours (7.43) than noncertified workers (8.57), though the number of workdays per month remains similar. Cooperative workers work comparable daily hours (8.14), but certified ones work slightly more days per month (24.47 vs. 22.96).

Wages in the sector remain low, frequently falling below the national poverty threshold due to the absence of a statutory minimum wage. Certified cooperative workers receive marginally higher wages, likely reflecting cooperative efforts to improve compensation. On average, cooperative workers earn 82.5 ETB per day, while farm workers earn 77 ETB. Certified cooperative workers are more likely to receive overtime pay (73%) and leave benefits (88%), though wage differences between certified and noncertified workers remain negligible.

Certified workers are more likely to receive in-kind benefits such as housing and food. Among farm workers, 30% of certified individuals receive housing compared to 16% of noncertified workers, while 33% receive food compared to 19% of noncertified workers. Cooperative workers follow a similar pattern, though benefits such as transportation and social allowances show no significant variation.

Work-related accidents and health outcomes do not significantly differ between certified and noncertified workers, though noncertified farm workers report slightly fewer accidents. Certification does not appear to influence access to health or unemployment insurance, nor does it significantly impact the availability of free healthcare services. Exposure to agrochemicals is minimal across all groups.

Regarding additional income, certified household/farm workers engaged in supplementary wage-earning activities report higher total earnings than their noncertified counterparts. Overall, while VSS certification enhances employment conditions through formal contracts, in-kind benefits, and overtime pay, persistent challenges remain, particularly concerning low wages and limited healthcare access.

► **TABLE 3. Summary statistics of wagedworkers employment, payment and working conditions by household/farm workers and cooperative workers and by their VSS certification status**

	Household/Farm Workers			Cooperative Workers		
	Total (N=340)	Noncertified (N=140)	Certified (N=200)	Total (N=220)	Noncertified (N=100)	Certified (N=120)
Working experience in this job (Year)	8.51 (7.88)	7.24 (6.47)	9.41** (8.64)	7.29 (4.76)	5.95 (4.32)	8.41*** (4.84)
Formal employment contract (Yes=1)	0.19 (0.39)	0.04 (0.19)	0.30*** (0.46)	0.63 (0.48)	0.52 (0.50)	0.72*** (0.45)
Current status of employment contract (1=Permanent; 2=Seasonal)	1.86 (0.37)	1.84 (0.42)	1.88 (0.33)	1.41 (0.50)	1.45 (0.52)	1.37 (0.49)
Working days in a month	24.47 (3.07)	24.91 (2.41)	24.16** (3.43)	23.78 (2.73)	22.96 (3.43)	24.47*** (1.69)
Working hours in a day	7.90 (4.00)	8.57 (6.04)	7.43*** (1.14)	8.14 (0.79)	8.22 (0.80)	8.07 (0.79)
Overtime payment (more than 8 hours per day or 39 hours per week) (Paid=1)	0.48 (0.50)	0.52 (0.50)	0.45 (0.50)	0.59 (0.49)	0.43 (0.50)	0.73*** (0.45)
Wage calculated based on (1=Per hour; 2=Per day; 3=Per month; 4=Per year; 5=Per tasks/piece)	2.55 (1.02)	2.64 (1.00)	2.49 (1.03)	2.89 (0.34)	2.83 (0.43)	2.94** (0.24)
Wage rate per day	77.00 (12.02)	76.07 (12.27)	77.65 (11.82)	82.50 (11.96)	81.70 (11.64)	83.17 (12.23)
Have you ever worked late at night or on a holiday? (Yes=1)	0.14 (0.35)	0.12 (0.33)	0.16 (0.36)	0.32 (0.47)	0.34 (0.48)	0.30 (0.46)
IF YES: Have you received any compensation? (Yes=1)	0.44 (0.50)	0.53 (0.51)	0.39 (0.50)	0.80 (0.41)	0.71 (0.46)	0.88* (0.33)
Can you take leave? (Yes=1)	0.73 (0.55)	0.72 (0.47)	0.73 (0.60)	0.84 (0.37)	0.79 (0.41)	0.88* (0.32)
Did you have any work-related accidents in the past 1 year? (Yes=1)	0.18 (0.38)	0.09 (0.29)	0.24*** (0.43)	0.12 (0.33)	0.14 (0.35)	0.11 (0.31)
Have you been exposed to agrochemical products in the past 12 months? (Yes=1)	0.01 (0.08)	0.01 (0.08)	0.01 (0.07)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Housing service (Yes=1)	0.24 (0.43)	0.16 (0.37)	0.30*** (0.46)	0.18 (0.39)	0.13 (0.34)	0.23* (0.42)
Food at work (Yes=1)	0.27 (0.44)	0.19 (0.40)	0.33*** (0.47)	0.09 (0.28)	0.08 (0.27)	0.09 (0.29)
Transportation service (Yes=1)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Allowances for social events	0.17 (0.38)	0.17 (0.38)	0.17 (0.38)	0.19 (0.39)	0.16 (0.37)	0.21 (0.41)
Health and/or unemployment insurance (Yes=1)	0.02 (0.13)	0.02 (0.15)	0.02 (0.12)	0.03 (0.16)	0.02 (0.14)	0.03 (0.18)

Free healthcare (Yes=1)	0.14 (0.35)	0.10 (0.31)	0.17 (0.37)	0.15 (0.35)	0.14 (0.35)	0.15 (0.36)
Have you received wage income from other jobs in the past 12 months (Yes=1)	0.28 (0.45)	0.25 (0.43)	0.31 (0.46)	0.30 (0.46)	0.36 (0.48)	0.25 (0.43)
IF YES: Total payment from other jobs (N= 92,34,58)	11038.04 (7915.53)	8611.77 (10623.15)	12460.34** (5396.68)	15845.59 (9254.50)	15676.32 (11733.15)	16060.00 (4705.58)
Are you optimistic about finding a new job? (Yes=1)	0.54 (0.50)	0.51 (0.50)	0.56 (0.50)	0.54 (0.50)	0.51 (0.50)	0.56 (0.50)
Membership of a labor union/worker committee (Yes=1)				0.29 (0.46)	0.15 (0.36)	0.41*** (0.49)

Notes: Mean values are shown with standard deviations in parentheses. Mean values are tested for statistically significant differences; *p < 0.1, **p < 0.05, ***p < 0.01 Binary responses are presented in percent

Training and capacity building programs

This study examines the role of VSS in shaping training and capacity-building opportunities for smallholder coffee workers. Participation in key training areas promoted by certification programs—occupational health and safety, nutrition, gender equality, child labor prevention, and climate change adaptation—remains low among both certified and noncertified workers. While certified workers show slightly higher engagement in some areas, overall participation is limited, indicating insufficient awareness and outreach.

Cooperative workers participate more frequently in occupational health and safety training than household/farm workers, though certification status does not significantly influence this trend. Similarly, participation in health, nutrition, and gender equality training is limited across groups, while climate change adaptation training remains notably low regardless of certification. Despite these gaps, cooperative workers generally engage more in safety-related training than household or farm workers.

Child labor remains widespread in Ethiopia's coffee sector due to weak law enforcement, particularly in rural areas, with some estimates suggesting up to 30% of workers in certain farms are children. Training on child labor prevention is scarce among household/farm workers, with no significant differences between certified and noncertified groups. However, certified cooperative workers report significantly higher participation (0.44) compared to their noncertified counterparts (0.29) and household workers, reflecting greater awareness and efforts within certified cooperatives.

Certified household/farm workers exhibit higher participation in training on coffee farming best practices, including planting, renovation, pest and disease management, and replanting. However, differences in training participation for harvesting, processing, and shade tree management are less pronounced. While cooperative workers are generally more engaged in health, gender, and child labor training, their involvement in specialized coffee farming and processing training varies. Certified cooperative workers report higher participation in select areas, such as cherry processing and bean drying, aligning with their primary employment roles.

The impact of VSS certification on training and capacity building is mixed. While certification is associated with increased participation in general training areas, its influence on specialized agricultural training for cooperative workers is inconsistent. Household workers also exhibit limited engagement in critical training areas. These findings suggest that factors beyond certification, such as workers' roles and specific needs, shape training participation. Most training programs are provided by government extension agents, cooperatives, and development agencies, with limited involvement from nongovernmental organizations. Despite these efforts, persistently low training participation rates highlight the need for more targeted and accessible programs across Ethiopia's coffee sector.

► **TABLE 4. Summary statistics of wageworkers training and capacity building by household/farm workers and cooperative workers and by their VSS certification status (Binary responses representing yes=1 and no=0, and the result is presented in %)**

	Household/Farm Workers			Cooperative Workers		
	Total (N=340)	Noncertified (N=140)	Certified (N=200)	Total (N=220)	Noncertified (N=100)	Certified (N=120)
Training on Occupational health and safety (including first aid)	0.10 (0.30)	0.11 (0.31)	0.10 (0.29)	0.55 (0.50)	0.55 (0.50)	0.56 (0.50)
Training on Health and nutrition	0.06 (0.24)	0.06 (0.24)	0.06 (0.24)	0.33 (0.47)	0.31 (0.46)	0.34 (0.48)
Training on gender equality	0.04 (0.20)	0.04 (0.20)	0.04 (0.20)	0.32 (0.47)	0.28 (0.45)	0.35 (0.48)
Training on combating child labor	0.14 (0.34)	0.11 (0.32)	0.15 (0.36)	0.37 (0.48)	0.29 (0.46)	0.44** (0.50)
Training on climate change adaptation	0.19 (0.39)	0.20 (0.40)	0.18 (0.39)	0.21 (0.41)	0.19 (0.39)	0.23 (0.42)
Training on best practices for Trainings on coffee farming and processing	0.48 (0.76)	0.37 (0.48)	0.56** (0.89)	0.59 (0.49)	0.56 (0.50)	0.62 (0.49)
Training on the establishment of coffee fields	0.45 (0.76)	0.45 (1.02)	0.46 (0.50)	0.41 (0.49)	0.39 (0.49)	0.43 (0.50)
Training on coffee planting/ renovation/ rehabilitation/ replanting	0.38 (0.49)	0.26 (0.44)	0.46*** (0.50)	0.25 (0.43)	0.24 (0.43)	0.25 (0.43)
Training on harvesting and processing the cherries, and drying the beans	0.60 (0.49)	0.56 (0.50)	0.62 (0.49)	0.60 (0.49)	0.52 (0.50)	0.68** (0.47)
Training on shade tree management	0.58 (0.49)	0.53 (0.50)	0.62 (0.49)	0.29 (0.46)	0.26 (0.44)	0.32 (0.47)
Training on soil management (e.g. mulching, composting, trenching)	0.58 (0.50)	0.58 (0.50)	0.58 (0.50)	0.35 (0.48)	0.30 (0.46)	0.38 (0.49)
Training on pests and diseases identification	0.27 (0.45)	0.20 (0.40)	0.33** (0.47)	0.31 (0.46)	0.28 (0.45)	0.33 (0.47)
Training on preparation of organic fertilizers and pesticides	0.64 (0.48)	0.62 (0.49)	0.66 (0.48)	0.22 (0.42)	0.21 (0.41)	0.23 (0.42)

Notes: Mean values are shown with standard deviations in parentheses. Mean values are tested for statistically significant differences; *p < 0.1, **p < 0.05, ***p < 0.01

Workers' job satisfaction and work-related outcomes

The study also examined the impact of VSS on job satisfaction and work-related conditions among smallholder coffee household/farm workers and cooperative workers. Satisfaction was measured on a five-point Likert scale (1 = strongly dissatisfied to 5 = strongly satisfied), with results presented in Table 5. Despite overall lower satisfaction levels, certified workers report higher satisfaction with their salary (2.63 vs. 1.81 for household workers and 2.22 vs. 1.89 for cooperative workers), suggesting slightly better perception despite lower level of wage and overall neutral satisfaction. Regarding employment security and occupational health and safety both

certified household/farm and cooperative workers report higher satisfaction than noncertified workers. Cooperative workers, irrespective of certification status, generally report neutral satisfaction with workload, work hours, and equipment availability, though certified workers tend to express slightly higher satisfaction.

VSS premiums support community projects, such as schools and health centers, yet satisfaction with public education and healthcare in both household and cooperative groups remains neutral, with minimal differences between certified and noncertified workers. Overall, certified cooperative workers report relatively higher satisfaction than noncertified ones and, in some cases, exceed the satisfaction levels of certified household/farm workers. However, satisfaction ratings across most dimensions remain neutral to slightly dissatisfied, highlighting the need for further enhancements to improve worker well-being in both certified and noncertified settings.

► **TABLE 5. Summary statistics of waged worker's level of satisfaction by household/farm workers and cooperative workers and by their VSS certification status (Results represent scales from 1 to 5)**

	Household/Farm Workers			Cooperative Workers		
	Total (N=340)	Noncertified (N=140)	Certified (N=200)	Total (N=220)	Noncertified (N=100)	Certified (N=120)
Satisfaction with salary	2.09 (0.90)	1.89 (0.92)	2.22*** (0.86)	2.25 (0.94)	1.81 (0.80)	2.63*** (0.89)
Satisfaction with employment security	2.85 (0.94)	2.66 (0.82)	2.99*** (0.99)	2.96 (0.84)	2.66 (0.70)	3.22*** (0.87)
Satisfaction with occupational health and safety	3.11 (0.92)	2.97 (0.81)	3.20** (0.98)	2.98 (0.87)	2.67 (0.78)	3.24*** (0.85)
Satisfaction with the hours, the amount of work	2.79 (0.90)	2.79 (0.88)	2.80 (0.91)	2.94 (0.91)	2.74 (0.87)	3.11*** (0.91)
Satisfaction with equipment and information	3.25 (0.91)	3.28 (0.81)	3.23 (0.97)	3.19 (0.91)	2.95 (0.86)	3.39*** (0.91)
Satisfaction with supervisor/employer	3.22 (0.96)	3.20 (0.96)	3.23 (0.97)	3.61 (0.88)	3.54 (0.91)	3.67 (0.85)
Overall satisfaction with job	2.57 (0.93)	2.66 (0.75)	2.51 (1.03)	2.73 (0.93)	2.78 (0.88)	2.69 (0.97)
Satisfaction with professional development	2.90 (0.87)	2.94 (0.78)	2.88 (0.93)	3.06 (0.90)	3.00 (0.93)	3.11 (0.87)
Satisfaction with public education	2.66 (1.05)	2.57 (0.92)	2.72 (1.14)	2.78 (0.98)	2.67 (0.83)	2.88 (1.08)
Satisfaction with public health care	2.69 (1.05)	2.54 (0.86)	2.80** (1.15)	2.88 (1.00)	2.80 (0.88)	2.95 (1.08)

Notes: Mean values are shown with standard deviations in parentheses. Mean values are tested for statistically significant differences; *p < 0.1, **p < 0.05, ***p < 0.01

Econometric results

In order to gain a more robust understanding of the causal impact of Voluntary Sustainability Standards (VSS) certification on decent rural employment, it is essential to go beyond descriptive statistics. While the descriptive analysis provides an initial comparison of decent work conditions between certified and noncertified groups of household/farm workers and cooperative workers, it does not account for potential endogeneity issues or unobservable factors that may influence both certification and employment outcomes. To address this limitation, econometric models are employed to establish causal inferences on the impact of VSS certification. A two-stage composite index of decent rural employment is constructed. First, nine key composite decent work indicators are derived by grouping multiple decent work components identified in the descriptive statistics. These indicators are then aggregated into a single decent work index using principal component analysis, as outlined in the methodology. The econometric results in Table 6 reveal the impact of VSS certification on various decent work

indicators and the decent work index (DWI). For household/farm workers, certification does not have a statistically significant effect on wages across models. However, for cooperative workers, the OLS model indicates a significant positive effect, suggesting that certification enhances wages through structured wage systems and profit-sharing mechanisms inherent in cooperative frameworks. Certification significantly promotes formal employment contracts for both household/farm and cooperative workers, highlighting its role in strengthening labor formalization and fostering structured employment arrangements.

The impact of certification on social integration is not statistically significant for either group. This indicates that certification does not substantially influence workers' sense of connection or support within their social environments. This finding suggests that social integration might be more strongly shaped by broader community or cultural factors than by certification initiatives. The 2SLS model reveals a significant negative relationship between certification and satisfaction with public education and health services among cooperative workers. This may reflect improved awareness and unmet expectations, as certified members might anticipate improved public services due to perceived certification benefits. Certification significantly enhances job satisfaction for cooperative workers, suggesting improvements in work conditions or rewards. In contrast, certification has no significant effect on household/farm workers' job satisfaction, implying that other factors shape their perceptions.

The impact of certification on training and capacity building varies. While certification has no significant effect on household/farm workers' training in gender, child labor, health, and nutrition, it significantly enhances these trainings for cooperative workers, reinforcing social and welfare priorities within cooperative structures. Similarly, certification significantly improves training in coffee production and processing for cooperative workers, fostering productivity and quality, while no significant effect is observed for household/farm workers, likely due to limited training access.

Both worker groups experience significant improvements in working conditions and benefits, as confirmed by OLS and 2SLS results, underscoring certification's role in enhancing workplace environments. Certification also significantly improves healthcare services for both household/farm and cooperative workers, supporting its role in promoting health and safety.

The impact of VSS certification on decent work outcomes generally differs between worker groups. Cooperative workers derive greater benefits, particularly in wages, training, and job satisfaction, whereas household/farm workers experience significant improvements primarily in employment contracts, working conditions, and healthcare. These findings highlight VSS certification's potential to lift up labor standards, though its effects are shaped by organizational structures and contextual factors.

To assess the overall impact of VSS certification on decent work, we estimated its impact using the Decent Work Index (DWI), constructed through Principal Component Analysis (PCA). The analysis was conducted using both Ordinary Least Squares (OLS) and Two-Stage Least Squares (2SLS) regression models. The Durbin-Wu-Hausman test for endogeneity indicated that certification is not endogenous, confirming that the OLS estimates are consistent and unbiased. The results reveal that VSS certification is associated with a statistically significant increase in the DWI of cooperative workers by 0.64 units ($p < 0.05$), suggesting that certification enhances employment conditions as indicated in the sub groups, including wages, contracts, training, and working conditions within cooperatives. In contrast, no significant impact of certification is observed for household workers, indicating that the benefits of VSS certification may be largely confined to cooperative structures, where compliance and monitoring mechanisms are more robust. This finding underscores the differentiated impact of certification across labor arrangements, highlighting the need for targeted interventions to improve decent work conditions for household workers, who may not fully benefit from VSS-related improvements in labor standards.

► **TABLE 6. Estimated impact of voluntary sustainability standards certification for decent work outcome variables on smallholder coffee farm workers and cooperative workers**

Decent Work Indicators	Household/Farm Workers			Cooperative Workers		
	OLS	2SLS	IV Probit	OLS	2SLS	IV Probit
Wage	0.69 (1.82)	6.16 (3.89)		10.81* (4.85)	2.84 (2.93)	
Employment Contract	0.37*** (0.06)		2.76*** (0.42)	0.88** (0.22)		0.88 (1.02)
Social Integration	-0.04 (0.05)	-0.12 (0.10)		-0.01 (0.08)	0.02 (0.07)	
Public Education and Public Health Services Satisfaction	0.11 (0.15)	-0.04 (0.31)		-0.25 (0.41)	-0.95* (0.46)	
Job Satisfaction	0.01 (0.10)	0.04 (0.22)		0.75*** (0.13)	-0.24 (0.31)	
Training and Capacity Building on Gender, Child labor, Health and nutrition	0.01 (0.020)	-0.03 (0.04)		0.09 (0.12)	0.27*** (0.08)	
Training and Capacity Building on Coffee Production and Processing	0.04 (0.04)	0.04 (0.09)		0.22** (0.07)	0.02 (0.09)	
Working Conditions and Other Benefits	0.07** (0.03)	0.21*** (0.07)		0.20** (0.06)	0.03 (0.07)	
Healthcare Service	0.04 (0.03)	0.17** (0.07)		0.02** (0.01)	0.02 (0.01)	
¹ Decent Work Index (DWI)	0.15 (0.20)	0.08 (0.42)		0.64** (0.17)	0.14 (0.89)	

Notes: Coefficients are presented with Standard errors in parentheses. *p < 0.1, **p < 0.05, ***p < 0.01

¹Decent Work Index (DWI) is constructed using Principal Component Analysis (PCA)

Discussion

The impact of Voluntary Sustainability Standards (VSS) on decent rural employment presents both opportunities and challenges, reflecting findings in the existing literature. This study contributes to the limited body of research by examining the outcomes for wage workers in smallholder coffee farms and cooperatives in Ethiopia, providing insights into the nuances of certification's impacts. The findings highlight the importance of understanding the underlying mechanisms and contextual factors influencing employment outcomes under VSS, as outlined in their theory of change.

VSS aim to improve social, economic, and environmental conditions by setting standards for production processes, often requiring compliance with fair labor practices and fostering capacity building through training and education. The theory of change suggests that certification should lead to better wages, improved working conditions, and greater job security. However, as seen in this study and others conducted in different country contexts, the realization of these goals is contingent upon multiple factors, including institutional capacity, cooperative structures, and the broader socioeconomic environment. For example, experiences from Uganda (Cramer et al., 2014) and Kenya (Riisgaard and Gibbon (2014) indicate that while certification can lead to better wages and working conditions in structured environments such as cooperatives, the benefits are less pronounced in fragmented smallholder setups where informal practices prevail.

Similarly, this study found that while cooperative workers experienced modest wage increases, certification had no significant effect on household or farm worker wages. This aligns with Krumbiegel et al. (2018) and Schuster and Maertens (2016), who observed higher wages on certified plantations. The structured wage systems within cooperatives likely contribute to this disparity, emphasizing the need to strengthen smallholder integration into certification systems. Formal employment contracts were also more common among certified household and cooperative workers, corroborating Meemken et al. (2019). Working conditions and safety improved for certified workers, with better housing and food access. However, limited differences were observed in work-related accidents and healthcare access, pointing to enforcement challenges identified in studies such as Loconto (2015) and Berthet et al. (2018). This underscores the need for more robust monitoring mechanisms within certification schemes to ensure compliance with labor and safety standards.

Training and capacity building were more accessible to certified workers, particularly in cooperatives, focusing on occupational health, safety, and coffee production techniques. While these findings align with Meemken et al. (2019) and Krumbiegel et al. (2018), the low participation in training on critical social issues, such as gender equality and child labor, in household/farm workers highlights a significant gap in the current framework influenced by the broader institutional and socioeconomic constraints, as noted by Oya et al. (2018). Cultural and societal norms further complicate the situation. In Ethiopia, traditional labor arrangements and gender roles may limit the extent to which certification can influence critical issues such as gender equality and child labor. Addressing these deeply rooted socio-cultural factors requires complementary interventions beyond certification, such as community-based awareness programs and policy reforms.

Despite the relatively higher satisfaction, the overall satisfaction levels among workers remained neutral, with only specific areas of job security and working conditions showing improvement for certified workers, particularly in the cooperative sectors. This echoes Oya et al. (2017), who noted that certification benefits often fail to address deeper socioeconomic grievances. Furthermore, social integration outcomes were limited, suggesting that cultural and community dynamics play a critical role that certification alone cannot influence.

The findings also raise questions about the differential impact of certification on cooperative versus smallholder contexts. Cooperatives provide a structured environment where standards can be implemented more systematically. In contrast, smallholder farms often operate in informal settings with limited oversight, making it harder to enforce labor standards. This disparity highlights the need to develop tailored strategies that address the specific challenges faced by smallholders, including the integration of informal labor systems into formal certification frameworks.

Another potential justification for the mixed findings could be the variability in cooperative performance, influenced by governance and leadership, which we had controlled for as proxy cooperative heterogeneity.

Cooperatives with strong governance and management are likely better positioned to enforce standards and deliver benefits to their members. Conversely, weak governance structures may lead to uneven implementation and limited worker benefits. This aligns with arguments by Bacon et al. (2008) and Valkila and Nygren (2010), who emphasize cooperative governance's role in mediating VSS's effectiveness.

Market dynamics also play a significant role in shaping outcomes. Certified farms and cooperatives often face fluctuating demand for certified coffee, which can affect their ability to provide consistent wage increases or invest in worker benefits. Moreover, the premium prices associated with certification are not always fully passed on to workers, as intermediaries and cooperative expenses consume a portion of the additional revenue. This is consistent with findings by Barham and Weber (2012), who observed that certification's financial benefits often dissipate along the supply chain. Studies suggest that VSS-certified farmers in the area earn higher coffee prices and income, but the benefits don't extend to wage workers. However, they hire more workers to meet VSS quality requirements, contributing to job creation.

The mixed findings suggest that VSS certification has a stronger impact on workers in cooperatives, where compliance and monitoring are more likely to be rigorous. In contrast, its effects on laborers in smallholder farms are limited, despite Fairtrade's specific requirements for hired workers. Its reach, especially among seasonal laborers on smallholder farms, is limited. It is particularly challenging to expect a living wage from smallholder employers, who often lack a living income themselves. Certification alone may not be enough to ensure better conditions for these workers without broader structural support. To enhance its impact, policymakers and certification bodies must tailor frameworks to local contexts, strengthen enforcement mechanisms, and expand training programs to address critical social and labor issues. Additionally, future research should investigate the long-term impacts of certification and explore strategies to overcome persistent challenges for smallholder farm workers, including the integration of informal labor systems.

The study acknowledges potential limitations. The cross-sectional nature of the data limits the ability to establish causal relationships over time. The reliance on self-reported data may also introduce biases, particularly regarding sensitive issues like wages and working conditions. The group-level certification process, in which farmers obtain certification through cooperatives rather than individually, has the potential to obscure wage worker outcomes in individual households/farms. Furthermore, the study's geographic focus on a single region in Ethiopia may limit the generalizability of findings to other contexts. Addressing these limitations in future research can provide a more comprehensive understanding of VSS's effectiveness in promoting decent rural employment.

Conclusion

This study explores the impact of Voluntary Sustainability Standards (VSS), such as Fairtrade and organic certifications, on rural employment conditions in Ethiopia's smallholder coffee sector, focusing on wage workers employed on certified and noncertified farms and cooperatives. It uses a detailed framework to analyze key indicators, including wages, employment contracts, working conditions, access to training opportunities, and job satisfaction.

The findings indicate that VSS certification has a varied influence on decent work outcomes. Workers employed by certified cooperatives experience notable benefits, including higher wages, formalized employment contracts, and better access to training programs, particularly in areas such as occupational health, safety, and coffee production techniques. However, for household/farm workers, these benefits are less evident. Wage improvements and participation in training programs remain limited in these settings, highlighting structural challenges faced by smallholder farms, which often lack the formal systems present in cooperatives.

Certified workers report improvements in working conditions and receive in-kind benefits, such as housing, food, and healthcare. However, the broader impacts on health and safety outcomes, as well as access to public services, are minimal. Job satisfaction shows marked improvement among cooperative workers, yet it remains largely unchanged for household/farm workers, underscoring the persistent socio-economic and systemic barriers to achieving equitable outcomes. Similarly, certification has minimal impact on fostering social integration, as these outcomes appear more strongly influenced by community and cultural factors.

The study offers valuable insights into how organizational contexts influence the effectiveness of VSS. Cooperatives, due to their structured environments, are better positioned to implement and benefit from certification standards, while smallholder farms face constraints that hinder the full realization of these benefits. This underscores the need for tailored approaches to certification that address the unique challenges faced by smallholders, particularly in formalizing labor practices and improving enforcement mechanisms. Expanding training programs to cover broader socio-economic issues, such as gender equality and child labor, is also critical to making these initiatives more inclusive and impactful.

Policy implications from this research include the necessity of designing certification frameworks that specifically target the challenges of smallholder farms. Strengthening monitoring and enforcement systems to ensure adherence to labor standards and safety regulations is essential, as is the expansion of training programs that address the socio-cultural and economic barriers impacting rural workers.

Future research should prioritize examining the long-term effects of VSS certification, particularly its influence on workers' economic resilience and social mobility. Additionally, exploring strategies to make certification schemes more inclusive and sustainable for smallholder farms is vital. Addressing these gaps will enable VSS initiatives to play a more transformative role in promoting decent employment conditions and fostering sustainable livelihoods in rural economies like Ethiopia's.

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Paper 02

► EIIP as a catalyst for local economic development and community engagement in forced displacement contexts

Evidence and experience from the PROSPECTS partnership

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Introduction

Forced displacement remains a reality for countries and regions affected by conflict. Whether displaced within their own countries, or across borders, forcibly displaced persons lose capital, assets and networks when fleeing their homes and often end up in communities that have few resources to host them. According to UNHCR figures, 71 per cent of the world's forcibly displaced persons are hosted in low- and middle-income countries (UNHCR Global Figures, 2024). The arrival of displaced persons in these contexts place additional strain on already weak infrastructure and services, and cause several challenges on labour market and local economies. However, the inflow of displaced persons also presents an opportunity for host governments, members of the international community and local actors to address pre-existing infrastructure needs as a catalyst for local development and community engagement.

ILO's Employment Intensive Investment Programme (EIIP) provides tangible and short-term outputs in the form of improved community infrastructure and income. When combined with longer-term employment and enterprise support, EIIP can help drive longer-term economic development. The PROSPECTS partnership, a multi-agency and multi-country programme funded by the Kingdom of the Netherlands to address forced displacement, provided space for ILO and partners to apply EIIP as part of a wider intervention model in support of local economic development and inclusion. The PROSPECTS countries that integrated EIIP in their intervention models saw how the employment intensive approach could contribute to productivity gains, spur demand for goods and services, promote skills-development and empower forcibly displaced persons and members of the host community as workers, community contractors, business owners and cooperative members. This happened when infrastructural projects were sequenced and used as a catalyst to open new avenues for value chains to offer opportunities for new livelihoods in communities hosting refugees.

This paper considers how EIIP served as a catalyst for local economic development and community engagement in contexts of forced displacement. It documents cases from PROSPECTS that used EIIP as part of an integrated intervention model. The first section looks at how EIIP activities connected to complementary actions in support of wider value chain development. It will look at direct and indirect impacts on local markets, businesses and cooperative associations that were mobilized around EIIP work and the infrastructure it supported. The next section will look at methods used to engage local communities in EIIP. This includes meaningful participation from both refugee and host community members and serves as a key component for the implementation of integrated models in forced displacement contexts. The third and final section will outline an integrated intervention model and associated recommendation, drawing on aspects of the different EIIP case studies.

EIIP as a catalyst for local economic development in forced displacement contexts

An employment intensive approach to infrastructure development improves community assets, generates immediate job opportunities which provides a source of short-term income for local workers, and contribute to local development efforts. These community assets can be used collectively, and when positioned as part of a wider value chain or market system, they can also address productivity bottlenecks, improve market linkages and generate demand for local goods and services. It is not only the EIIP work itself, but the knock-on effect that new and improved infrastructure can have on the surrounding community. For ILO, and under the PROSPECTS Partnership programme, this is significant in terms of the indirect jobs it can create, the business operations that can be improved and new services that can be made available for both forcibly displaced persons and members of the host community.

PROSPECTS and many similar programmes operate in contexts of resource scarcity. This includes natural, financial and human resources. When displaced populations arrive in a host community there is risk of rising social tensions if the arrival is seen to threaten resource availability (jobs, income, customer base etc). The EIIP model can ease perceived threats in the short term, serving to calm tension between communities. Having EIIP situated within a larger integrated intervention model can have additional and positive knock-on effects in the

longer-term. The examples that are detailed below from Kenya and Ethiopia demonstrate how EIIP operated to provide immediate solutions and also enable longer-term value chain development.

Market systems and value chain analysis were starting points in both cases, providing a wholistic look into opportunities and constraints for local economic development in the refugee hosting areas. In this wider market, EIIP was a means to an end. In both Ethiopia and Kenya, EIIP was used to address productivity bottlenecks in dairy and camel milk value chains. Development and maintenance of public infrastructure in both countries not only provided improved water resources, production facilities and workdays, but also enabled improvements to production quality and quantity, thereby facilitating access to markets, incentivizing formation of producer groups and the creation of value added businesses along the value chains.

In Garissa County of Kenya, an arid climate and underdeveloped water collection and management systems disrupted water access for households and livestock. Similarly, in Ethiopia, the arid climate challenged the regularity and reliability of access to water for both animals and households. At the community level, both suffered from poorly maintained or missing water sources. Because the quality and quantity of dairy (milk) production hinges on having a constant source of drinking water for animals, the improvement of water sources directly contributed to an increase in yield, translating into improved income for local herders and producers. A pre and post assessment of camel milk production done in Kenya showed that after the rehabilitation of dams, water could be conserved for two additional months each year. Milk production then rose from 6,000 litres during the dry season, to 21,000 litres in July and August, yielding a profit of approximately USD 10,000.

As already noted, EIIP in these cases was a means to an end. The work did not stop at infrastructure development, but connected to interventions that directly aimed to grow local businesses, associations and cooperatives. These measures connected infrastructure improvements into wider market development. Along both value chains where EIIP work took place, there were opportunities identified as part of the market systems and value chain. In Kenya, the integrated intervention model also supported the establishment of a community based milk collection centre, which helped extend the shelf life of milk and allow producers to store production in bulk. The same animal herders and producers that had improved access to water sources could now store their increased production safely and hygienically. The volume they could store also allowed the same producers to sell in larger markets.

In the Somali Regional State of Ethiopia, veterinary services were absent in the rural areas where livestock rearing took place, resulting in increased instances of death and disease among those rearing cattle for milk production. PROSPECTS supported the development of community animal health worker (CAHWs) networks, providing local capacity to administer vaccinations and basic care. The animal herders and traders that had access to improved water resources could now also ensure greater health of their herds, reducing losses from death and disease. The quality of feed was also identified by the market systems analysis as an aspect contributing to productivity loss and reduced quantity of milk production. At the local level, PROSPECTS supported the introduction of improved seed varieties and mechanized hulling processes. By improving fodder production quality, the volume and quality of milk also improved further.

Indirect employment and business development is evident, exceeding what could be accomplished through EIIP alone. In Ethiopia, 134 community members participated in the construction of water detention ponds, but an integrated approach created 15 additional long-term jobs for community animal health care workers, who in turn treated over 350 animals each in their initial months on the job. In Kenya, work to rehabilitate water sources produced 569 short-term jobs, whereas the work linked to the establishment of a milk cooling facility enabled 155 producers to produce and sell in bulk, opening up new market opportunities. The running of the facility itself also generated 379 new, long-term jobs in the community. These figures do not reflect additional indirect impacts, such as household incomes improved as a result of the accessing improved facilities and services. These impacts go beyond any single intervention area, and are enabled by a variety of interventions.

EIIP as a mechanism to engage local communities in forced displacement contexts

Community leaders and representative groups played a leading role in directing the integrated intervention models described above. This was important for interventions to have relevance and deliver impact as contexts evolved. While market assessments and value chain analysis capture a snapshot in time, meaningful engagement of local actors helps refine these intervention models and maintain their relevance. Doing so in a manner that draws on participation from both forcibly displaced and host communities is also an enabler of social cohesion. This sub-section explains measures taken to engage local communities in EIIP and related work.

In Kenya, the rehabilitated water sources provided more reliable and secure drinking water for animals. As the previous section noted, this linked to other areas of support to enable continuous and long-term development along the camel milk value chain. One aspect included ongoing maintenance and administration of the water sources themselves. To address this, village committees were established to coordinate community use and avoid over-use of the shared water resources. This included representatives from both refugee and host communities. As a measure of local ownership and ongoing sustainability, the committee introduced a small fee per animal that used the water source, which in turn was used to pay for the water sources' maintenance.

In Sudan, EIIP was used to address water availability for local households in main refugee and IDP hosting areas. While not part of an integrated model, measures taken to include local communities provide a useful case that can be integrated into future models. Accompanying work to construct solar powered water pumps, the intervention supported Local Economic Development Committees (LEDC) to monitor progress and smooth handover of the rehabilitated community assets after EIIP was completed. The committees themselves had women, men and youth representatives from both forcibly displaced and host community backgrounds, reducing risk of tensions in the handover and ongoing maintenance. This also provided additional measures of buy in and facilitated trust between communities as the work progressed. During the rainy season when project sites became inaccessible, LEDCs enabled the project to monitor progress of EIIP worksites, and adherence to regulations set by the Ministry of Infrastructure. Their monitoring role became even more critical as instability in the country increased throughout 2022-23, cutting off access to sites by project staff. LEDC members stepped in to monitor, report on and guide the continuation of work. Even during the conflict, they continued to engage in monitoring and administration of each site to ensure the continuation of essential water and health services that the project had helped rehabilitated.

PROSPECTS Iraq built an integrated EIIP model that made use of existing services at the directorate level, including the Ministry of Labour and Social Affairs (MOLSA) Employment and Vocational Training Centres to recruit EIIP workers. The implementation of works directly engaged local actors to plan, design, and execute labour-based works using local resources. EIIP Technical Committees drew on active participation of local chapters of trade unions, employers organizations and youth representatives, alongside more traditional members, including district level governments, municipalities and contractors. Youth representatives helped mobilize additional young engineers and technicians from the University of Dohuk and the University of Mosul to play a role in monitoring and reporting on infrastructure development and working conditions on EIIP work sites. Real time tracking and monitoring tools were introduced to help the young engineers learn new skills as part of their monitoring role (Kobo Toolbox). The young engineers conducted regular inspection visits to the EIIP work sites and reported back to the programme team and Technical Committee. Like the case in Sudan, young engineers also helped provide continuous access to project sites. In Mosul, the legacy of the 2018 ISIL invasion meant that travel to the city came with additional protocols, making regular site visits more difficult. In such instances, localizing the monitoring and reporting process can be a positive measure to support continuity and local ownership.

Alongside the youth representatives, representatives from local trade union chapters took a role on the ground, advising worker committees on their labour rights. This ultimately enabled EIIP workers to successfully negotiate for improved break areas, and improvements to signage on work sites indicating occupational hazards. The direct involvement of unions in this case also helped build relationships between EIIP workers and trade unions. As the intervention unfolded, trust between both grew, setting up an environment where EIIP workers saw themselves as representatives with capacity to understand and advocate for their rights and better working conditions. The trade union representatives also took ownership of the role, and helped hold the project accountable to the workers it was employing, serving an additional mechanism for local ownership.

The above cases demonstrate measures taken to support local ownership of EIIP assets and processes, both during construction and after its completion. In displacement contexts, this is particularly critical, as ensuring buy-in between and across communities, where there is a risk for rising social tension if resources are not seen to benefit and be for the use of all on an equal basis.

An integrated EIIP model for local economic development and community engagement

The importance of tangible and short-term results in contexts of forced displacement are clear: immediate employment opportunities, income and visible improvements in physical community infrastructure. Employment creation and business development can take time, as does local economic development. As these aspects take time, EIIP plays an important role in easing pressure and social tensions. PROSPECTS countries are located in regions with multiple and ongoing conflicts. Here, EIIP is a very useful short term tool, but can also be situated within integrated intervention models to support development from multiple and reinforcing angles.

The above case studies have provided a useful tool box of approaches that can support multiplier effects related to EIIP in displacement contexts. These are first and foremost guided by a wider analysis of local markets in refugee hosting areas, unpacking value chains where there is potential for job creation and business development. These will set out a variety of entry points for EIIP. How different intervention areas are layered and sequenced will also be oriented by market assessments, and can equally benefit from community led dialogue to ensure interventions are relevant and adjust to ongoing and changing dynamics. The intervention areas that were layered and sequenced in Kenya and Ethiopia all aimed to build out the related value chain, focusing on opportunities that would benefit both host communities and forcibly displaced persons. Based on the case studies in Kenya, Ethiopia, Iraq and Sudan, the following recommendations to leverage EIIP as part of local economic development and community engagement:

- Use market systems and value chain analysis to identify entry points for EIIP to contribute to job generation and local economic development.
 - Relevant tools: [Designing and Implementing Market-led Interventions in Forced Displacement Settings](#) (ILO, 2024)
- Operationalize local steering committees to validate selection of value chains, EIIP work and sequenced intervention to ensure work remains relevant amidst changing and volatile contexts.
 - Relevant detailed case: [State-level Local Economic Development Committees capacitated to provide critical field-level feedback in Sudan](#) (ILO, 2021)
- Committees and other related governance and management structures should ensure representation from both forcibly displaced and host communities.
 - Relevant tools: [ILO Employment Intensive Investment Programme \(EIIP\) and the Humanitarian Development Peace Nexus](#) (HDPN) (ILO, 2023)
- The knowledge and capacity of trade union representatives can be leveraged to help EIIP workers understand and advocate for their rights, ultimately holding the project and partners responsible.
- Invest in building local capacity to monitor and report on EIIP work, including working conditions. This will ensure continuity in of work when physical access to project sites is interrupted for project staff.
- Monitoring roles can be taken up by local youth, providing them an additional opportunity to learn and apply skills in quality control, data collection, monitoring and analysis.
- Based on context, sequence EIIP to provide a short term and tangible output, while building capacity and systems that can enable job creation and business development along the value chain.
- Common areas of integration, that will vary based on value chains, include opportunities for skills development, business development and cooperative formation and strengthening.
 - Relevant tools: [ILO Guide for Skills Development in Employment-Intensive Investment Programmes](#) (ILO, 2021)

With the scale and duration of forced displacement, a single area of support is no longer adequate to address development challenges in host communities. Sequencing and layer areas of support that provide tangible benefits, yet also give space and contribute to long-term development processes are key. Within ILO, there are technical areas and approaches that can blend to respond more effectively. EIIP, as one of the sole areas of ILO that delivers results relatively quickly and with direct benefits to income, is a key tool for bridging longer-term change. Learning how to blend this area with other technical areas is important as the ILO supports governments and social partners in contexts of forced displacement.

► Des infrastructures résilientes dans des écosystèmes fragiles

L'expérience Tunisienne pour une meilleure adaptation des villages forestiers et oasiens au changement climatique

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Abstract

Face aux défis complexes mêlant fragilité économique, tensions sociales et vulnérabilités environnementales les collectivités locales tunisiennes se trouvent dans l'obligation de prioriser la planification et la mise en œuvre d'investissements durables afin de promouvoir la résilience et le développement inclusif. Avec des approches novatrices et intégrées, l'OIT via son programme initiative pilote pour un développement local intégré et le ministère de l'intérieur « Département des affaires locales » travaillent ensemble depuis 2018 pour concilier croissance économique et durabilité sociale et environnementale au profit d'une population vulnérable installée dans des zones frontalières à faibles indices de développement et souffrant d'une précarité causée **par l'enclavement et l'inaccessibilité à l'eau et aux services sociaux de base, la pauvreté et les faibles moyens de subsistance et l'impact du changement climatique.**

Vulnérabilité et changement climatique: un enjeu majeur pour les collectivités locales

Notre article détaillera l'approche d'investissement en infrastructure résiliente basée sur l'approche HIMO valorisant les ressources locales dans des régions à vocation forestière et oasienne. Des régions où la désertification et la raréfaction des ressources en eau exacerbent les vulnérabilités structurelles et où l'Etat à travers ses approches classiques n'arrive pas à renverser la donne.

De la planification participative utilisée comme un outil pour cerner les potentiels des zones d'interventions et les attentes des communautés¹ qui se trouvent en première ligne de défense face aux phénomènes climatiques extrêmes à la traduction des plans de développement en des programmes d'investissement intégrant la nécessité d'ouverture des villages sur leur environnement en adoptant des outils innovants pour la mise en œuvre des projets d'infrastructure afin de contrecarrer la vulnérabilité et accroître la résilience. Le programme initiative pilote pour un développement local intégré mis en œuvre par l'OIT et en partenariat avec le département des affaires locales au ministère de l'intérieur ont intensifié les efforts pour incarner les investissements pour la durabilité selon l'approche intégrée dans les pratiques de collectivités territoriales et des services déconcentrés de l'Etat.

Les objectifs de l'article :

L'article partagera l'expérience Tunisienne appuyée par l'OIT dans la mise en œuvre **de projets pilotes d'infrastructure** ainsi que le montage **des activités économiques génératrices de revenus** en mettant l'accent sur les **impacts socioéconomiques et environnementaux** garantissant la durabilité des interventions qui sont basées sur :

- **Une implication active des bénéficiaires dans la planification, la conception, la mise en œuvre** et la préservation des projets pour maximiser leur durabilité.
- Une priorisation de recours à main-d'œuvre locale et aux matériaux écologiques, réduisant l'empreinte carbone des projets tout en renforçant les capacités des partenaires institutionnels et des communautés.
- La réhabilitation des routes rurales, désenclavement **de villages forestiers**, préservation du **patrimoine culturel** et des sites archéologiques, infrastructures **d'irrigation, protection contre les inondations**, conservation des eaux et du sol et **une amélioration de l'accès à l'eau potable : Des investissements porteurs de changement et leviers d'un développement durable.**
- Des actions orientées vers le renforcement de la résilience des populations face aux crises économiques et climatiques (**Chantiers écoles de travaux forestiers, Chantiers écoles de travaux oasiens, pratiques agricoles résilientes...**)
- Des approches de création d'opportunités d'emplois locaux durables grâce à un processus de certification et d'apprentissage dans l'action bâtie autour des principes du travail décent.

¹ 1,2 millions de tunisiens soit 10% de la population vivent dans les forêts

- La création d'une dynamique économique locale génératrice de moyens de subsistance pour les groupes vulnérables.
- Une veille et une vigilance rendant les parties prenantes (Collectivités, administrations sectorielles et bénéficiaires) capables d'anticiper et de se prémunir contre les crises conjoncturelles et les phénomènes climatiques extrêmes grâce à une sensibilisation sur l'importance de préservation de l'écosystème (Forêts et Oasis) Exp : Gestion des eaux pluviales, protection contre les inondations et les incendies causés par la chaleur excessive.

L'article visera à montrer que même dans un contexte de fragilité, il est possible de construire un avenir plus résilient en plaçant la durabilité au cœur des stratégies d'investissement. L'expérience de l'OIT en Tunisie combine investissements, résilience climatique et inclusion sociale pour dessiner une trajectoire vers un développement durable, capable de répondre aux défis complexes de notre époque.

Introduction et contexte général :

Le monde d'aujourd'hui évolue dans un contexte marqué par de profondes transformations économiques, sociales et écologiques. La succession des crises bouleverse l'équilibre des économies mondiales, redéfinissant les priorités et les stratégies de développement. Après la crise sanitaire liée au COVID-19, la guerre russo-ukrainienne et les tensions au proche orient sont venues accentuer l'instabilité, affectant sévèrement le pouvoir d'achat et mettant en évidence une vulnérabilité accrue face aux crises systémiques. Dans ce sillage, l'urgence climatique se profile comme un défi encore plus conséquent. Face à ces bouleversements, plusieurs organisations internationales, tel que le World Economic Forum (WEF), soulignent la nécessité d'une refonte structurelle de l'économie mondiale, une reconstruction ne saurait reposer sur des modèles obsolètes ; elle exige une prise en compte rigoureuse des impératifs écologiques et climatiques.

Depuis des années, la lutte contre le changement climatique s'est imposée comme une priorité globale au cours de la dernière décennie. L'Accord de Paris², adopté en 2015, constitue une avancée majeure dans la définition d'un cadre international visant à limiter le réchauffement climatique bien en deçà de 2°C, idéalement à 1,5°C. Il ambitionne également de renforcer la capacité des États à atténuer les effets du changement climatique et à s'y adapter durablement. Dans ce cadre, de nombreux pays ont engagé des réformes structurelles afin d'aligner leurs économies sur les objectifs de décarbonation, avec une perspective de neutralité carbone à l'horizon 2050. Les Contributions Déterminées au niveau National (CDN) définissent les stratégies à court et moyen terme pour accélérer cette transition.

Dans cette dynamique, plusieurs gouvernements ont mis en place des plans de relance budgétaire intégrant les principes de durabilité et d'inclusion pour atteindre un double objectif : concilier croissance économique et transition écologique tout en garantissant une meilleure prise en charge des populations vulnérables. Ces stratégies s'inscrivent dans une logique de résilience face aux crises futures, en réorientant les politiques publiques vers des modèles de développement plus équilibrés et plus durables.

Dans ce contexte de mutations profondes, la Tunisie peine à surmonter ses fragilités économiques et sociales. Malgré une nette amélioration des indicateurs de développement dans toutes les régions, les disparités régionales restent marquées, et l'inégal développement territorial demeure un défi majeur. On peut ainsi affirmer que plusieurs réalités coexistent au sein du même pays, opposant une « Tunisie développée » à une « Tunisie sous-développée ». Cette dualité engendre un déséquilibre préoccupant pour l'avenir du pays, illustré par la fracture entre « le littoral et l'intérieur désertique »

Une analyse approfondie des indicateurs de développement révèle non seulement l'ampleur des écarts régionaux, mais également les disparités entre les milieux urbains et ruraux, mettant en lumière la marginalisation croissante des zones rurales en Tunisie.

Le pays affiche une vulnérabilité croissante face aux chocs successifs, révélant un modèle de développement insuffisamment résilient et de plus en plus inadapté aux aspirations de la population.

Malgré ces difficultés, la Tunisie exprime la volonté de s'inscrire dans une trajectoire de croissance verte et de sobriété carbone. Le pays s'est doté, au fil des années, d'une expertise dans l'économie verte, et plusieurs institutions nationales œuvrent dans ce domaine. Depuis les années 1990, la préservation de l'environnement figure parmi les préoccupations des politiques publiques, une orientation qui s'est maintenue après la révolution de 2011. Toutefois, les avancées concrètes restent limitées et en deçà des attentes, nécessitant une refonte plus ambitieuse des stratégies de développement durable.

Pour la Tunisie, cette transition représente une opportunité de reconstruire une économie plus résiliente, durable et inclusive. La mise en place de réformes structurelles audacieuses, couplée à une gouvernance efficace et à une mobilisation des ressources internes et externes, sera essentielle pour relever les défis de demain et engager le pays sur la voie d'un développement équilibré et durable.

² <https://unfccc.int/fr/a-propos-des-ndcs/l-accord-de-paris>

Le changement climatique : une véritable menace pour les écosystèmes fragiles en Tunisie

Les forêts Tunisiennes : Entre précarité et menaces climatiques

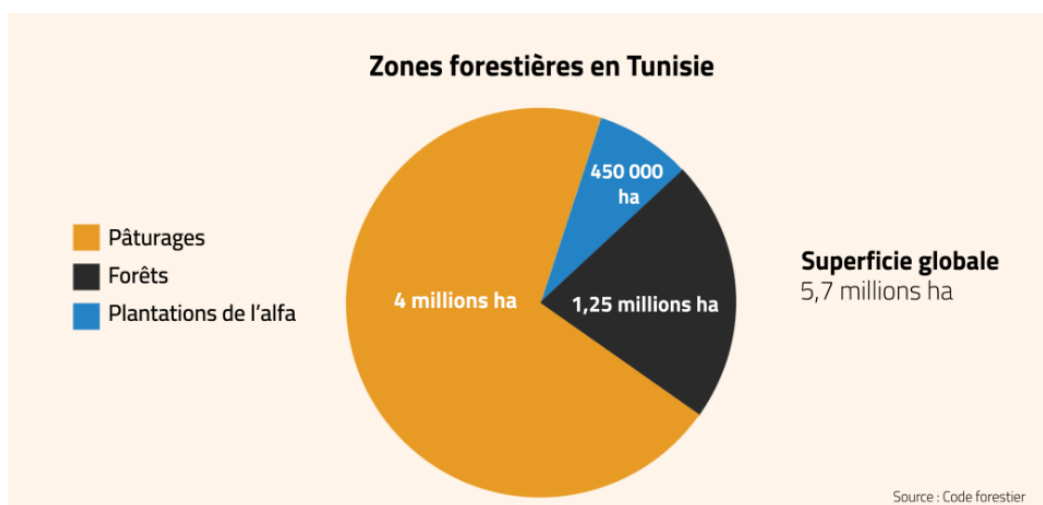
Les populations vivant dans les forêts et les montagnes tunisiennes comptent parmi les plus vulnérables du pays. Elles dépendent fortement de leur environnement rural et forestier, qui constitue à la fois leur lieu de résidence et leur principale source de revenu, souvent de manière saisonnière. La majorité des emplois liés aux activités forestières sont temporaires et occupés en grande partie par des femmes, ce qui les rend particulièrement exposées à la précarité économique.

Les forêts tunisiennes couvrent une superficie totale de 5,7 millions d'hectares, englobant les zones montagneuses, les pâturages et les plantations d'alfa. Le Code forestier tunisien divise ces espaces en trois grandes catégories :

- Les forêts, principalement situées dans le nord et le centre-ouest du pays, s'étendent sur 1,25 million d'hectares, dont 90 % appartiennent à l'État et 10 % sont en propriété privée.
- Les pâturages, qui couvrent une superficie de 4 millions d'hectares.

Cette répartition témoigne de l'importance des espaces naturels pour ces populations, dont la survie dépend directement de la gestion et de l'exploitation de ces ressources.

► Figure : Les zones forestières en Tunisie



Forêts Tunisiennes et emploi rural

En Tunisie, près d'un million de personnes vivent en permanence dans les zones forestières, dont une grande partie dépend d'activités forestières, qu'elles soient saisonnières ou permanentes. Les forêts jouent un rôle significatif dans l'économie nationale, représentant 1,33 % du PIB et 14% du PIB agricole.

D'après une étude du Forum tunisien pour les droits économiques et sociaux (FTDES)³, les forêts génèrent entre 6 et 7 millions de journées de travail par an. Cette dynamique est favorisée par l'intégration des populations locales

³ Cahier N6 Forêts tunisiennes : Entre marginalité territoriale et valorisation des ressources naturelles. Regards croisés entre gestionnaires et usagers

dans des projets de développement forestier ainsi que dans diverses structures agricoles réparties sur l'ensemble du territoire forestier, bien au-delà des seules zones montagneuses.

Vulnérabilité et pauvreté dans les forêts tunisiennes

Les forêts tunisiennes sont un refuge pour de nombreuses populations vivant en milieu rural, souvent dans des conditions de grande précarité. Environ 60% des habitants des zones forestières vivent en dessous du seuil de pauvreté (FTDES, 2020), dépendant des ressources naturelles pour leur subsistance. **Le manque d'infrastructures, le chômage élevé et l'absence d'alternatives économiques** les contraignent à exploiter de manière non durable les ressources forestières, accentuant la dégradation des écosystèmes.

L'accès limité aux services de base, tels que l'éducation, la santé et l'eau potable, exacerbe la vulnérabilité de ces communautés. Les femmes, en particulier, sont fortement impactées, car elles dépendent largement des forêts pour la collecte de bois de chauffage et de plantes médicinales, et pour la production artisanale. La pression sur les forêts entraîne une réduction progressive de ces ressources, rendant les conditions de vie encore plus précaires.

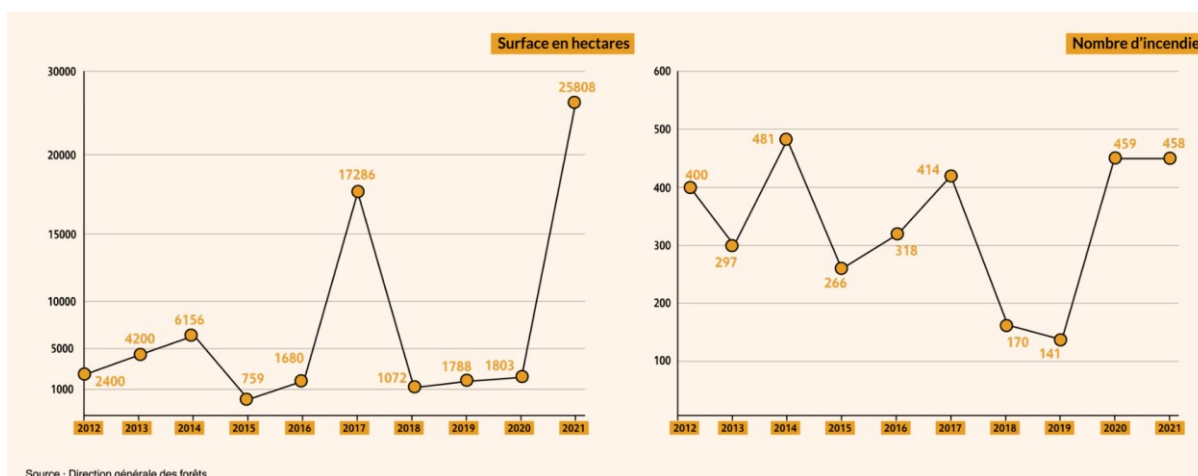
Par ailleurs, le changement climatique amplifie les inégalités existantes. La diminution des précipitations et l'augmentation des températures rendent l'agriculture de subsistance plus difficile, obligeant les populations à exploiter davantage les forêts pour compenser la perte de revenus agricoles. Cette spirale de pauvreté et de surexploitation fragilise encore plus ces écosystèmes déjà menacés.

Impacts des changements climatiques

Les changements climatiques exercent une pression significative sur les écosystèmes forestiers tunisiens. Les projections climatiques indiquent une augmentation des températures moyennes annuelles de 1,8°C à l'horizon 2050 et jusqu'à 3,6°C d'ici 2100 (UNFCCC, 2024). Cette hausse des températures est accompagnée d'une diminution prévue des précipitations de 5 à 10% d'ici 2050, pouvant atteindre 20% en 2100 (UNFCCC, 2024). Ces modifications climatiques entraînent une augmentation de la fréquence et de l'intensité des sécheresses, des incendies de forêt et des infestations par des ravageurs, compromettant la santé et la résilience des forêts.

Les projections économiques indiquent que, d'ici 2030, l'impact du changement climatique sur le seul secteur forestier pourrait s'élever à 11,52 millions de dollars par an. Par ailleurs, les pertes d'emplois estimées dans ce secteur oscillent entre 8 250 et 16 500 postes, voire jusqu'à 37 000 en cas de sécheresse sévère.

► **Figure : Evolution du nombre d'incendies dans les forêts tunisiennes**



Par exemple, la vague d'incendies survenue en 2023 à Melloula a détruit 400 hectares de couvert forestier diversifié, principalement composé de pins d'Alep et de chênes-lièges (Global Forest Watch, 2023). Ces événements exacerbent la vulnérabilité des communautés locales qui dépendent des ressources forestières pour leur subsistance.



Dégâts des incendies à Melloula – Gouvernorat de Jendouba (2023) - Photos Nawaat

Pressions anthropiques

Outre les défis climatiques, les forêts tunisiennes sont soumises à des pressions anthropiques considérables. L'abattage illégal d'arbres, l'urbanisation galopante, le surpâturage et l'exploitation non durable des ressources forestières contribuent à la dégradation et à la fragmentation des habitats. Entre 2001 et 2023, la Tunisie a perdu 36 500 hectares de couverture arborée, soit une diminution de 16% depuis 2000 (Global Forest Watch, 2023).

Cette déforestation affecte non seulement la biodiversité, mais aussi les services écosystémiques essentiels tels que la régulation hydrologique et la protection contre l'érosion. Les populations locales, en particulier les femmes impliquées dans les activités forestières saisonnières, voient leurs moyens de subsistance menacés par la diminution des ressources disponibles.

Initiatives de préservation : un effort insuffisant

Face à ces défis, diverses initiatives ont été mises en place pour préserver les forêts tunisiennes et renforcer leur résilience aux changements climatiques. L'adaptation basée sur les écosystèmes (AbE) est une approche privilégiée, consistant à gérer durablement, conserver et restaurer les écosystèmes pour aider les populations à s'adapter aux effets néfastes des changements climatiques. Cette approche vise à maintenir et à améliorer la résilience des écosystèmes tout en réduisant la vulnérabilité des communautés humaines.

Par ailleurs, le gouvernement tunisien a élaboré des stratégies nationales, telles que la Stratégie nationale de transition écologique (SNTE) adoptée en 2023. Cette stratégie comprend des axes prioritaires tels que la gouvernance institutionnelle, la gestion rationnelle des ressources naturelles, la promotion de l'économie verte et la sensibilisation à la culture environnementale.

Des efforts sont également déployés pour impliquer les communautés locales dans la gestion et la protection des forêts. L'intégration des habitants des zones forestières dans les programmes de développement économique et la mise en œuvre de pratiques de gestion durable sont essentielles pour assurer la pérennité des écosystèmes forestiers et améliorer les conditions de vie des populations concernées.

La fragilité de l'écosystème oasien en Tunisie : défis économiques, sociaux et climatiques

Les oasis tunisiennes, véritables havres de verdure au cœur des zones arides, jouent un rôle crucial dans la préservation de la biodiversité et le soutien des communautés locales. Cependant, ces écosystèmes sont confrontés à une série de défis majeurs, notamment la vulnérabilité économique et sociale, les impacts du changement climatique sur l'agriculture et les habitants, ainsi que les répercussions sur l'activité touristique.

La fragilité des écosystèmes oasiens en Tunisie résulte d'une combinaison de facteurs économiques, sociaux et environnementaux en l'absence d'une stratégie qui vise à assurer la gestion durable des ressources en eau, la promotion de pratiques agricoles résilientes au climat, la diversification des sources de revenus et le développement d'un tourisme responsable adapté aux nouvelles réalités climatiques.

Vulnérabilité économique et sociale dans les oasis tunisiennes :

Les oasis tunisiennes abritent une population estimée à environ 10% de la population nationale, soit près de 1,1 million de personnes. Ces communautés dépendent principalement de l'agriculture oasienne, qui représente jusqu'à 60% de leurs revenus. Cependant, la dégradation des systèmes d'irrigation et la mauvaise gestion des ressources naturelles ont conduit à une baisse significative de la productivité agricole. Par exemple, la production de dattes, pilier économique des oasis, a connu une diminution de 20%⁴ au cours de la dernière décennie. Cette situation a entraîné une augmentation du taux de chômage, atteignant 25% dans certaines régions oasiennes, et a poussé de nombreux jeunes à migrer vers les zones urbaines en quête de meilleures opportunités.

► Tableau : Distribution de la pauvreté par région

Région	Part dans la population	Nombre d'individus	Taux de pauvreté
Nord-Ouest	10,1%	1 184 119	22,5%
Centre-Ouest	12,9%	1 523 158	37,0%
Sud Est	9,1%	1 067 724	23,2%
Sud-Ouest	5,5%	642 286	18,1%

Source : Profil et déterminants de la pauvreté en Tunisie en 2022 : analyse de l'enquête ménage 2021-2022 (Unicef, CRES, MAS)

Impact du changement climatique sur les habitants et l'agriculture oasienne

Le changement climatique exacerbe les défis auxquels sont confrontées les oasis tunisiennes. Les projections indiquent une augmentation des températures moyennes annuelles de 1,1 à 2,1°C d'ici 2050, accompagnée d'une diminution des précipitations de 5 à 10%. Ces conditions entraînent une raréfaction des ressources en eau, essentielle pour l'irrigation des cultures. La surexploitation des nappes phréatiques, avec un taux d'extraction dépassant de 30% le taux de recharge naturelle, conduit à une baisse continue des niveaux d'eau et à une salinisation accrue des sols. Cette situation affecte directement la production agricole : la superficie des terres cultivées a diminué de 15%⁵ au cours des deux dernières décennies, et les rendements des cultures céréalières ont chuté de 25%. De plus, l'apparition de nouveaux ravageurs et maladies, favorisée par les changements climatiques, menace davantage les cultures.

⁴ Rapport de la banque mondiale : le réveil des oasis crée des emplois et renforce la résilience au changement climatique

⁵ Climate change and adaptation strategies: cabidigitallibrary



La sécheresse véritable cause de désertification : un phénomène préoccupant en Tunisie

Impact du changement climatique sur l'activité touristique

Le tourisme constitue une source importante de revenus pour les régions oasiennes, représentant jusqu'à 20% de l'économie locale dans certaines zones. Cependant, les effets du changement climatique, tels que l'augmentation des températures et la dégradation des paysages et la forte salinité de l'eau rendent ces destinations moins attractives pour les visiteurs. Par exemple, la fréquentation touristique dans les oasis du sud tunisien a diminué de 15% au cours des cinq dernières années. Cette baisse s'explique en partie par la perception accrue des risques liés aux conditions environnementales défavorables et par la concurrence d'autres destinations offrant des climats plus tempérés. Cette diminution de l'activité touristique affecte non seulement les revenus directs issus du secteur, mais également les activités connexes telles que l'artisanat et les services locaux, aggravant ainsi la vulnérabilité économique des communautés oasiennes.

L'expérience Tunisienne pour une meilleure adaptation des villages forestiers et oasiens au changement climatique : L'approche du projet EIIP en Tunisie (IPDLI)

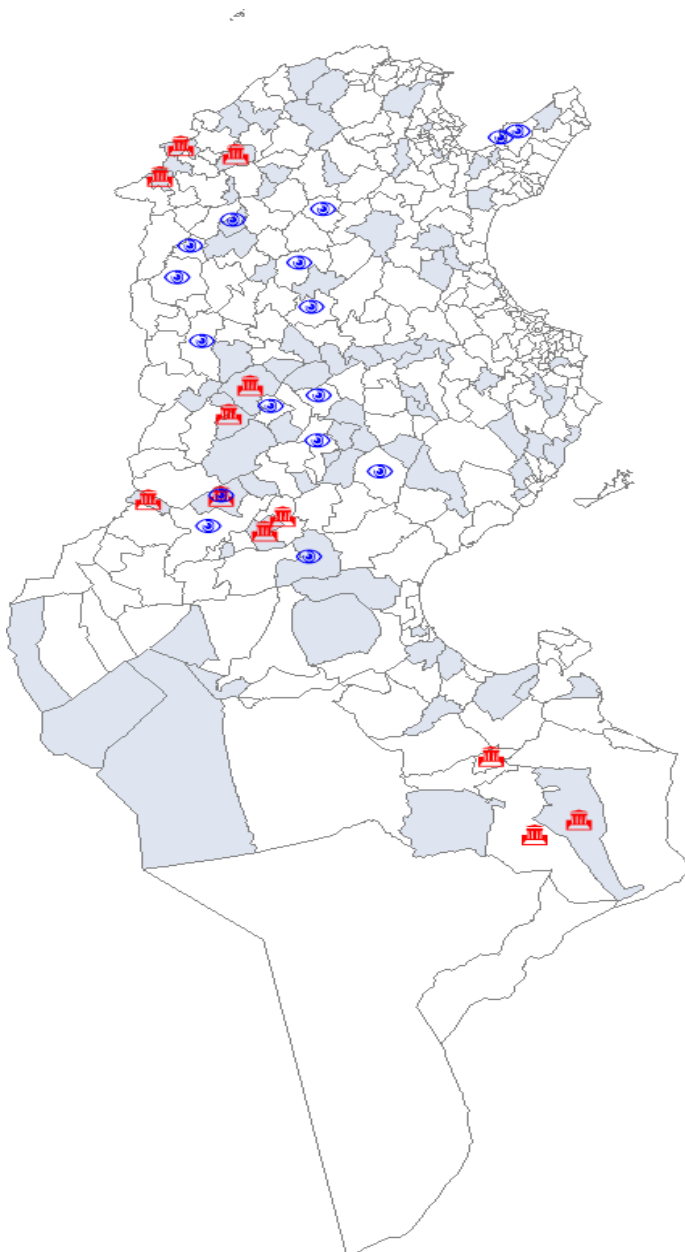
Dans le cadre de l'accompagnement technique dans l'action et l'appui des partenaires internationaux au processus de décentralisation initié par les autorités tunisiennes, l'Organisation Internationale du Travail (OIT) à travers le projet « Initiative Pilote pour un Développement Local Intégré » (IPDLI), cofinancé par l'UE, la Confédération Suisse (DDC) et l'UNIEF pour un budget global de 19,3 Millions de dollars, intervient prioritairement dans 19 communes à vocations rurales réparties sur 6 gouvernorats frontaliers (Tataouine, Gafsa, Kasserine, Jendouba, Beja et Kébili). Le projet a démarré en décembre 2017 et s'étalera jusqu'au octobre 2025.

Dans son principal objectif, le projet IPDLI est basé sur la contribution à l'amélioration des conditions de vie des populations dans les zones communales défavorisées, notamment en termes d'accès aux services de base de proximité, de création d'opportunité d'emploi décent et d'augmentation des revenus, à travers la réalisation de projets d'infrastructure communale démonstrative et l'accompagnement à la maîtrise d'ouvrage pour les nouvelles communes. La formation dans l'action a aussi une place importante dans les activités, à tous les niveaux : la communauté, particulièrement les jeunes et les femmes, les équipes communales, le secteur privé (PME), les partenaires régionaux, ou les autres programmes.

Parmi les axes prioritaires du projet IPDLI la promotion du développement local et régional et de priorisation des besoins via un dialogue social entre les différents acteurs locaux et une planification participative intégré.

Le fait de travailler dans des communes à vocations forestières et oasiennes a poussé l'équipe du projet à intégrer les questions climatiques tout au long du processus d'implémentation des interventions menés en appui aux efforts de développement régional du gouvernement Tunisien.

► Zones d'intervention du programme développement local intégré en Tunisie



Composante 1:

Projet IPDLI 2018-2025 (19 Communes sur 6 gouvernorats)

- Jendouba (04) : Khemeiria, Balta Bou Aouene, Galaa Maaden Forgssan et Jouaouda
- Kasserine (02) : Bouzguem et Chrayaa Machreg Chamss
- Gafsa (04) : Sidi Boubaker, Sidi Aich et Zanouch, Senad
- Tataouine (04) : Bir Lahmar, Tataouine, Smar et Tataouine Sud
- Beja (01) : Testour
- Kebelli (02) : Faouar, Bechelli-Jersine-El Blidete

Composante 2:

Capitalisation sur les acquis du Projet AZD 2012- 2017(OIT/UE) (sur 5 gouvernorats) :

- Kef (03) : Bahra, kef et Tejerouine
- Siliana (03) : Siliana, kesra et laaroussa
- Sidi Bouzid : Jelma, Regueb et Sidi Bouzid
- Kasserine (02) : Sbeitla et Thala
- Gafsa (03) : Gafsa, Belkhir Sidi Aich
- Nabeul (01) : Maamoura
- Tunis (01) : Djebel Jelloud

Projet d'appui au relèvement du gouvernorat de Nabeul post-inondation 2018-2019 (OIT/RBTC) dans (02) communes :

- Takelsa
- Korbos

Composante 3 :

Renforcement et accompagnement du processus de décentralisation pour les nouvelles communes (86 nouvelles communes sur 22 gouvernorats)

Des ateliers locaux participatifs pour l'élaboration des plans de développement locaux : La question climatique au cœur des préoccupations des habitants des régions forestières et oasiennes

Dans le cadre d'une démocratie participative et d'une gouvernance ouverte, les communes sont appelées, conformément au Code des Collectivités Locales, à élaborer leurs plans de développement local (PDL) selon une approche participative et avec l'appui des services de l'État. Ce plan constitue le cadre de référence pour l'action et les interventions des collectivités locales et des organes qui en dépendent en matière de développement global et durable.

Face aux défis liés au changement climatique, notamment dans les zones forestières et oasiennes, l'élaboration des PDL a essayé d'intégrer des stratégies de résilience et d'adaptation aux risques environnementaux. La préservation des ressources naturelles, la gestion durable de l'eau, la lutte contre la désertification et la protection des écosystèmes vulnérables doivent être prises en compte dans les priorités du développement local.

Les ateliers participatifs pour l'élaboration des PDL au niveau des communes ont permis de :

- Conscientiser les différents participants des avantages compétitifs de leurs territoires (savoir-faire, ressources locales, patrimoines...) tout en tenant compte des contraintes environnementales et des effets du changement climatique.
- Identifier les enjeux majeurs des communes, y compris les risques climatiques, et proposer des stratégies d'adaptation et d'atténuation, en particulier dans les zones forestières et oasiennes.
- Élaborer une vision concertée du développement du territoire en intégrant des orientations stratégiques pour la transition écologique, les axes et objectifs de développement pour la période 2018-2021.
- Proposer des projets structurants, notamment ceux qui favorisent la résilience climatique, la gestion durable des ressources naturelles et la protection des espaces fragiles.
- Définir les critères de priorisation des projets et des zones en intégrant des indicateurs environnementaux et climatiques.

L'exercice de planification a associé l'équipe communale (élus), les antennes locales des services déconcentrés, l'autorité locale, les représentants de la société civile active, les acteurs économiques locaux (services privés, corps de métiers, GDA⁶, SMSA⁷) ainsi que les habitants de la commune.

Les services déconcentrés intervenant sur le territoire communal ainsi que les directeurs régionaux de la CPSC⁸ sont invités en tant que personnes ressources et participent activement aux travaux de groupe, en apportant leur expertise sur les enjeux environnementaux et climatiques.

Dans ce cadre, 90 ateliers communaux, d'une durée de trois jours chacun, ont été organisés, couvrant 22 gouvernorats de la Tunisie et réunissant environ 17 000 participants.

En intégrant la question du changement climatique dans l'élaboration des PDL, ces ateliers ont doté les communes d'outils de diagnostic permettant d'anticiper les défis environnementaux et d'adopter des stratégies durables pour un développement plus résilient et inclusif.



Atelier PDL – Gouvernorat de Jendouba



Atelier PDL –Gouvernorat de Gafsa

6 Groupement de Développement Agricole

7 Société Mutuelle de Services Agricoles

8 Caisse des prêts et de soutien aux collectivités locales

Renforcer la résilience des populations locales grâce à des projets pilotes :

Pour l'implémentation de projets pilotes intégrés dans les plans de développement locaux et traduits en programmes d'investissement concrets, l'équipe du projet était confrontée à des défis majeurs :

- Désertification et dégradation des sols affectant les écosystèmes forestiers et oasiens.
- Ressources en eau limitées et surexploitées, menaçant l'agriculture et la biodiversité.
- Exode rural lié à la vulnérabilité économique et climatique des populations locales.
- Augmentation des températures et des périodes de sécheresse, impactant les productions agricoles et les moyens de subsistance.
- Pression anthropique sur les forêts et oasis (surexploitation, urbanisation, pollution).

Notre mission vise à développer des projets adaptés aux spécificités des communes forestières et oasiennes, axés sur la résilience climatique, à renforcer les capacités des collectivités locales et des acteurs locaux pour la mise en œuvre de solutions durables, à valoriser les savoir-faire locaux et les pratiques traditionnelles de gestion des ressources, en les combinant avec des approches innovantes et à mobiliser des financements et des partenariats pour assurer la viabilité des investissements.

Projet intégré de désenclavement du Douar Ncham : une infrastructure résiliente au service du développement durable (Exemple de village forestier)

Situé au pied du Mont Khmir, épine dorsale du nord-ouest de la Tunisie, Douar Ncham incarne l'archétype du hameau forestier isolé. Pendant près de 60 ans, ce village est resté coupé du monde, limitant l'accès de ses 146 habitants aux services essentiels tels que la santé, l'éducation et les opportunités économiques. Grâce à une approche intégrée et résiliente du programme IPDLI, un projet structurant de désenclavement a été mis en place pour reconnecter le village, tout en préservant son environnement naturel fragile et en favorisant son adaptation aux défis du changement climatique.

Des travaux verts et des infrastructures résilientes :

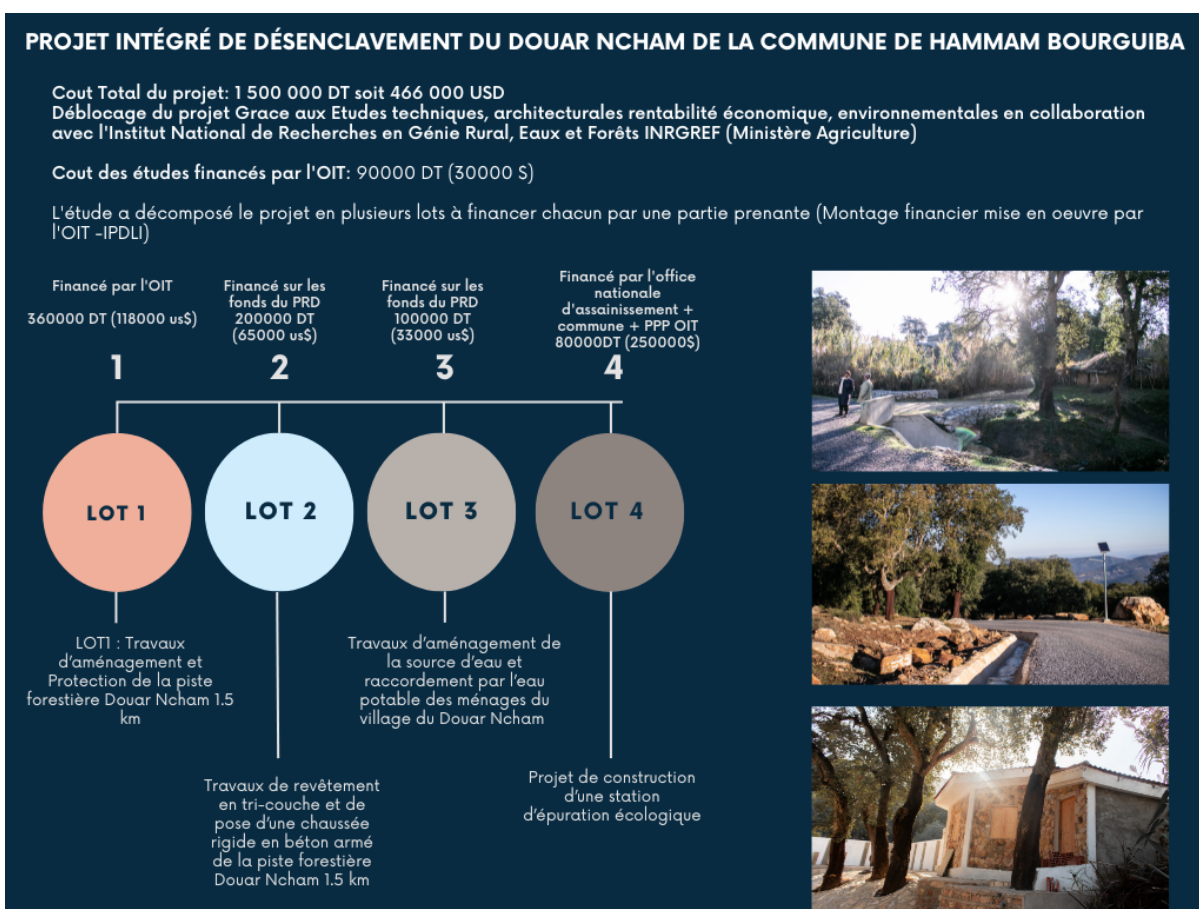
Le cœur du projet repose sur la construction d'une piste de 1,5 km, reliant Douar Ncham à la route goudronnée la plus proche. Consciente des défis environnementaux et climatiques, l'équipe en charge du projet a adopté une approche écologique et durable basée sur :

- **La Minimisation de l'impact forestier** : La piste a été conçue pour suivre un tracé sinueux, permettant de limiter l'abattage des chênes (seulement 6 arbres coupés).
- **L'optimisation des ressources locales** : Les déblais de curage des oueds ont été réutilisés pour renforcer l'assise de la voirie, réduisant ainsi les coûts et l'empreinte carbone du chantier. (Avec un appui du ministère de l'agriculture et de la commune)
- **L'aménagement hydraulique** : Des ouvrages de protection ont été mis en place pour prévenir l'érosion des sols, renforcer la résistance de l'infrastructure aux précipitations extrêmes et garantir la durabilité de l'accès au village face aux aléas climatiques.
- **Sécurisation de l'accès à l'eau et résilience face aux sécheresses** : Grâce à l'aménagement d'un lac collinaire permettant le stockage des eaux pluviales, l'approvisionnement en eau pour l'irrigation et la recharge des nappes phréatiques, aidant à préserver les ressources en eau à long terme.
- **Exploitation des énergies renouvelables** : Installation de lampadaire solaire photovoltaïque pour l'éclairage public.

Favoriser l'adaptation et la résilience de la population

Le projet ne se limite pas à l'infrastructure routière, mais s'inscrit dans une vision de développement territorial intégré, visant à renforcer la résilience et l'adaptation des populations locales aux défis socio-économiques et environnementaux :

- **Sécurisation des ressources en eau** : L'aménagement d'une source d'eau naturelle permettra un meilleur accès à l'eau potable, essentielle pour faire face aux périodes de sécheresse.
- **Revitalisation économique et retour des jeunes** : Le désenclavement du village permet aux habitants de vendre leurs productions locales sur les marchés voisins, favorisant ainsi leur autonomie financière. Certains jeunes, attirés par les nouvelles opportunités, commencent à revenir s'installer au village.
- **Écotourisme et artisanat** : Un projet de tourisme communautaire est en cours, misant sur la préservation de l'environnement et le savoir-faire local. Les artisanes potières appuyées dans leur processus de formation et de certification, diversifient leur production pour répondre aux nouvelles demandes du marché.



Un engagement fort des partenaires locaux et une mobilisation technique et financière pour la réussite du projet

Des solutions écologiques innovantes mobilisées grâce à l'appui de l'OIT :

Dans le cadre de ses efforts de mobilisation des ressources et de partenariat, le projet IPDLI a réussi grâce à son équipe régionale à Jendouba à intégrer dans ce projet une contribution secteur privé (Société Premier-Tech) qui consiste en l'installation d'une station de traitement tertiaire des eaux usées 100% écologique utilisant la technologie ECOFLO.

Ecoflo est un dispositif de traitement des eaux usées domestiques composé d'une fosse toutes eaux (anciennement « fosse septique ») et du filtre végétal à fragments de bourres de noix de coco : résidus naturels revalorisés, renouvelables, et compostables en agriculture ou jardinage. Le traitement se fait sans consommation d'énergie par une filtration naturelle et végétale.

► Figure : Le bio filtre ECOFLO



Projet d'intervention intégrée dans le périmètre irrigué Ouled Ali – Commune de Galaa Maaden Forgsan : Des infrastructures résilientes pour un impact écologique immédiat

Le projet a contribué à gestion rationnelle et durable des ressources en eau grâce à la construction d'un micro-barrage et de canaux d'irrigation et la réhabilitation des seguias traditionnels sur 2,1 km préservant ainsi les méthodes d'irrigation ancestrales et limitant l'érosion des sols d'où une amélioration de la disponibilité de l'eau, une réduction de la vulnérabilité aux sécheresses grâce à l'exploitation plus efficace des ressources en eau disponibles.

► Figure : Projet intégré dans le périmètre irrigué Ouled Ali



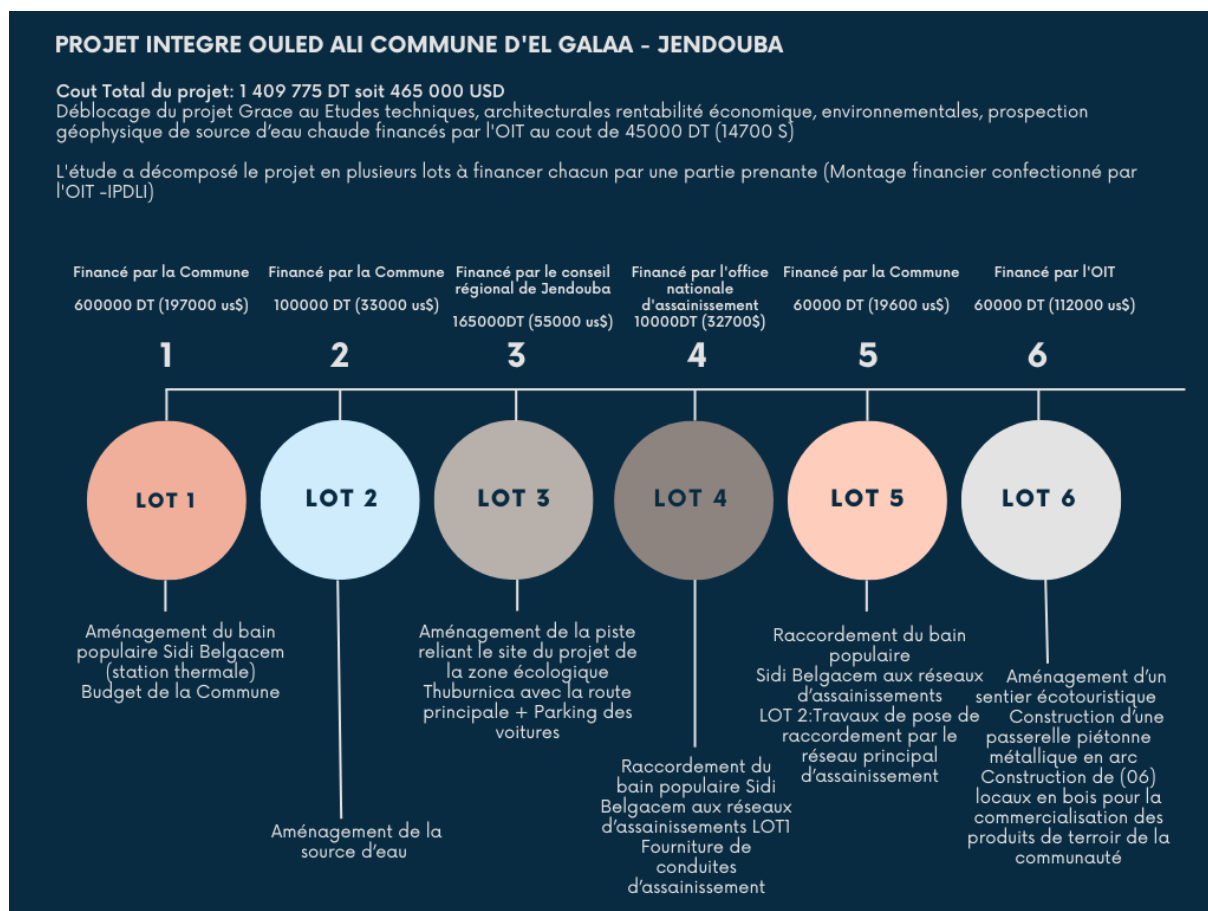
Grace à cette intervention on a réussi à réduire le gaspillage et à améliorer l'approvisionnement en eau pour l'agriculture locale, conséquence : Le projet a triplé la surface agricole exploitée, favorisant ainsi la culture d'oliviers, grenadiers et légumes.

Le projet a été également construit autour de la valorisation du patrimoine naturel et écotourisme via l'aménagement d'un sentier écotouristique longeant les canaux en favorisant une approche respectueuse de l'environnement en sensibilisant les visiteurs à la biodiversité locale. En parallèle l'étude de faisabilité pour un bain maure moderne pourrait encourager une utilisation durable des ressources thermale naturelles. (Projet encours à la charge de la commune)

Toujours dans cette approche intégrée alliant maîtrise d'ouvrage et formation sur le tas, 31 jeunes ont été formés aux travaux agricoles et forestiers contribuent à une gestion plus durable des terres et des ressources naturelles.

En associant agriculture, transformation des produits locaux et écotourisme, le projet diminue la dépendance à une seule activité économique, rendant la communauté plus résiliente aux chocs climatiques. Le projet a travaillé également sur l'organisation des exploitants agricoles et l'accompagnement technique des agriculteurs favorisent une meilleure gestion des ressources naturelles.

L'extension des surfaces cultivées, notamment via des cultures pérennes comme l'olivier et le grenadier, contribue à la séquestration du carbone et à la stabilisation des sols.



Montage technique et financier du projet intégré Ouled Ali

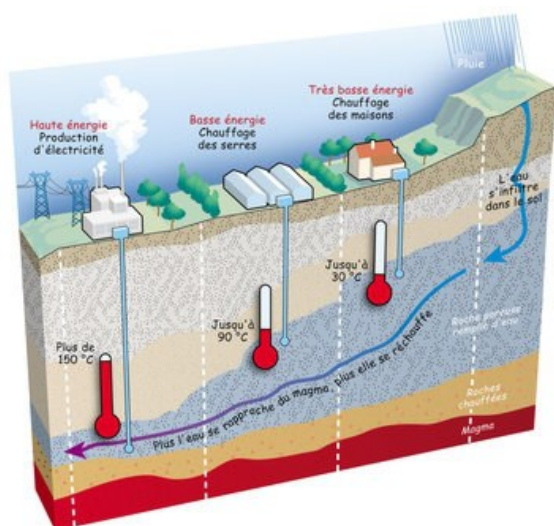
Projet intégré d'agriculture géothermale dans la commune d'el Faouar (Exemple d'une commune Oasienne) :

La géothermie, une énergie renouvelable issue de la chaleur stockée dans le sous-sol terrestre, offre des solutions prometteuses pour l'optimisation des ressources, notamment dans les régions arides comme le Sud tunisien. Le potentiel géothermique de cette région, exploité dans des projets tels que ceux soutenus par l'OIT IPDLI, joue un rôle crucial dans le développement durable des écosystèmes oasiens. En utilisant la chaleur géothermique, non seulement pour le chauffage des serres agricoles, mais aussi pour l'irrigation et d'autres applications agricoles, la géothermie contribue significativement à la sécurité alimentaire et à la résilience climatique.

Cette énergie, stockée sous forme de calories dans le sous-sol, est utilisée depuis des décennies pour diverses applications allant de la production d'électricité au chauffage domestique et industriel. Dans le contexte des défis climatiques actuels, la géothermie apparaît comme une solution viable et durable, particulièrement pertinente

pour les régions arides et semi-arides où les ressources en eau sont limitées et les conditions climatiques extrêmes.

► **Figure : Qu'est-ce que la géothermie ?**



Valorisation de l'agriculture géothermale et infrastructures résilientes à Faouar II : Un projet intégré face aux défis climatiques

Dans un contexte marqué par les effets du changement climatique et la nécessité de renforcer la résilience des populations locales, le projet IPDLI a entrepris d'apporter un appui technique aux serriculteurs de la région de Faouar II, située dans la commune de Faouar à Kébili. L'initiative vise à promouvoir une agriculture durable et adaptée aux conditions climatiques extrêmes du sud tunisien, tout en intégrant des infrastructures résilientes pour assurer un développement économique et social pérenne.

a) Une agriculture innovante pour une meilleure adaptation climatique

L'agriculture géothermale, déjà pratiquée dans la région, représente une solution innovante pour faire face aux défis posés par la raréfaction des ressources en eau et les températures élevées. L'appui technique fourni aux agriculteurs vise à :

- Optimiser l'utilisation des ressources géothermiques pour la production sous serre, réduisant ainsi la dépendance à l'eau d'irrigation conventionnelle.
- Améliorer les rendements agricoles en limitant l'impact des variations climatiques grâce à des techniques de gestion intelligente de l'eau et du sol.
- Renforcer la résilience des agriculteurs en leur offrant des solutions adaptées aux défis environnementaux et en diversifiant leurs sources de revenus.

b) Des infrastructures résilientes au service du développement durable

En complément du soutien à l'agriculture locale, le projet prévoit la construction d'un complexe agrotouristique et de points de vente destinés à la population locale. Ces infrastructures, conçues selon des normes environnementales strictes, contribueront à :

- Valoriser les productions locales en offrant aux visiteurs une immersion dans les techniques agricoles adaptées au climat aride.
- Promouvoir un écotourisme durable basé sur la découverte des savoir-faire traditionnels et innovants de la région.
- Réduire l'empreinte écologique des infrastructures grâce à l'utilisation de matériaux locaux et de solutions énergétiques durables.

c) Un levier de résilience sociale et économique

Au-delà des infrastructures physiques, le projet contribue également au renforcement de la résilience économique et sociale des habitants de Faouar II :

- Création d'emplois locaux, notamment dans l'agriculture, la transformation des produits et les services liés au tourisme rural.
- Accès facilité à des produits frais et locaux, favorisant la sécurité alimentaire et la diversification économique.
- Dynamisation du tissu économique local, avec une meilleure mise en réseau des producteurs et des consommateurs.

Les études techniques, finalisées en 2023, ont intégré les spécificités géologiques et climatiques de la région pour assurer la pérennité des infrastructures face aux défis climatiques futurs. Les travaux ont été entamés en 2024 selon une approche garantissant :

- Une intégration harmonieuse des infrastructures dans le paysage local, minimisant les impacts écologiques.
- Une gestion durable des ressources naturelles, notamment l'eau et l'énergie.
- Une approche participative, impliquant les acteurs locaux et favorisant l'appropriation du projet par la communauté.

► Figure : Plan 3D du projet de promotion de l'agriculture géothermale a el Faouar



Valorisation des ressources locales et infrastructures résilientes : un levier d'adaptation au changement climatique et de résilience des communautés locales

Le changement climatique impose de profondes transformations aux territoires et aux populations, en particulier dans les zones fragiles comme les forêts, les oasis et les zones semi-arides. Dans ce contexte, la valorisation des ressources locales apparaît comme une réponse stratégique pour renforcer la résilience des infrastructures et des communautés face aux défis environnementaux. L'expérience du programme IPDLI en Tunisie, illustre comment une gestion intégrée des ressources naturelles permet d'assurer un développement durable et inclusif, tout en s'adaptant aux effets du changement climatique.

L'exploitation des ressources locales, notamment les substances utiles comme les roches, argiles et sables, constitue un pilier fondamental pour la construction d'infrastructures adaptées aux conditions climatiques locales. L'IPDLI adopte une approche basée sur l'utilisation de matériaux locaux, réduisant ainsi l'empreinte carbone liée au transport et à la transformation des matières premières. L'optimisation des savoir-faire artisanaux, tels que la taille de pierre ou l'écoconstruction en argile, permet d'élaborer des bâtiments et des infrastructures mieux adaptés aux contraintes climatiques locales. Ces techniques ancestrales, remises au goût du jour par des formations et des chantiers-écoles, offrent une alternative durable aux méthodes de construction conventionnelles, souvent énergivores et peu adaptées aux milieux arides. La valorisation de ces ressources joue ainsi un rôle clé dans l'atténuation des effets du changement climatique en limitant l'utilisation de matériaux à forte empreinte écologique, tout en favorisant l'autonomie des territoires en matière de construction.



Aménagement du parc familial de la commune de Sidi Aich

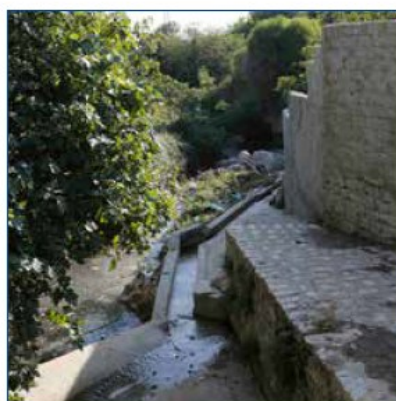


Aménagement du parc familial de Bir Lahmar

Au-delà de l'aspect matériel, les infrastructures mises en place dans le cadre du programme IPDLI sont pensées pour résister aux aléas climatiques, notamment les épisodes de sécheresse, les inondations et l'érosion des sols. L'intégration de bassins de rétention d'eau, de lacs collinaires et de systèmes de drainage adaptés permet de renforcer la gestion des ressources hydriques, un enjeu majeur pour l'adaptation aux périodes de stress hydrique. Les routes et pistes rurales, construites en tenant compte des spécificités géologiques et climatiques des zones concernées, bénéficient de techniques de stabilisation des sols qui limitent leur dégradation et assurent un accès pérenne aux services essentiels, notamment en période de fortes pluies. De même, les bâtiments publics et les infrastructures socio-économiques, tels que les marchés et centres artisanaux, sont conçus avec des matériaux locaux à forte inertie thermique, favorisant ainsi la régulation des températures intérieures et réduisant les besoins en climatisation. Cette approche d'ingénierie climatique appliquée au bâti s'inscrit dans une dynamique d'adaptation proactive face aux bouleversements environnementaux.

► **Encadré 1 : Travaux hydrauliques au village de Kesra – Siliana – un modèle de résistance contre le stress hydrique****Les Travaux Hydro-agricoles:****Les travaux hydrauliques au village de Kesra Supérieur-Gouvernorat de Siliana**

Sur une superficie de 20 Ha et pour le bénéfice de 100 agriculteurs, des interventions ont été identifiées dans une zone touchée par un déficit hydrique et une érosion accentuée. Les problématiques comprenaient des obturations de conduite, des fuites dans les canalisations et les canaux suspendus, la dégradation de la chaussée, la perte d'eau par infiltration dans les champs, une mauvaise répartition de l'eau de source, l'érosion et la perte de terrain, ainsi que des conflits entre les exploitants agricoles concernant la gestion de l'eau. Les résultats obtenus incluent l'élimination des pertes d'eau dues aux fuites, une meilleure répartition de l'eau d'irrigation dans les champs, une diminution du temps d'irrigation, l'organisation des agriculteurs en fonction des vannes de sectionnement, la reprise de parcelles abandonnées, la plantation de nouveaux figuiers et le retour à la pratique de cultures maraîchères.



L'impact de cette démarche dépasse le cadre strict des infrastructures et s'inscrit dans une dynamique plus large de résilience socio-économique. L'un des principaux enjeux du développement local en contexte de changement climatique réside dans la capacité des populations à diversifier leurs moyens de subsistance et à limiter leur vulnérabilité face aux crises environnementales. En favorisant la structuration de filières locales de production, de transformation et de commercialisation des matériaux de construction, l'IPDLI contribue à dynamiser l'économie des territoires, en particulier dans les zones rurales enclavées. La création de petites entreprises locales spécialisées dans l'exploitation et la valorisation des ressources naturelles génère des emplois et permet de lutter contre l'exode rural, un phénomène aggravé par la dégradation des conditions de vie liée aux impacts climatiques.

L'intégration de ces dimensions dans une stratégie globale de développement territorial durable offre une alternative efficace aux modèles de développement conventionnels, souvent centrés sur une exploitation intensive des ressources naturelles au détriment des équilibres écologiques. En promouvant une exploitation raisonnée des ressources, en privilégiant des techniques de construction adaptées et en impliquant les communautés dans la gestion des infrastructures, l'IPDLI pose les bases d'un modèle reproductible et adaptable à d'autres contextes, en Tunisie et au-delà. Cette approche holistique illustre comment la valorisation des ressources locales peut être un levier de transformation durable, capable de concilier impératifs économiques, sociaux et environnementaux dans une perspective de résilience à long terme.

L'adaptation au changement climatique ne peut être dissociée d'une transformation structurelle des modes de production et de consommation des ressources locales. En intégrant l'innovation sociale, l'ingénierie climatique et la gouvernance participative, cette initiative offre un exemple concret de développement territorial résilient, capable de répondre aux défis écologiques tout en améliorant durablement les conditions de vie des populations locales.

Le renforcement des capacités et les chantiers démonstratifs : un levier pour la création d'emplois verts et la résilience face au changement climatique

Le renforcement des capacités à travers la formation professionnelle et les chantiers démonstratifs apparaît comme une solution clé pour favoriser la création d'emplois verts, tout en contribuant à l'adaptation et à la résilience des communautés locales face aux effets du changement climatique. L'expérience du programme IPDLI notamment dans les forêts de Jendouba et les oasis de Kébili, illustre comment une approche intégrée de formation et d'apprentissage pratique peut permettre aux populations vulnérables de développer des compétences adaptées aux défis écologiques contemporains.

La formation et le renforcement des capacités : un moteur pour l'emploi vert

Le développement des emplois verts, définis comme ceux qui participent à la préservation de l'environnement tout en assurant des conditions de travail décentes, nécessite une main-d'œuvre qualifiée. Dans ce cadre, les formations techniques et professionnelles dispensées par l'IPDLI visent à fournir aux jeunes et aux femmes des compétences en lien avec les métiers de la gestion forestière, de l'agriculture durable et de la transformation des ressources naturelles.

En s'appuyant sur une approche participative et de proximité, le programme permet aux populations locales d'accéder à des formations adaptées à leurs besoins spécifiques. L'apprentissage des techniques de reboisement, de sylviculture durable, de conservation des eaux et des sols, ou encore de valorisation des produits forestiers non ligneux (comme les plantes aromatiques et médicinales) leur permet non seulement d'acquérir un savoir-faire valorisable sur le marché du travail, mais aussi de jouer un rôle actif dans la préservation de leur environnement.

L'approche adoptée par l'IPDLI repose sur des formations qualifiantes qui intègrent des modules théoriques et pratiques, favorisant ainsi une meilleure assimilation des compétences et une transition fluide vers l'emploi. Ces formations s'accompagnent également de programmes d'accompagnement à l'entrepreneuriat, permettant aux bénéficiaires de développer leurs propres activités économiques autour de la valorisation durable des ressources locales.



Les chantiers démonstratifs : une approche appliquée pour l'apprentissage et l'adaptation climatique

L'un des principaux axes d'intervention du programme IPDLI repose sur la mise en place de chantiers démonstratifs, qui permettent aux participants d'appliquer leurs connaissances sur le terrain tout en contribuant directement à des projets d'aménagement résilients. Ces chantiers-écoles, réalisés en partenariat avec les services déconcentrés de l'État et les collectivités locales, couvrent plusieurs domaines stratégiques :

- Reforestation et protection des écosystèmes forestiers, afin de limiter l'érosion des sols et d'améliorer la capacité de stockage du carbone.
- Construction d'infrastructures résilientes, notamment des pistes et ouvrages hydrauliques intégrant des techniques respectueuses de l'environnement.
- Mise en place de systèmes de gestion des ressources en eau, comme les lacs collinaires ou la récupération des eaux pluviales pour l'irrigation.

Ces initiatives permettent non seulement d'améliorer les conditions de vie des habitants en facilitant l'accès aux services de base (routes, eau potable, énergie renouvelable), mais aussi de renforcer l'autonomie des communautés face aux aléas climatiques. En effet, en dotant les populations locales des compétences nécessaires pour entretenir et gérer durablement ces infrastructures, le programme favorise une résilience à long terme face aux défis environnementaux.



Création d'opportunités économiques grâce à la valorisation des ressources locales

La valorisation des ressources naturelles est au cœur de l'approche de l'IPDLI, notamment dans les zones forestières, oasiennes et rurales. L'exploitation durable du bois, des produits forestiers non ligneux et des plantes médicinales représente un potentiel économique considérable, souvent sous-exploité en raison du manque de formation et d'infrastructures adaptées.

En intégrant les principes de l'économie circulaire et de la gestion durable des forêts et des oasis, le programme encourage la création de coopératives locales spécialisées dans :

- La production et la transformation des produits issus des forêts et oasis, comme les huiles essentielles et les plantes médicinales, le bois de palmier...
- L'artisanat forestier et oasien, incluant la menuiserie et la fabrication d'objets en bois certifiés, valorisation du jonc et du bois d'olivier....
- Le développement de l'écotourisme, en exploitant les paysages forestiers et oasiens pour des activités touristiques à faible impact environnemental.

L'intégration de ces filières permet non seulement de diversifier les sources de revenus des populations locales, mais aussi d'assurer une gestion plus durable et équitable des ressources forestières et oasiennes, en limitant la surexploitation.

► Encadré 2 : la valorisation du marbre et de la pierre naturelle : un levier pour le développement durable et la création d'emplois verts

La pierre naturelle et le marbre représentent des ressources stratégiques pour l'économie et le développement territorial. Leur exploitation, transformation et valorisation peuvent constituer un levier de croissance économique, tout en favorisant la création d'emplois verts et l'adaptation aux défis environnementaux et climatiques. En Tunisie, ces matériaux occupent une place essentielle dans plusieurs secteurs, notamment l'industrie de la construction, l'artisanat et l'aménagement urbain, et leur valorisation repose sur des savoir-faire ancestraux qui nécessitent d'être renforcés et modernisés.

La Taille de la Pierre et du Marbre : Un Métier d'Art et d'Industrie

La taille et la transformation de la pierre naturelle et du marbre constituent un secteur qui combine tradition et innovation. Ce métier requiert une expertise technique et une connaissance approfondie des propriétés des matériaux pour garantir des produits de qualité adaptés aux besoins du marché.

D'une part, les techniques artisanales de taille, gravure et sculpture permettent de préserver un patrimoine culturel et architectural riche, en favorisant une production locale adaptée aux spécificités esthétiques et historiques du pays. D'autre part, l'industrie moderne du marbre et de la pierre intègre des technologies avancées pour l'extraction, la découpe et le polissage, améliorant ainsi la productivité et la compétitivité du secteur.

Le développement des compétences dans ce domaine a été assuré par le programme IPDLI via la formation de nouveaux artisans et techniciens, capables de maîtriser les techniques traditionnelles et les outils modernes. La création d'ateliers de formation et de chantiers démonstratifs constitue un levier essentiel pour transmettre les savoir-faire et favoriser l'émergence d'une nouvelle génération de tailleurs de pierre et de marbriers.

Il est à noter que l'exploitation du marbre et de la pierre naturelle soulève des enjeux environnementaux majeurs, notamment en termes de gestion des déchets d'extraction et de transformation, d'optimisation des ressources en eau et en énergie, ainsi que de préservation des paysages et des écosystèmes locaux.

L'essor des pratiques écoresponsables dans ce secteur favorise l'émergence d'emplois verts, notamment dans la gestion des déchets, le développement de matériaux écologiques et la conception de produits à faible empreinte environnementale.

Appui institutionnel : des initiatives et un plaidoyer collectif pour l'intégration de la dimension environnementale dans les politiques publiques de développement

Consciente de l'importance de la thématique « Changement climatique » l'équipe IPDLI a multiplié les efforts pour assurer un renforcement des capacités des partenaires nationaux et sociaux en vue de garantir un ancrage de l'approche HIMO dans sa composante « Travaux verts et infrastructure résiliente » dans les politiques d'investissement public. A cet effet, 3 actions majeurs ont été lancées et qui consiste à :

L'appui technique et logistique aux formations organisées par ITC Turin :

Ce qui permet la formation des décideurs sur les pratiques durables en matière d'investissement. Parmi les cours où le programme IPDLI a pris en charge une délégation tripartite composée de représentants de l'unité de coordination nationale sur les changements climatiques au ministère de l'environnement, le ministère de l'agriculture, le ministère de l'équipement, le commissariat général au développement régional au ministère de l'économie, le département des affaires locales au ministère de l'intérieur et les 2 partenaires sociaux UGTT et UTICA à travers les 2 fédérations de bâtiment, on trouve le cours d'adaptation aux changements climatiques par les travaux verts. Ce cours a permis la montée en compétence des partenaires clés du projet en les sensibilisant sur le rôle joué par les travaux verts, à savoir les activités physiques pour le développement et l'entretien des

infrastructures, des écosystèmes ou des atouts communautaires qui ont un impact positif global sur l'environnement.

Une présence annuelle à la conférence des parties sur le changement climatique COP :

Depuis la COP26 le programme IPDLI a assuré une présence continue dans cet événement phare que ce soit pour partager son expérience ou pour identifier les expériences comparées et les solutions innovante en matière d'adaptation au dérèglement climatique. Des délégations de haut niveau présidées par les ministres de l'environnement ont été appuyées techniquement et logistiquement par l'OIT pour assurer une représentativité et une participation active à cet événement.

Transition climatique locale dans les villes de la région MENA
Les meilleures pratiques

Francophonie Climate Pavilion, CdP26, Glasgow, Ecosse
10 novembre 2021
9.45am to 10.45am

La lutte contre le changement climatique est un défi mondial mais ses impacts et solutions sont à prendre en charge au niveau local. Cette session parallèle traite de la transition climatique locale dans les villes de la région MENA. Elle vise à montrer les progrès de l'action climatique au niveau local dans la région méditerranéenne. Elle traitera aussi des mécanismes de partage des meilleures pratiques entre les villes, en décrivant comment elles élaborent leurs plans d'action pour le climat et les mettent en œuvre. Dans le même temps, des recherches académiques axées sur la résilience climatique des villes méditerranéennes sont mises en évidence. Par conséquent, nous rassemblons les gouvernements locaux, les ONG, les universités et d'autres acteurs connexes pour discuter des nouvelles opportunités pour la transition climatique au niveau local dans les villes de la région MENA.

Objectifs:

- Fournir aux participants des connaissances sur l'importance des villes pour lutter contre le changement climatique
- Mettre en avant les bonnes pratiques de la transition climatique dans les villes MENA
- Mettre en évidence les freins à la lutte contre le changement climatique au niveau local
- Discussion sur les approches de la transition climatique dans les villes MENA
- Des recommandations pour une meilleure gouvernance locale du climat

Participants:

- Leila CHIKAOUI, Ministre de l'Environnement, Tunisie
- Cecile Martin-Phipps, Directrice de l'IFDD
- Mondher BOUSNINA, MALE, Tunisie
- Aïda ROBBANA, ONU-Habitat Afrique du Nord
- Jad BOUBAKER, Organisation Internationale du Travail
- Adel BEN YOUSSEF, Université Côte d'Azur
- Amel MAKLOUF, Climat-Med, Union Européenne
- Fateh BELAID KAPSARC, Arabie Saoudite

Exemple de side event organisé par le projet IPDLI lors de la COP26

COP29, Baku Azerbaïdjan : Le projet a organisé un SIDE Event intitulé « Transition climatique locale en Tunisie : un territoire résilient premier rempart face aux changements climatiques » ce SIDE Event a permis de Fournir aux participants des connaissances sur l'importance des communes / municipalités pour lutter contre le changement climatique, de mettre en avant les bonnes pratiques de la transition climatique dans les communes tunisiennes, de mettre en évidence les freins à la lutte contre le changement climatique au niveau local, de discuter des approches de la transition climatique dans les communes tunisiennes et de formuler des recommandations pour une meilleure gouvernance locale du climat.

Une académie de construction durable : une initiative de l'OIT portée par les partenaires sociaux

Dans le cadre de sa mission régulière d'appui au développement stratégiques des fédérations de bâtiment au sein de l'UGTT et de l'UTICA, et dans le cadre du renforcement du dialogue sectoriel⁹ pour un écosystème de construction prospère et durable, le programme IPDLI a mobilisé une expertise technique pour le lancement du programme STA Academy qui est une initiative innovante visant à former une nouvelle génération de professionnels qualifiés dans le domaine de la construction durable en Tunisie. Conçu pour répondre à la pénurie de main-d'œuvre spécialisée dans le secteur du BTP, il offre aux jeunes une formation complète alliant enseignements théoriques, pratiques et accompagnement entrepreneurial. Structuré en plusieurs phases, le programme inclut une sélection rigoureuse des candidats, une formation intensive sur les techniques de construction durable et l'entrepreneuriat, ainsi que des compétitions et défis collaboratifs pour renforcer l'esprit d'innovation et de créativité. Afin d'assurer une intégration réussie sur le marché du travail, un système de mentorat et de parrainage par des entreprises partenaires accompagne chaque participant, facilitant ainsi son insertion professionnelle ou la création de son propre projet. Soutenu par des partenaires stratégiques, ce programme favorise la transition énergétique et écologique, en développant un vivier de talents pour les entreprises tout en promouvant l'auto-entrepreneuriat et l'économie verte.

⁹ [A strategic dialogue for the future of the construction sector in Tunisia | International Labour Organization](#)

Conclusion :

La Tunisie, à l'instar de nombreux pays méditerranéens, fait face à des défis climatiques croissants qui affectent particulièrement ses écosystèmes fragiles, notamment les forêts du nord-ouest et les oasis du sud. La déforestation, la désertification, la raréfaction des ressources en eau et les températures extrêmes menacent non seulement l'environnement naturel, mais également les conditions de vie des populations qui en dépendent. Face à ces enjeux, une approche intégrée combinant formation, valorisation des ressources locales et mise en place d'infrastructures résilientes devient une nécessité pour assurer un développement durable et inclusif.

Les différentes initiatives mises en œuvre dans le cadre de l'IPDLI démontrent que la formation et le renforcement des compétences jouent un rôle central dans l'adaptation des populations aux changements climatiques. En préparant une nouvelle génération de professionnels qualifiés dans les métiers de la construction durable, de l'agriculture résiliente et de la gestion des ressources naturelles, ces programmes permettent de répondre aux besoins d'un marché en pleine transformation tout en contribuant à la lutte contre les effets du changement climatique. L'accent mis sur les chantiers démonstratifs et l'apprentissage par la pratique permet non seulement une transmission efficace des savoir-faire, mais aussi une appropriation locale des solutions durables, garantissant ainsi leur pérennité.

Dans les zones forestières du nord-ouest, les actions de reboisement, de gestion durable des forêts et de valorisation des produits forestiers non ligneux permettent d'atténuer l'érosion des sols et de restaurer la biodiversité tout en générant des emplois verts. La structuration de filières économiques locales, intégrant l'exploitation durable du bois, l'artisanat forestier et l'écotourisme, constitue un levier essentiel pour renforcer la résilience des communautés locales. De même, dans les oasis du sud, où les impacts climatiques se traduisent par une salinisation croissante des sols, une raréfaction des ressources hydriques et une perte de fertilité, les travaux oasiens mis en place par l'IPDLI permettent de préserver ces écosystèmes grâce à l'amélioration des systèmes d'irrigation, la protection contre l'ensablement et la diversification des cultures.

L'infrastructure résiliente constitue un autre axe fondamental de cette démarche. Les projets de désenclavement rural, de construction d'ouvrages hydrauliques et de réhabilitation des voies de communication adoptent des solutions adaptées aux contraintes environnementales en utilisant des matériaux locaux et des techniques de construction écologique. L'optimisation des ressources naturelles, notamment à travers l'utilisation de déblais de curage des oueds pour le renforcement des routes ou l'intégration de solutions de gestion de l'eau comme les lacs collinaires, contribue à rendre ces infrastructures plus durables et résistantes aux aléas climatiques.

Dans ce cadre, la transition énergétique et écologique constitue un enjeu transversal. En intégrant des solutions innovantes en matière d'efficacité énergétique, de recyclage et de gestion durable des ressources, ces initiatives ouvrent la voie à un modèle de développement plus résilient, moins dépendant des énergies fossiles et mieux adapté aux réalités climatiques du pays. Cependant, pour garantir le succès de ces efforts, une mobilisation accrue des acteurs publics, privés et de la société civile est nécessaire, ainsi qu'un renforcement des politiques de soutien à l'entrepreneuriat vert et à l'économie circulaire.

Ainsi, à travers une approche intégrée combinant formation, infrastructures résilientes et valorisation durable des ressources, la Tunisie dispose d'une véritable opportunité pour atténuer les impacts du changement climatique tout en créant des opportunités économiques locales. La clé du succès réside dans l'implication des populations locales, l'innovation et la mise en œuvre de solutions adaptées aux spécificités de chaque territoire. En misant sur ces leviers, le pays pourra non seulement protéger ses écosystèmes fragiles, mais aussi transformer les défis climatiques en opportunités de développement durable et inclusif

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► Sustainable utilization of *Prosopis juliflora* as a pathway to green jobs and livelihood enhancement in Garissa and Tana river counties, Kenya

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Acknowledgements

We acknowledge the support received from the Embassy of the Government of Netherlands and ILO PROSPECTS Programme Kenya for the financial support (implementation agreement No. 40449764/0) that has made this project successful. Further appreciation goes to the Kenya Forestry Research Institute (KEFRI) staff who worked to ensure the successful implementation of this project. Our special thanks go to other key institutions, especially Garissa University and Kenya Industrial Research and Development Institute for the technical support provided throughout the implementation process, not forgetting the Project Implementation Committee for their efforts in overseeing the project activities carried out as planned. Lastly, our gratitude goes to the host community and refugees in Garissa and Tana River counties that provided valuable information and participated in project activities.

Abstract

Prosopis juliflora (Mathenge) plant is found growing vigorously within the drylands of Kenya which comprises of 80% of total landmass. It's a multipurpose and ever-green invasive alien species introduced in Kenya to curb desertification due to its fast growth and resilience to drought. It is estimated that over 972 km² and 1,132 km² of crops and range lands in Garissa and Tana River Counties, respectively, are now under Mathenge which is spreading annually at an estimated rate of 143 km² (NPS, 2020). Though invasive, Kenya has developed a *Prosopis* management strategy, which advocates for the control of this invasive plant through a pilot project that explores sustainable strategies on decent green job creation and livelihood support through the Employment Intensive Investment Programme (EIIP). The EIIP approach aims at utilizing locally available resources to deliver community benefits while creating green jobs and providing skills to communities. It seeks the balance between labour, technology, and innovation to generate decent green jobs. It aims to examine the potential for mechanical removal of the species from farmlands and subsequently restoring the degraded land with high value crops. The project aims at creating jobs through the production of charcoal, briquettes, animal feed and other value-added products derived from the species while examining the negative ecological, economic and social impacts. The project employs participatory approaches by engaging the local communities, government agencies and other stakeholders to design interventions on Mathenge utilization, capacity building on utilization technologies and pilot demonstrations of processing equipment and products. The sampled farmlands were identified across eight (8) project sites where youths were engaged in weekly cohorts to carry out the mechanical removal of the species. The youth were equipped with modern charcoal kilns and chaff cutters for harvesting, producing charcoal and pods for animal feeds. In six months, a total of 2,485 direct decent green jobs have been created, livelihoods improved for the vulnerable populations through the revenue stream generated from the value chain. Lessons learned from the project show that the products from the species can be transformed into assets for economic growth and environmental restoration using the EIIP approaches. It is envisaged that policy and regulatory frameworks will align economic development with environmental conservation, emphasizing innovation and community-driven sustainable solutions. Therefore, comprehensive community management plans and legal framework is needed for commercial utilization of *P. juliflora* into viable economic products. Moreover, there is need to upscale the use of technology and local innovations in the management of the species while monitoring long-term impacts.

Keywords: Mathenge, Green jobs, Livelihood, Labour, Innovation.

Introduction

Global concerns over deforestation, desertification and fuelwood shortages in the 1970s and 1980s promoted a wave of projects that introduced *P. juliflora* and other hardy tree species to new environment across the world. *Prosopis juliflora* commonly known as “Mathenge”, is found growing very fast within the Arid and Semi- Arid Lands (ASALs) of Kenya which account for about 80% of the country's land area. These ASALs are undergoing massive natural resource depletion, declining land productivity, a sharp rise in demand for food, fibre, wood and other raw materials due to increasing human population that negatively impacts on natural environment and human poverty (1). The species grows within the natural vegetation that comprises of *Acacia – Commiphora* species and bushes of *Slavadora persica* (2). *P. juliflora* is tolerant to harsh and drought conditions and grows to form a dense impenetrable thicket (3). Millions of hectares within the rangelands have been invaded and invasion continues in South Africa, Australia, Coastal Asia (4) and Eastern Africa (5). Land use changes, competitive ecological advantages and climate change are thought to be key factors influencing the probability of invasion and hence *P. juliflora* has been rated as one of the world's 100 least wanted species (6)

Prosopis juliflora is native to South America, although the exact period of introduction in Kenya largely remains unknown. It is reported to have been introduced in Kenya in the 1930s for fodder, shade and as ornamental plant (7). In the 1970s and owing to drought, there was increased planting of *P. juliflora* to rehabilitate degraded areas and mitigate recurrent famines and massive losses of human and livestock population. The first records of propagation of *P. juliflora* in Kenya (presumably *P. pallida* and/or its hybrid) can be traced to species trials of 1973 in Mombasa and Menengai (Nakuru County). These trials targeted trees and shrubs that are likely to thrive in marginal areas with potentials to produce fodder or high value cash crops (3).

The spread of *P. juliflora* has significant socio-economic and ecological implications in Kenya's arid and semi-arid lands (ASALs), particularly in Garissa and Tana River Counties (8). While it was introduced as a solution for desertification, the encroachment of this invasive species on agricultural and pastoral lands has led to reduced crop yields and livestock productivity, exacerbating food insecurity and poverty in the region (9). Farmers and pastoralists, who rely on these lands for their livelihoods, have been particularly affected (10). The dense thickets of *P. juliflora* make it difficult to access grazing areas and water sources, leading to conflicts over scarce and limited resources and further marginalizing vulnerable populations (11). Despite these challenges, *P. juliflora* also presents opportunities for economic development. Its wood is highly valued for charcoal production, which is a major source of energy in Kenya (12). Additionally, its pods can be processed into animal feed, providing a sustainable alternative to traditional fodder sources (9). The potential for utilizing *P. juliflora* in these ways has sparked interest in developing sustainable management strategies that can mitigate its negative impacts while harnessing its economic potential.

Communities in dryland areas have increasingly turned to *Prosopis* biomass as a resource for fuelwood, construction material and fodder for subsistence and income generation. Studies in Ethiopia and Sudan have documented how *P. juliflora* utilization has contributed to household incomes by up to 45%, reduced dependence on conventional fuel sources, and empowered vulnerable groups (13-14). This aligns well with Kenya's Vision 2030 development agenda, which emphasizes on the sustainable natural resource utilization and the creation of green jobs. Based on this scenario a project entitled “*Prosopis juliflora* Management for Decent Green Jobs and Livelihood Support to Communities and Refugees in Garissa and Tana River Counties” was formulated to address some the aforementioned concerns. The Employment Intensive Investment Programme (EIIP) was adopted as implemented by the International Labour Organization (ILO) that seeks to address the dual challenges of environmental degradation and unemployment by promoting green jobs and sustainable livelihoods. The EIIP approach emphasizes the use of labour-intensive methods to achieve environmental and socio-economic objectives, creating employment opportunities while restoring degraded ecosystems (15). In the context of *P. juliflora* management, the EIIP approach aims to balance ecological restoration with economic development, leveraging the invasive species as a resource for green job creation and livelihood enhancement.

The objective of the project is to enhance livelihood and build resilience of host communities and refugees through sustainable use of forest products thereby creating decent jobs and improved livelihoods. Furthermore, this project aims to evaluate the ecological, economic, and social impacts of *P. juliflora*, its role in improving

livelihoods and creating decent green jobs and illustrate community-driven approaches for sustainable management strategies for controlling the plant in Garissa and Tana River Counties.

The significance of this project is multiple fold. First, it addresses a pressing environmental issue that has far-reaching implications for biodiversity, ecosystem services, and climate resilience in Kenya's drylands. Second, it explores innovative approaches to invasive species management that can serve as a model for other regions facing similar challenges. Thirdly, it highlights the potential of jobs creation to contribute to poverty alleviation and sustainable development, aligning with the United Nations Sustainable Development Goals (SDGs) (16).

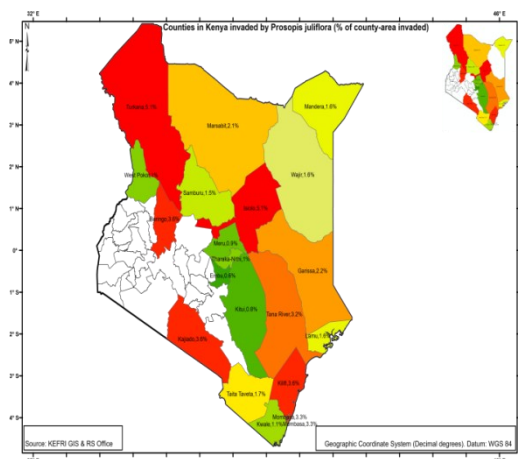
The project is grounded in the principles of sustainable development, which emphasize the integration of ecological, economic, and social objectives (16). It draws on the concept of ecosystem-based adaptation (EbA), which seeks to enhance the resilience of ecosystems and communities to climate change through sustainable management practices (17). The Project also incorporates the principles of participatory development, which emphasize the active involvement of local communities in the design and implementation of interventions.

Research methodologies

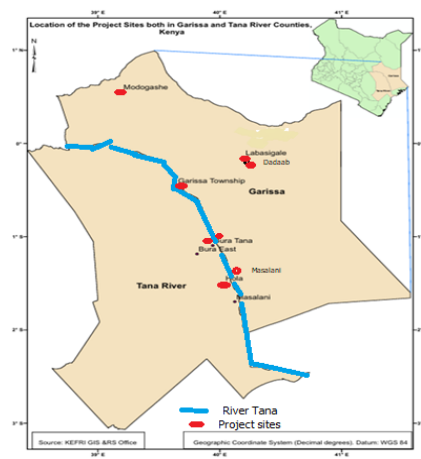
Description of the project implementation area

The project was implemented in Tana- River and Garissa Counties. Tana-River is located on the northern main land part off-Coast line between latitudes 0°0'53" and 2°0'41" South and longitudes 38°25'43" and 40°10'29" East. The county borders Tana Delta to the South, Garissa and Fafi to the Northeast, Ijara to the East, Mutomo to the West, Mwingi to the Northwest and Garbatula to the North. The County covers a total area of 37,904 Km² (18), where 90% is communal land and has not been adjudicated. The vegetation ranges from scrubland to thorny thickets within the riverine area. Shrubs and annual grasses dominate most parts of the region. However, there are enclaves of trees and perennial grasses dominating wetter parts.

► FIGURE 1(a) *Prosopis* infested counties in Kenya



► FIGURE 1(b) Project implementation sites



Garissa County is part of the former North Eastern Province and borders Wajir County to the North, Tana River County to the West, Isiolo County to the North West, Somalia to the East and Lamu County to the South. The County covers a total area of 44,753.2 Km² (18) and rises from an elevation of 0m above sea level on the Indian Ocean through bush-covered plains up to 400m above sea level on the North. The major physical features are seasonal lagoons and Tana River basin. The soils range from the sandstones, dark clays to alluvial soils along Tana River basin. The soils have a low water retention capacity but supports vegetation, which remains green long after the rains. Garissa and Tana River Counties are located in Kenya's ASALs, which experience annual rainfall below 300 mm and frequent droughts. These conditions have contributed to the spread of *P. juliflora*, which now dominates over 40% of rangelands in the region (7). The project areas were selected based on high infestation levels and community interest in *Prosopis* utilization projects. The project sites are Jamhuri farm, Bura East, Bura Tana, Hola, Masalani, Modogashe, Labasigale and Dadaab.

Participatory approach

The project employed a participatory approach, engaging local communities, government agencies, and other stakeholders in the design and implementation of interventions. This approach ensured that the interventions were context-specific and aligned with the needs and priorities of the local communities.

Project sites and criteria for selection of beneficiaries

The project sites selection was based on the level of infestation and community willingness (heavily infested by *P. juliflora* areas while the local communities showed willingness to participate) based on on spatial data from satellite imagery and community reports. Over 2,485 participants (youth, women, and PWD) were engaged in mechanical removal, charcoal production, and animal feed processing. The beneficiaries' identification and selection was guided by the county government officials and community representatives, with priority given to households directly affected by *P. juliflora* encroachment and community groups interested in utilizing the cleared land for agroforestry purposes.

Project stakeholder's engagements strategies

A mixed-methods approach was adopted, integrating both qualitative and quantitative tools for the engagements of the various levels of stakeholders.

- Surveys- structured questionnaires were administered to households to examine income levels, food security, and perceptions on *P. juliflora*.
- Focus group discussions (FGDs) were conducted with youth groups, women's groups, and Persons with disabilities (PWDs) to understand their experiences and challenges with the management of the invasive species.
- Key Informant Interviews was done with government officials, NGO representatives, and project implementing partners provided insights into policy gaps and opportunities for up-scaling the technologies and innovations.
- Field Observations were made at project sites to evaluate farmlands restoration, biomass processing outcomes and *Prosopis* pods for animal feeds.

The project interventions

Mechanical removal: Eight project sites were selected based on the extent of *P. juliflora* infestation and the socio-economic characteristics of the local communities. Youth from local communities were trained on mechanical removal techniques, including the use of chainsaws and manual tools. Weekly cohorts of youth were engaged in the removal of *P. juliflora*, with a focus on restoring degraded lands and preventing re-infestation.

Value-Added Product Development: Communities were provided with modern charcoal kilns and chaff cutters to process *P. juliflora* into charcoal, briquettes, and animal feed. Training sessions were conducted on the production and marketing of these value-added products, with a focus on enhancing the economic viability of *P. juliflora* utilization.

Capacity Building: Workshops and training programs were organized to build the capacity of local communities and refugees on sustainable *P. juliflora* management and utilization including sessions on ecological restoration and business development using innovative technologies.

Project Employment Intensive Investment Programme (EIIP) approaches

The use of Employment Intensive Investment Programme (EIIP) approaches played a crucial role in the project through the following aspects; Management and utilization, Job creation and skills development, Livelihood support and environmental conservation. The Economic, environmental and social indicators were used in measuring the impact of the EIIP approaches. The adoption of sustainable Practices and long-term economic benefits were monitored based on the uptake of sustainable harvesting and processing practices among community members and stability and growth of income-generating activities as the project sustainability indicators.

Results and discussion

This section presents the findings of the project interventions and impacts, focusing on the EIIP approaches, youth's employability, land restoration and socio-economic and ecological impacts of *P. juliflora* utilization in Garissa and Tana River Counties. The results are discussed in the context of relevant literature to provide a comparative understanding of the challenges and opportunities associated with *P. juliflora* management.

Decent green job creation and income generation

The project has successfully created 2,485 direct decent green jobs over a six-month implementation period (Table 1).

► **Table 1: Number of green jobs created monthly (2024/25)**

Month	Number of direct green jobs	Number of indirect green jobs	Total jobs created	Sources of the green jobs
July	160	24	184	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
August	195	52	247	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
September	593	148	741	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
October	299	120	419	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
November	243	140	383	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
December	160	80	240	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
January	206	65	271	• Mechanical removal of <i>Prosopis</i> and products value addition • Indirect employment involves transportation and selling of the various products.
Total	1856	629	2,485	

These opportunities primarily targeted youth and vulnerable groups, including women and pastoralist communities affected by land degradation and loss of livestock through drought. Youth participation in *P. juliflora* harvesting, processing, utilisation and marketing provided a stable income source, reducing rural-to-urban migration. The project engaged more than 280 youth monthly with an average monthly income of USD 200 per participant. Each of the eight project sites engaged youths organized into weekly cohorts of 11 persons and each allocated specific area. Wages were paid in accordance with local labour rates, supplemented by earnings from the commercialization of *Prosopis* products namely charcoal, construction poles and animal feed.

Total revenue from product sales amounted to an estimated KES 14 million (approximately USD 92,000), of which 70% was redistributed to workers as additional income, 30% was reinvested into land preparation for farming with high value crops. Household surveys indicated a 25% increase in average household income among participants, leading to improved access to food, education, and other services ultimately enhancing community resilience and well-being. This success highlights the Employment Intensive Investment Programme (EIIP)'s ability to transform *P. juliflora* into an economic asset, supporting job creation and livelihood goals.

The households involved in *Prosopis* value chain activities reported a 40-60% increase in income, with the highest earnings being from charcoal production. A comparative project in Ethiopia found that households engaged in *Prosopis* charcoal-making earned 38% higher incomes than those relying solely on traditional pastoral activities (19).

► **FIGURE 2(a) Assembled *Prosopis* poles**



► **FIGURE 2(b) Pole arrangement in the kiln**



► **FIGURE 2(c) Charcoal production using the modern metal kiln**



► **FIGURE 2(d) Ready *Prosopis* charcoal in the market**



Land and ecological restoration

The project cleared 576 acres of land across eight sites, averaging 72 acres per site, through the mechanical removal of mature *P. juliflora* stands (height >2 meters). Complete root extraction was carried out to prevent regrowth and ensure long-term ecosystem recovery. Following the removal of the species, 330 acres (57%) were restored with a mix of pasture for livestock feeding, high value food crops including maize, cowpeas, melon, onions and drought-tolerant fruit trees depending on site-specific conditions and community priorities. Preliminary assessments conducted three months post-planting revealed a 15% improvement in soil moisture retention due to reduced competition from *P. juliflora*, and higher yields in restored plots compared to untreated areas. These findings demonstrate the dual benefit of ecological restoration and increased agricultural productivity, paving the way for more sustainable land use.

Additionally, a decrease in native species populations due to competition for resources, presence of pathogens harboured by *P. juliflora*, leading to the loss of native species, was highlighted. Furthermore, a decrease in the growth rate of native species was observed. These findings underscore the widespread ecological challenges posed by *P. juliflora* in these regions (Table 2).

► **Table 2: Ecological impacts of *P. juliflora* invasion**

Ecological impact	County, Response (%)		Total (n=523)
	Tana River (n=237)	Garissa (n=286)	
Loss of Indigenous habitats	22.4	19.2	20.7
Hydrological impact	15.6	13.6	14.5
Biological community	15.6	15.4	15.5
Species population impacts	15.6	22.4	19.3
Harbors pathogens	9.3	14.3	12.0
Decrease in the growth rate of native species	21.5	15.0	18.0

Rangeland productivity and fodder availability

The mechanical removal of *P. juliflora* has opened up 570 acres of land (Table 3) and its replacement with high value pasture grasses resulted in a 15% increase in rangeland productivity within a year. In communities where *Prosopis* pods were processed into livestock feed, goat weight and milk is reported to have increased (KIIs) reducing the need for expensive commercial feeds. This aligns with studies in Ethiopia and Sudan, where *Prosopis* pod-based animal feed reduced livestock feeding costs by 50%, making it a viable alternative for pastoralists (20).

► **Table 3: Number of ccres uprooted on monthly basis in the project sites**

Month	Number of acres
July 2024	50
August 2024	87.2
September 2024	114
October 2024	101
November 2024	82
December 2024	97
January 2025	38.5
Total	570

However, the manual and mechanical removal efforts and the conversion of *Prosopis* biomass into value-added products have contributed to targeted ecological restoration. The project beneficiary communities removed and restored 570 acres of degraded farmlands as shown in Table 1 leading to a 15% increase in rangeland productivity and a measurable improvement in soil quality, particularly organic matter content. These results are consistent with findings from (13), who reported similar restoration outcomes in Ethiopia.

► **FIGURE 3(a) Farmland under *Prosopis* invasion before the project**



► **FIGURE 3(b) Manual removal of *Prosopis* with support from the project**



► **FIGURE 3(c) Harvested poles for charcoal production**



► **FIGURE 3(d) Cleared farm land from *Prosopis***



► **FIGURE 3(e) Grass forage planted on cleared land**



Value-added Product Development

The project met its product development objective by producing poles for construction, charcoal, and animal feed through improved processing technologies which has significantly boosted the productivity and marketability of *P. juliflora* products. Key advancements were achieved in both charcoal production and animal feed processing. The project deployed 12 modern metallic kilns, resulting in the production of 1200 bags of high-quality charcoal per month. The 25% conversion efficiency achieved marked a significant gain over the 15% efficiency typical of traditional methods. Market response was positive, with 80% of the charcoal sold locally at an average price of KES 1,000 per 50-kg bag, contributing to increased earnings for community groups while promoting sustainable harvesting and utilization practices.

To support livestock nutrition and add value to *P. juliflora* pods and leaves, the project introduced 14 multipurpose chaff cutters, each with a capacity of 300–500 kg per hour. These machines processed a total of 20 tons of raw material, which was enriched with molasses to produce a protein-rich feed containing 12% crude protein. The production was low due to uptake of the technology by the community. Livestock fed with the processed feed experienced a 10% average weight gain over a three-month period, leading to increased income of approximately KES 500 per animal sold. This innovation provided a practical solution for turning invasive biomass into a profitable and nutritious product for pastoralist communities.

The utilization of *P. juliflora* has emerged as a viable economic activity for local communities. Charcoals made from *Prosopis* generated household income increases of up to 30%, while animal feed production reduced livestock feed costs by 10-15%. Additionally, the use of modern kilns and chaff cutters as shown in Figures 3(a) and (b) below, introduced through the project, enhanced efficiency, allowing producers to meet local market demands.

► **FIGURE 4(a) Equipment for charcoal production**



► **FIGURE 4(b) Equipment for processing *Prosopis* pods**



Capacity building and community engagement

Eight *Prosopis* community groups (20–30 members each, 160–240 total, 40% refugees) were formed and trained in removal, processing, and marketing (1,200 hours estimated), meeting capacity-building objectives. An average of 280 youth engaged monthly, with 70% (196) transitioning to value chain roles. Post-training, 85% operated equipment independently, and 60% initiated small-scale sales, though no cooperatives were formed.

Training empowered sustained management, with high skill uptake reflecting efficacy. Group members engagement ensured labour continuity, despite variability, and refugee inclusion enhanced cohesion. Initial resistance to *P. juliflora* use shifted to 40–50% acceptance via sensitization, but lack of cooperatives limits collective marketing potential. Scaling requires equipment and financial support, supporting utilization objectives.

Market competitiveness of *Prosopis* products

Market analysis revealed that *Prosopis* charcoal was 30% cheaper than conventional charcoal, making it an attractive alternative for consumers. Additionally, *Prosopis* biochar was found to have higher calorific value and lower ash content compared to conventional hardwood charcoal. Similar studies in India demonstrated that *Prosopis* briquettes had 15–20% higher energy efficiency, making them a sustainable biomass energy source (21). Furthermore, the growing demand for *Prosopis* pod-based animal feed has opened new income streams for community groups. In Sudan, processed *Prosopis* feed contributed 18–25% of total household income in pastoral communities, demonstrating its commercial viability (22). However, market constraints such as inadequate processing equipment and limited awareness about *Prosopis* feed benefits were noted as barriers to scaling up these enterprises.

Cost-benefit analysis of *Prosopis* utilization

A cost-benefit analysis comparing *P. juliflora* utilization versus eradication showed that sustainable utilization was economically more viable. The estimated cost of mechanical removal per hectare was USD 300–500, while utilizing *Prosopis* for biomass energy, fodder, and wood products generated USD 800–1,200 per hectare annually. This reinforces findings from the Horn of Africa, where *Prosopis* management initiatives led to 3–5 times higher financial returns than eradication programs alone (23).

Impacts of *Prosopis juliflora* on livelihood

Prosopis juliflora has improved livelihood of the local people in the areas of project through its various products enterprise which has contributed to the increase household income through charcoal, pods, posts, poles, fitto and carvings/hand crafts (Table 4).

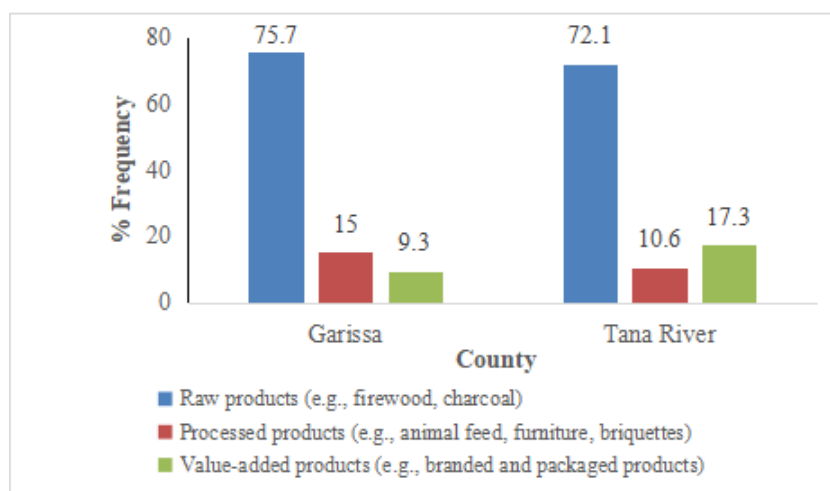
► **Table 4: Prices of *Prosopis* products**

Product	Size	Price
Charcoal	A 50 kg sack	350–400
Pods	Small	100
Posts	Pieces	150
Poles	Pieces	80
Fitto	Bunch	50

Demand for *Prosopis* products

Noted is a strong demand for *Prosopis* products ranging from raw, processed and value added products in Garissa and Tana River counties respectively (Figure 5).

► **FIGURE 5** *Prosopis* products in high demand



Transforming challenges into opportunities

The findings demonstrate the potential of transforming *P. juliflora* from an invasive species to an economic asset that contributes to environmental restoration and community development. The utilization of *Prosopis* when promoted as an enterprise will lead to its reduction and eradication in vital biodiversity and riparian sites. This aligns with the principles of sustainable development, which emphasize the integration of ecological, economic, and social objectives (16).

Role of innovation and community participation

The success of the project can be attributed to the adoption of innovative technologies, such as modern metal kilns and chaff cutters, which enhanced the efficiency and sustainability of *P. juliflora* utilization. The use of EIIP approaches and the active participation of local communities ensured that the interventions were context-specific and aligned with their needs and priorities. The support from County Governments was key to success as *Prosopis* is found on community land.

Challenges and opportunities

Key challenges included limited access to modern equipment, inadequate policy support, negative perception on utilization of *Prosopis* and low pricing for *Prosopis*-based products. For example, policy ambiguities regarding the commercialization of *Prosopis* charcoal hindered larger-scale operations. However, the project identified significant opportunities in expansion and formalization of enterprise through cooperatives to unlock large market and support policy advocacy. Other opportunities include value-chain development, including biochar production for soil amendment, poles and furniture making, as suggested by (24).

Sustainability strategies

Long term integration and support: Aligning with the National *prosopis* management strategy and action embeds the project within national priorities, ensuring ongoing support. Institutionalizing intervention through collaboration with national and county institutions, universities, charcoal producers and policy makers creates a support environment for sustain growth. Capacity building empowers local communities and refugees to manage *prosopis*, fostering long term socio-economic benefits. Private sector engagement secures market access and business opportunities reinforcing economic sustainability and job creation.

Conclusion and recommendations

Conclusion

The project has demonstrated that *P. juliflora* can be transformed from an ecological threat into a Socio-economic asset for communities in Garissa and Tana River Counties. Sustainable utilization strategies that integrate community involvement and technological innovations have the potential to create green jobs, enhance livelihoods, and restore degraded ecosystems. Capacity building and awareness of community and County government is key to success in reducing the menace caused by *P. juliflora*

Recommendations

- Develop policy frameworks that support the commercialization of *P. juliflora* products while regulating its spread.
- Formalization of the enterprises
- Restoring Lands with agroforestry and developing value chains e.g Moringa species
- Invest in capacity-building initiatives, including technical training and access to modern equipment for biomass processing.
- Promote value-chain development and marketing, particularly in emerging applications such as biochar and energy.
- Consider diversification of technologies in control and management of *P. juliflora*.
- Upscale successful technologies within the region.
- Facilitate further research on the long-term socio-economic and ecological impacts of *P. juliflora* utilization in Kenya's drylands.

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► L'approche HIMO à la rescousse de l'équilibre régional et du développement durable

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Remerciements

Les auteurs de cet article remercient le BIT, l'AVFA, la DGF, l'ANETI, le CRDA de Jendouba, le CRDA de Kasserine, l'ODESYANO, l'INRGREF, les autorités locales de Jendouba et de Kasserine pour leur précieux appui. Un hommage particulier est adressé à Madame Nozha Maalaoui et à Messieurs Mohamed Saidani et Mabrouk Grami pour leur engagement et sacrifice.

Résumé

Vu son indice de développement humain en 2021 (IDH = 0.73), la Tunisie figure parmi les pays ayant un développement humain élevé. Néanmoins, cet indicateur ne doit pas voiler le déséquilibre entre les régions. En effet, le taux de pauvreté était de 28.4% au Nord-Ouest, 30.8% au Centre-Ouest et seulement 5.3% au Grand Tunis en 2015. Ce déséquilibre ainsi que le chômage des jeunes, notamment les diplômés de l'enseignement supérieur, étaient les détonateurs de la révolution du 14 janvier 2011. L'exode rural et l'immigration clandestine sont perçus par les populations démunies comme étant la planche de salut.

En vue de soutenir le processus de décentralisation et la création d'une dynamique économique territoriale génératrice d'emplois décents qui améliorent le standing de vie des populations déshéritées au Nord-Ouest et au Centre-Ouest conformément à l'ODD1, l'Organisation Internationale du Travail, à travers le projet Initiative Pilote pour un Développement Local Intégré (IPDLI), a favorisé l'ancrage de l'approche HIMO dans le dispositif de la formation agricole. C'est ainsi que l'AVFA, à travers son Centre de Formation Professionnelle Agricole dans le Secteur Forestier de Rimel (Centre praticien de l'approche HIMO dont l'actuel directeur est membre élu du comité exécutif de l'accord général de collaboration entre les institutions HIMO en Afrique) a assuré une formation extramuros de 37 jeunes, dont deux filles, dans les zones précitées. Les apprenants ont acquis des compétences dans la reconnaissance du cortège floristique, le reboisement forestier, les techniques sylvicoles, la valorisation des produits forestiers non ligneux, la santé et la sécurité au travail, l'organisation des populations locales, la création et la gestion d'une entreprise forestière. A l'issue de la formation, des certificats ont été délivrés par l'AVFA aux apprenants. Les titulaires de ces certificats sont éligibles aux subventions de l'Etat pour la création des très petites entreprises (TPE). Par ailleurs, ces jeunes ont été encouragés à créer des Organisations Professionnelles Agricoles. Vu le succès de cette expérience pilote, plusieurs voix réclament sa duplication dans d'autres zones déshéritées pour fixer les jeunes dans leurs territoires.

Mots clés : Emploi, Inclusion sociale, Développement Durable

Introduction

La Tunisie couvre une superficie de 164 000 Km² et compte 11 887 412 habitants en 2024. Il est à noter que près du dixième de la population vit dans les forêts sur la base d'une agriculture de subsistance, l'élevage, ainsi que des activités liées à l'exploitation des ressources forestières telles que la récolte de bois, de plantes aromatiques et médicinales et les produits dérivés des forêts. Les jeunes dans ces contrées sont de plus en plus attirés par les villes ce qui pose un problème social, économique et même sécuritaire.

Depuis son indépendance en 1956, la Tunisie a misé sur la démocratisation de l'éducation, la santé et le genre. En effet, la constitution tunisienne stipule dans son article 44 que l'état garantit le droit à un enseignement public gratuit à tous les jeunes quel que soit le niveau d'études. Le même article stipule que l'enseignement est obligatoire jusqu'à l'âge de 16 ans. Par ailleurs, le Code du Statut Personnel (CSP), promulgué par la loi du 13 août 1956, a interdit dans son article 18 la polygamie. Le programme de planning familial a été déterminant dans la maîtrise de la croissance démographique. Selon l'INS (2016), le taux d'accroissement démographique était de l'ordre de 1.03% au cours de la décennie 2004-2014. Depuis 2017, ce taux a chuté en dessous de la barre de 1%. Cette politique volontariste a permis à 235 482 jeunes d'être inscrits dans 6163 établissements scolaires répartis sur tout le territoire national. Au niveau universitaire, le nombre d'étudiants était de 266 837 au cours de l'année académique 2022-2023, dont 67% des filles. Au cours de la même année, le nombre de doctorants était de 10 191 dont 62% des filles. Pour promouvoir le développement des zones intérieures et la décentralisation, le gouvernement tunisien a favorisé la création de 13 universités et 206 établissements universitaires publics répartis sur tout le territoire national. Le nombre de diplômés de l'enseignement supérieur était 51 580 en 2023, dont 70% des filles (MESRS, 2024). Il est à noter que ni le secteur public, ni le secteur privé, ni les deux à la fois sont à même d'absorber cet effectif. Pour résorber le chômage, l'Etat a mis en place un train de mesures favorisant la création de startups, des très petites entreprises (TPE) et des petites et moyennes entreprises (PME).

Par ailleurs, le contexte économique du pays était marqué par une contraction de la croissance économique durant la décade 2011-2020. En effet, la croissance économique moyenne durant cette décennie était de 0.7% contre 4.2% durant la décennie précédente. Cette contraction a contribué à la paupérisation d'un large pan de la population et à une plus grande vulnérabilité des franges sociales démunies. En effet, selon l'UNICEF (2022), le PIB per capita, exprimé en USD courant, a chuté de près de 10% entre 2010 et 2021 passant de 4345 USD à 3924 USD. La pandémie du Covid-19 a exacerbé la situation socioéconomique en enregistrant une récession historique de 8.7% en 2020. Bien que porteuse d'espoir, la reprise économique amorcée en 2021 s'est opérée avec un taux de croissance de seulement 3.1% (UNICEF, 2022).

La situation sociale des populations vulnérables a été lourdement impactée par la situation économique. C'est ainsi que le phénomène de déscolarisation a évolué crescendo depuis les années 1980 : environ 26 000 au cours de l'année 1984/1985 et 57 613 en 1994/1995 pour franchir le seuil fatidique de 100 000 après la révolution de 2011 (ITECQ, 2022). Pis encore, plus de 10% des jeunes dans la tranche d'âge 15 et 19 ans sont non scolarisés, sans formation et sans emploi, et font partie de la catégorie des NEET, soit environ 93 000 individus (ITECQ, 2022). Les disparités régionales en termes de genre sont manifestes chez les NEET. En effet, le taux de NEET est de 33.4% pour les hommes et 50.4% pour les femmes en milieu rural contre 20.3% pour les hommes et 32.4% pour les femmes en milieu urbain (Banque Mondiale, 2014). Le problème se pose avec plus d'acuité dans les zones intérieures et au sud qui ont été le berceau de la révolution du 14 janvier 2011. En effet, selon la Banque Mondiale (2014), le taux de NEET affecte plus d'un quart des jeunes des régions côtières (23.6% en milieu urbain, 37.3% en milieu rural), plus d'un tiers dans la région du sud (35.9% en milieu urbain, 47.9% en milieu rural), et près d'un tiers des jeunes dans les zones intérieures du pays (31.4% en milieu urbain, 42.4% milieu rural).

Les disparités susmentionnées ont favorisé l'exode rural, la migration clandestine et le travail informel. Ce dernier est très répandu en milieu rural (71.9%) sous forme d'emploi occasionnel agricole. En milieu urbain, près de 55.4% des jeunes travaillent de manière informelle. Par ailleurs, l'ETF (2023) rapporte que les taux de migration ont augmenté durant les 20 dernières années, passant de 5% en 2000 à 7.6 % en 2022.

Le nombre d'entreprises privées est de 782115 réparties comme suit : agriculture, sylviculture et pêche (5310), industrie (89190), bâtiments (43077), Commerce, réparation automobile et d'articles domestiques (364727), transport et entreposage (107360), hébergement et restauration (43832), information et communications (15684), activités immobilières (5332), activités de services administratifs et de soutien (21861), etc. (*RNE*, 2020). Selon *I'INS* (2024), les secteurs économiques assurent 3471700 emplois formels répartis comme suit : agriculture et pêche 533000 (15%), industries manufacturières 6560000 (19%), industries non manufacturières 454300 (13%) et les services 1824400 (53%). La contribution des différents secteurs au PIB illustre l'importance du secteur des services depuis 2010 (55.9%). Le secteur agricole a vu sa contribution au PIB passer de 6.8% en 2010 à 10.1% en 2022 (*ETF*, 2023). A contrario, la part du secteur industriel dans le PIB a fortement baissé de 29.5% en 2010 à 21.5% en 2020 pour reprendre légèrement en 2022 à 23%. Le taux de chômage des diplômés de l'enseignement supérieur était de 23.7 % au deuxième trimestre de l'année 2023. Ce taux est de 14.9% chez les hommes et de 31% chez les femmes.

Choix des zones d'intervention

Le territoire tunisien est découpé en 24 gouvernorats. La figure 1 illustre la localisation des sites d'intervention.

► **FIGURE 1 : Carte de la Tunisie et localisation des zones d'intervention.**



Pour améliorer les conditions de vie des populations locales dans les zones déshéritées en vue de les fixer dans leurs territoires, le Bureau International de Travail (BIT) et l'Agence de la Vulgarisation et de la Formation Agricoles (AVFA) ont conjugué leurs efforts pour conduire deux actions pilotes dans les gouvernorats de Jendouba et une action dans le gouvernorat de Kasserine. Ces deux gouvernorats se distinguent par des indicateurs socio-économiques défavorables comme indiqué au tableau suivant :

► **Tableau 1 : Indicateurs socioéconomiques des gouvernorats de Jendouba et Kasserine.**

Indicateur	Jendouba	Kasserine	Source
Taux de pauvreté	22.4 (7 ^{ème} /24)	32.8 (3 ^{ème} /24)	Banque Mondiale (2020)
Taux de migration	-12722 (3 ^{ème} /24)	-12827 (2 ^{ème} /24)	INS (2017a)
Taux d'analphabétisme	33% (2 ^{ème} /24)	32.7% (3 ^{ème} /24)	INS (2017b)
Réussite au baccalauréat	22 ^{ème} /24	24 ^{ème} /24	Ministère de l'Education (2021)
Investissement/individu*	980 DT (20 ^{ème} /24)	1356 DT (11 ^{ème} /24)	LOB n°15 du 13/02/2019
IDR**	0.31 (21 ^{ème} /24)	0.16 (24 ^{ème} /24)	ITCEQ (2012)

*Investissement moyen par individu en Dinars Tunisiens (DT) durant la période 2016-2020.

**IDR = Indice de Développement Régional

L'IDR est défini par l'ITECQ comme étant la moyenne de 17 variables se référant à 4 domaines : richesse et emploi, savoir, santé et population, justice et équité.

Potentialités des zones d'intervention

Le gouvernorat de Jendouba, situé au Nord-Ouest, dispose d'une superficie agricole utile de 300700 ha. Il a une vocation agricole par excellence. Les plus belles forêts denses du pays se trouvent dans cette région et s'étendent sur 118470 ha. Ces forêts sont le siège d'une biodiversité faunistique et floristique variées. Elles produisent du bois, du liège et des huiles essentielles. Considéré comme le château d'eau de la Tunisie, le gouvernorat de Jendouba compte 4 grands barrages, 17 barrages collinaires et 39 lacs collinaires. Les périmètres irrigués s'étendent sur plus de 39035 ha. La région contribue à la production agricole nationale à hauteur de 10% des céréales, 12% du lait et 15.2% des viandes rouges. Quant au potentiel halieutique, il est estimé à 20000 tonnes/an. Le gouvernorat dispose également de réserves en substances minérales utiles (argile, roches marbrières, etc.), de sites archéologiques (Bella Regia et Chemtou) et d'un complexe sportif de haut niveau. Ces filons sont prometteurs pour le développement d'un tourisme écologique, de chasse, de sport et culturel (ODNO, 2020).

Le gouvernorat de Kasserine, situé au Centre-Ouest, a une vocation agricole. En effet, près du tiers de sa population active vit de l'agriculture. Etant donné qu'environ 56.4% de la population vit hors des périmètres communaux, le gouvernorat a un caractère rural. Avec un indicateur de développement régional de 0.359, le gouvernorat de Kasserine est classé dernier à l'échelle nationale. La surface agricole utile dans la région est de 744046 ha dont 44108 ha de périmètres irrigués. La région compte 3 barrages, 19 barrages collinaires et 90 lacs collinaires. Elle dispose de 226046 ha de nappes alfatières et 158000 ha de forêts. Le point culminant de la Tunisie est situé dans la région, plus particulièrement à Djebel Chaambi qui fait partie de la dorsale tunisienne (1544 m). La région dispose de sites archéologiques (Sbeitla et Thelepte) et de parcs naturels (Chaambi et Djebel Mghilla). Le nombre d'entreprises industrielles employant 10 personnes et plus n'excède pas 65. Il y'a un mésappariement flagrant entre les offres d'emplois (340 dont 52 pour les diplômés de l'enseignement supérieur) et les demandes d'emplois (4349 dont 2524 pour des diplômés de l'enseignement supérieur) en 2021. Quatre projets seulement ont été financés en 2021 par la Banque de Financement des Petites et Moyennes Entreprises (BFPME) à hauteur de 7390 Milles DT ce qui a permis la création de 183 postes de travail. Par contre, le nombre de projets financés par la Banque Tunisienne de Solidarité (BTS) était de 688, mobilisant un investissement de 8662 Milles DT contribuant à la création de 1401 postes d'emplois (ODCO, 2021).

Mise en œuvre de l'approche HIMO

L'approche HIMO a été implémentée pour la première fois en Tunisie par le Bureau International du Travail (BIT), l'Agence de la Vulgarisation et de la Formation Agricoles (AVFA) à travers son Centre de Formation Professionnelle Agricole dans le Secteur Forestier de Rimel à Bizerte, le Commissariat Régional au Développement Agricole (CRDA) de Jendouba, le Commissariat Régional au Développement Agricole de Kasserine, la Direction Générale des Forêts (DGF), l'Agence Nationale de l'Emploi et du Travail Indépendant (ANETI), l'Office de Développement Sylvopastoral du Nord-Ouest (ODESYANO) et les autorités régionales des gouvernorats de Jendouba et de Kasserine et ce dans le cadre du projet IPDLI. Ce projet, financé par l'Union Européenne, est mis en œuvre par le BIT pour le compte du Ministère des Affaires Locales et de l'Environnement. Les partenaires sociaux (Union Générale des Travailleurs Tunisiens UGTT et l'Union Tunisienne de l'Industrie, du Commerce et de l'Artisanat UTICA) ont été associés au projet en vue de soutenir le processus de décentralisation et d'insuffler une dynamique économique locale génératrice d'emplois décents dans six gouvernorats : Jendouba, Nabeul, Gafsa, Kasserine, Tataouine et Kébili.

Une première visite de reconnaissance a été effectuée à deux communes forestières situées dans la zone d'intervention du projet dans le gouvernorat de Jendouba : Tebaynia et Galaa-Maaden-Forssane. La quintessence des recommandations issues de cette visite et du dialogue avec les partenaires se résume dans ce qui suit :

- la promotion du rôle du secteur privé dans l'instauration d'un modèle économique créateur de richesse et générateur d'emplois décents à même de fixer les populations dans leurs territoires. A cette fin, la recherche scientifique a été associée pour produire des solutions innovantes et durables. Tout en favorisant le partenariat entre les acteurs, le projet a veillé au transfert des technologies et des acquis de la recherche vers les bénéficiaires.
- le renforcement de la gouvernance des territoires communaux afin de préserver les écosystèmes fragiles (aménagement des espaces forestiers, valorisation des produits forestiers non ligneux PFNL et des sous-produits de la forêt, mobilisation des eaux, etc.).
- le renforcement du dispositif de la formation professionnelle agricole pour accompagner la mise en œuvre de l'approche HIMO et se l'approprier en vue de l'autonomisation du public cible (formation des jeunes, développement de l'esprit entrepreneurial et communautaire à travers la création des petites entreprises et de Groupements de Développement Agricole GDA).

Matériel et méthodes

Le premier chantier école a été organisé au profit de 11 jeunes de sexe masculin de 22 à 32 ans. Ils sont tous originaires de la zone de Galaa-Maaden-Forssan sise dans la délégation de Ghar Dimaou. Quatre stagiaires parmi les bénéficiaires de la formation sont titulaires d'un diplôme universitaire. Le deuxième chantier a été organisé au profit d'une cohorte de 11 jeunes âgés de 22 à 32 ans dont deux filles. Tous les stagiaires du deuxième groupe sont originaires de la zone de Tebaynia, sise dans la délégation de Ain Draham. Cinq stagiaires de ce deuxième groupe sont diplômés de l'enseignement supérieur. Pour les deux cohortes, les autres apprenants sont des jeunes travailleurs occasionnels dans les chantiers forestiers.

Afin d'atteindre ses objectifs, le projet IPDLI s'est doté d'un modèle de gouvernance locale au niveau de chaque site d'intervention à travers un dispositif d'accompagnement et de mise en place du chantier école forestier composé :

- des autorités locales représentées par le délégué régional et le président de la commune,
- des arrondissements de forêts de Jendouba et de Ain Draham relevant du Commissariat Régional au Développement Agricole de Jendouba,
- de l'Agence de la Vulgarisation et la Formation Agricoles en tant que dispositif national chargé de la formation agricole et de la validation de l'apprentissage par le truchement des certificats qu'il délivre. Les titulaires de ces certificats sont éligibles aux subventions et encouragements de l'Etat pour la création d'entreprises dans le secteur agricole. L'AVFA exerce la tutelle administrative, financière et pédagogique sur 31 centres de formation professionnelle agricole, 8 centres de formation dans le domaine de la pêche et l'aquaculture et sur l'Institut National Pédagogique et de Formation Continue Agricole (INPFCA) de Sidi Thabet. Ce dernier est chargé de l'ingénierie de la formation et de la formation des formateurs et des vulgarisateurs. Les établissements de formation sous tutelle de l'AVFA assurent une formation initiale aux jeunes en décrochage scolaire et aux titulaires du baccalauréat. Selon le niveau, la formation initiale est sanctionnée par un Certificat de Compétence (CC), un Certificat d'Aptitude Professionnelle (CAP), un Brevet de Technicien Professionnel (BTP) ou un Brevet de Technicien Supérieur (BTS). La formation continue est de courte durée (environ trois mois) et est destinée aux personnes âgées de plus de 22 ans. Des certificats sont délivrés aux apprenants qui valident les modules de formation. Les titulaires de ces certificats sont éligibles aux encouragements et subventions de l'Etat pour créer des très petites entreprises (TPE) et/ou des petites et moyennes entreprises (PME).
- de l'Agence Nationale pour l'Emploi et le Travail Indépendant en tant que structure d'appui et d'accompagnement des promoteurs pour la mise en place de leurs entreprises. L'espace entrepreneurial de Jendouba et celui de Tabarka, tous deux sous tutelle de l'ANETI, ont octroyé une bourse d'études aux apprenants des deux cohortes.
- des partenaires socio-économiques représentés par le syndicat et le patronat (UGTT et UTICA).
- de l'Office de Développement Sylvopastoral du Nord-Ouest (ODESYANO) en tant que partenaire technique.
- de la Direction Générale des Forêts (DGF) qui veille à la protection durable des forêts et leur exploitation rationnelle. La DGF a mis à la disposition du projet IPDLI un poste forestier pour la formation pratique sur site et les ressources forestières (bois, chêne liège, etc.). Outre ses missions énoncées ci-dessus, la DGF a à charge la gouvernance du secteur. Plusieurs lobbyistes ont milité pour l'amendement de l'article 18 du code forestier pour permettre aux habitants des forêts de jouir des ressources forestières sans nuire à l'écosystème. En effet, l'article 18 de la loi n°2005-13 du 26 janvier 2005 stipule que les forêts domaniales peuvent être classées en réserves naturelles, en parcs nationaux ou en réserves de chasse selon des modalités fixées par décret. Ainsi, l'essence même de cet article est la protection et la gestion durables des ressources forestières. Malheureusement, cet objectif si noble fait fi des conditions de vie des populations qui vivent dans les forêts. La DGF est l'organisme idoine pour favoriser l'ancrage institutionnel de l'approche HIMO en partenariat avec l'AVFA et le développement d'un partenariat public-privé dans le domaine forestier.

Aux fins de la formation extramuros, deux formateurs du Centre de Formation Professionnelle Agricole dans le Secteur Forestier de Rimel ont été mobilisés. Le processus de sélection des jeunes stagiaires a été participatif incluant les populations locales, les autorités régionales et les partenaires institutionnels. La distance entre le centre de formation de Rimel et les deux sites susmentionnés est d'environ 200 Km. Durant la période de formation, les deux formateurs ont été logés au Centre de Formation Professionnelle Agricole de Hakim Sud à Oued-Mliz, Jendouba. Chaque jour, les deux formateurs parcouraient environ 100 Km entre aller et retour pour dispenser la formation pratique aux jeunes. Le projet IPDLI a mis à la disposition des apprenants les équipements nécessaires pour la formation pratique. Celle-ci, de forme modulaire, a duré 400 heures réparties comme suit :

► **Tableau 2 : Modules de formation et durée**

Module	Durée
Technique de bucheronnage, utilisation et maintenance de la tronçonneuse	60 h
Reboisement et lutte contre l'ensablement littoral et continental	90 h
Exploitation des arbres forestiers	160 h
Protection des forêts contre les incendies	30 h
Techniques de récolte de liège	60 h

La formation au profit des jeunes du gouvernorat de Kasserine, plus précisément de la région de Semmama de la délégation de Sbeïtla, a été organisée à la demande des autorités régionales. Des réunions de coordination ont été organisées avec tous les acteurs et partenaires susmentionnés. Le processus de sélection des jeunes a obéi à la même démarche et a abouti à l'identification de 15 stagiaires âgés de 25 à 35 ans dont cinq sont des diplômés de l'enseignement supérieur au chômage. Avant le démarrage de la formation, une visite a été organisée au Nord-Ouest pour permettre aux 15 stagiaires sélectionnés de discuter avec leurs pairs de la région de Tebynia-Ain Draham. Cet échange était une occasion inouïe pour que les anciens stagiaires expliquent aux nouveaux l'intérêt de la formation pratique et ravivent chez eux l'envie de travailler dans le secteur forestier. Pour des raisons sécuritaires liées au contexte local de Djebel Semmama, la formation pratique a été dispensée au Centre de Formation Professionnelle Agricole dans le Secteur des Forêts de Rimel à Bizerte durant la période allant de 06 Mai au 14 Octobre 2024. Un troisième formateur, en l'occurrence une formatrice, a été associé à la formation. Celle-ci s'est déroulée en mode présentiel sur 60 jours, soit 373 heures au total à raison de 6 à 7 heures par jour. La formation a fait appel à des techniques andragogiques innovantes telles que :

- la pédagogie active fondée sur les quatre principes suivants : (1) l'apprentissage par l'action, (2) l'interaction et la collaboration qui favorisent l'échange d'idées et le travail de groupes, (3) l'autonomie et l'engagement qui encouragent les apprenants à explorer le problème par eux-mêmes et à construire leurs connaissances et (4) la réflexion et la métacognition qui stimulent l'apprenant à réfléchir sur son propre apprentissage, à analyser ses erreurs et améliorer ses stratégies.
- la carte mentale (mind mapping) qui consiste à recourir à une représentation visuelle des idées sous forme de diagramme. Elle permet d'organiser les informations et les idées de manière intuitive en les structurant, en stimulant la créativité et la mémoire et en facilitant la résolution des problèmes. Cette approche est utilisée dans les sciences de l'éducation, la gestion des projets, le brainstorming, la prise de décision, la prise des notes, les résumés des cours, etc.

La formation modulaire a été organisée comme suit :

► **Tableau 3 : Modules de formation et durées pour la troisième cohorte**

Module	Durée
Importance et exploitation rationnelle des ressources forestières	10 h
Santé et sécurité au travail et protection de l'environnement	08 h
Exploitation des arbres forestiers	295 h
Création et développement d'une entreprise forestière	30 h
Gestion d'une entreprise forestière	30 h

Résultats et discussion

Le bilan de la formation des deux premières cohortes du gouvernorat de Jendouba est le suivant :

- Les 11 jeunes de la première cohorte ont exercé en tant que prestataires de services forestiers lors de la phase de démarrage. A cette fin, ils ont utilisé les équipements pédagogiques cédés par le projet IPDLI en guise d'encouragement. Il est à noter que cinq jeunes parmi ces onze avaient quitté leurs territoires avant le projet IPDLI à la recherche d'un emploi dans les grandes agglomérations. Un autre jeune était sur le point de quitter le pays clandestinement vers l'Europe. Le projet IPDLI a le mérite d'avoir ravivé l'espoir chez ces jeunes pour s'installer définitivement dans leurs territoires et y vivre dignement de la sueur de leurs fronts.
- Parmi les 11 jeunes de la deuxième cohorte, deux hommes et une femme ont d'ores et déjà créé leurs propres entreprises de travaux forestiers. Les autres jeunes ont exercé en tant que prestataires de services forestiers en utilisant les équipements cédés par le projet IPDLI. Quatre garçons parmi ces jeunes avaient quitté leurs territoires avant ledit projet à la recherche d'un emploi dans les grandes villes. Le projet IPDLI a réussi à les convaincre à revenir chez eux pour être formés et y vivre durablement et dignement.
- Les zones forestières qui ont abrité les formations extramuros ont été désenclavées. En effet, le BIT a veillé à aménager de pistes rurales dans ces zones pour faciliter la mobilité des populations forestières concernées.
- Bien qu'originaires d'un milieu forestier, la formation a élargi le spectre des connaissances des jeunes apprenants qui affichent fièrement leur enthousiasme à protéger la forêt contre tout type de déprédation ou menaces.
- La forêt de pin d'Alep de Djebel Semmama est infestée par le scolyte (ravageur xylophage). Les 15 jeunes originaires de Djebel Semmama-Sbeitla devraient créer des TPE ou PME spécialisées dans l'exploitation forestière. Des grands chantiers sont attendus incessamment pour l'abattage des arbres infestés et le reboisement subséquent. Il importe de noter que la législation tunisienne autorise l'Etat à accorder aux TPE et aux PME des marchés gré à gré à concurrence de 20% du budget du marché global à titre d'encouragement. Les autres jeunes seront avantagés pour travailler comme salariés dans les chantiers prévus et dans les régions avoisinantes.
- Les populations locales ont été sensibilisées et incitées à créer des organisations professionnelles agricoles (Groupement de Développement Agricole GDA, Alliances Productives, Sociétés Communautaires, Sociétés Mutuelles de Services Agricoles SMSA, Groupement d'Intérêt Economique GIE ou autre) pour mutualiser les moyens et peser plus fort dans les négociations (achat des intrants, ventes des produits, etc.),
- La Direction Générale des Forêts s'oriente vers l'externalisation de la cueillette du liège en favorisant les jeunes qui ont suivi une formation HIMO,
- La Direction Générale des Forêts s'oriente à faire appel à des TPE et des PME dans le secteur forestier au lieu de compter sur une armada d'ouvriers de chantiers à faible rentabilité économique.
- La Direction Générale des Forêts, la société civile et les acteurs institutionnels exercent un lobbying en faveur de la promulgation du nouveau code forestier par une loi votée par le parlement. Ce nouveau code devrait amender, entre autres, l'article 18 qui a protégé les forêts au détriment de l'intérêt des populations locales. Il devrait continuer à assurer la protection durable des forêts tout en développant l'entrepreneuriat vert et la création des emplois décents au profit des populations forestières pour les fixer dans leurs territoires.
- Le Centre de Formation Professionnelle Agricole dans le Secteur Forestier de Rimel à Bizerte est qualifié Centre HIMO, chargé de la diffusion et de l'appropriation de cette approche en Tunisie et en Afrique.

Conclusion

L'approche HIMO a été implémentée en Tunisie pour la première fois dans le cadre du projet IPDLI, piloté par le BIT, au niveau de deux zones du gouvernorat de Jendouba. Vingt-deux jeunes ont profité de la formation extramuros dans le domaine de l'exploitation forestière. Les résultats probants ont incité les responsables régionaux du gouvernorat de Kasserine à réclamer une formation similaire au profit de quinze jeunes originaires de Djebel Semmama. Face aux faibles offres d'emplois dans ces régions déshéritées, les jeunes sont contraints à l'exode, à la migration clandestine, au chômage, au travail informel et précaire. Les actions engagées dans le cadre du projet IPDLI ont permis d'inverser le flux migratoire et promouvoir l'emploi vert et durable dans ces régions. Certains jeunes ont réussi à créer, pour la première fois, des TPE et des PME dans le domaine forestier. Une dynamique partenariale a été initiée pour la promotion de la cogestion des forêts en impliquant les populations locales. Au niveau de la gouvernance des ressources forestières, des actions de lobbying ont été menées par la société civile, les acteurs institutionnels et l'administration pour amender le code forestier en vue d'assurer l'adéquation entre l'équilibre des écosystèmes forestiers d'une part et les impératifs socioéconomiques d'autre part. Bien que les effectifs des personnes formées soient modestes, l'approche HIMO a néanmoins fait preuve d'efficacité au niveau des zones pilotes choisies. Son ancrage institutionnel dans le dispositif de la formation et sa duplication à grande échelle requiert la mobilisation des fonds nécessaires. Pour atteindre cet objectif, il est crucial d'asseoir :

- une approche participative contractuelle impliquant les communautés locales au lieu de l'approche participative passive fondée sur les doléances des populations forestières,
- la révision de l'approche de cogestion en favorisant le recours aux emplois qualifiés, la concurrence, l'entrepreneuriat vert et la création des organisations professionnelles efficaces dans le secteur forestier,
- un nouveau paradigme pour la gestion des projets de développement intégré qui promeut l'intersectorialité, la territorialité et la valorisation des acquis des projets antérieurs et de la recherche en vue d'améliorer le standing de vie des populations locales et des acteurs.
- le développement des compétences des acteurs.
- un modèle de gestion des forêts qui vise la résilience aux changements climatiques, l'agroécologie, l'agroforesterie et l'économie circulaire. La transformation du Centre de Formation Agricole dans le Secteur Forestier de Rimel en un centre d'excellence dédié à ces thématiques est de nature à servir le développement durable dans ses dimensions économiques, sociales et environnementales.

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► Interdisciplinary research project towards community resilience enhancement by reducing road disasters caused by expansive soil in Ethiopia

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Acknowledgement

This research was conducted as part of the SATREPS project titled “Development and Operation Model of Plant-derived Soil Additives for Road Disaster Reduction on Problematic Soil,” funded by JST and JICA. We would like to express our gratitude to the faculty and students of Addis Ababa Science and Technology University and Jinka University for their collaboration in the field implementation and technical support. Special thanks to Ethiopian Roads Administration, Road Research Center and the local communities in southern Ethiopia for their invaluable participation and cooperation throughout the field trials.

Abstract

It has been considered as one of the sustainable approaches towards community road improvement to empower the community to participate in road repair works through the technical transfer of local resources and labour-based effective methods. This approach has enabled the trainees to develop their own road construction company, leading to employment promotion. However, road disasters caused by expansive soil characteristics have been beyond the scope of the community participatory road repair works. Conventional countermeasures, such as replacing one meter depth of soil with non-expansive soil or improving it with cement or lime mixtures, require equipment and are too costly for community roads. This paper presents an interdisciplinary research project towards community resilience enhancement by reducing road disasters caused by expansive soil in Ethiopia, where expansive soil prevails in more than 10% of the country's area. The project was a joint research project between Japanese and Ethiopian universities, and Ethiopian roads authorities, financed by Japan International Cooperation Agency (JICA) and Japan Science and Technology Agency (JST) and sought a solution to improve rural road accessibility at the area with expansive soil by using local plants and engaging local villagers. The project focused on identifying plant materials for soil stabilisation (e.g., indigenous plant materials such as coffee parchment, ensete leaves, or sugarcane bagasse), developing methods of processing and mixing, verifying improvement effects, and promoting practical implementation through community-based measures to tackle expansive soil issues.

Introduction

In Sub-Saharan Africa, the inaccessibility of rural roads during the rainy season is one of the major contributors to the persistence of poverty in rural regions (1). This is primarily due to the vulnerability of roads built on expansive soils, which swell during the rainy season and shrink during dry season, causing road cracking, heaving, and eventual impassability (2, 3). The limited accessibility leads to a cascade of problems, including disrupted transportation of agricultural produce, restricted access to education and healthcare, and limited mobility for economic activities.

While substantial investments have been made in the development of trunk road networks across the region, there remains a significant work in the rural and community road development. Financial constraints, technical complexity, and an over-reliance on equipment-based construction methods have restricted the reach and sustainability of rural infrastructure. Compounding this issue is the absence of effective, low-cost, and scalable technical solutions for constructing durable roads on expansive soils.

To address the challenges of developing road infrastructure on expansive soils, an internationally collaborative research project, under the agreement between the Government of Ethiopia and Japan, has been conducted from 2019 to 2025. This paper presents this interdisciplinary research project towards community resilience enhancement by reducing road disasters caused by expansive soil in Ethiopia, where expansive soil prevails in more than 10% of the country's area.

Overview of interdisciplinary research project

Project objectives and design

The interdisciplinary project was developed under the Japanese government program, which promotes international joint research aimed at solving global issues, whose name was SATREPS (Science and Technology Research Partnership for Sustainable Development) (4). The project, titled “Development and Operation Model of Plant-derived Soil Additives for Road Disaster Reduction on Problematic Soil” (5) was conceived as a scientific and technical intervention to address road disasters caused the characteristics of expansive soil. Running from April 2019 to March 2025, this initiative was a collaborative effort between Japanese and Ethiopian research institutions, with support from the Japan International Cooperation Agency (JICA) and the Japan Science and Technology Agency (JST).

The core objective of the project was to improve the durability and maintainability of rural roads in Ethiopia through the development of plant-based soil stabilizers. These additives, derived from locally available agricultural residues, would be mixed into expansive clay soils to enhance their strength, reduce swelling and shrinkage, and ultimately prevent road disasters and failures. Beyond technical outcomes, the project sought to empower local communities through training and technology transfer, thus promoting sustainable road management practices.

Interdisciplinary approach

The SATREPS project brought together an interdisciplinary team of civil engineers, geotechnical experts, agronomists, environmental scientists, and social anthropologists. Japanese institutions included Kyoto University, Ehime University, and the University of Miyazaki. Ethiopian partners included Addis Ababa Science and Technology University (AASTU), Jinka University and Ethiopian Road Administration (ERA). The collaborative nature of the research ensured a holistic approach, integrating technical innovation with local knowledge and community engagement.

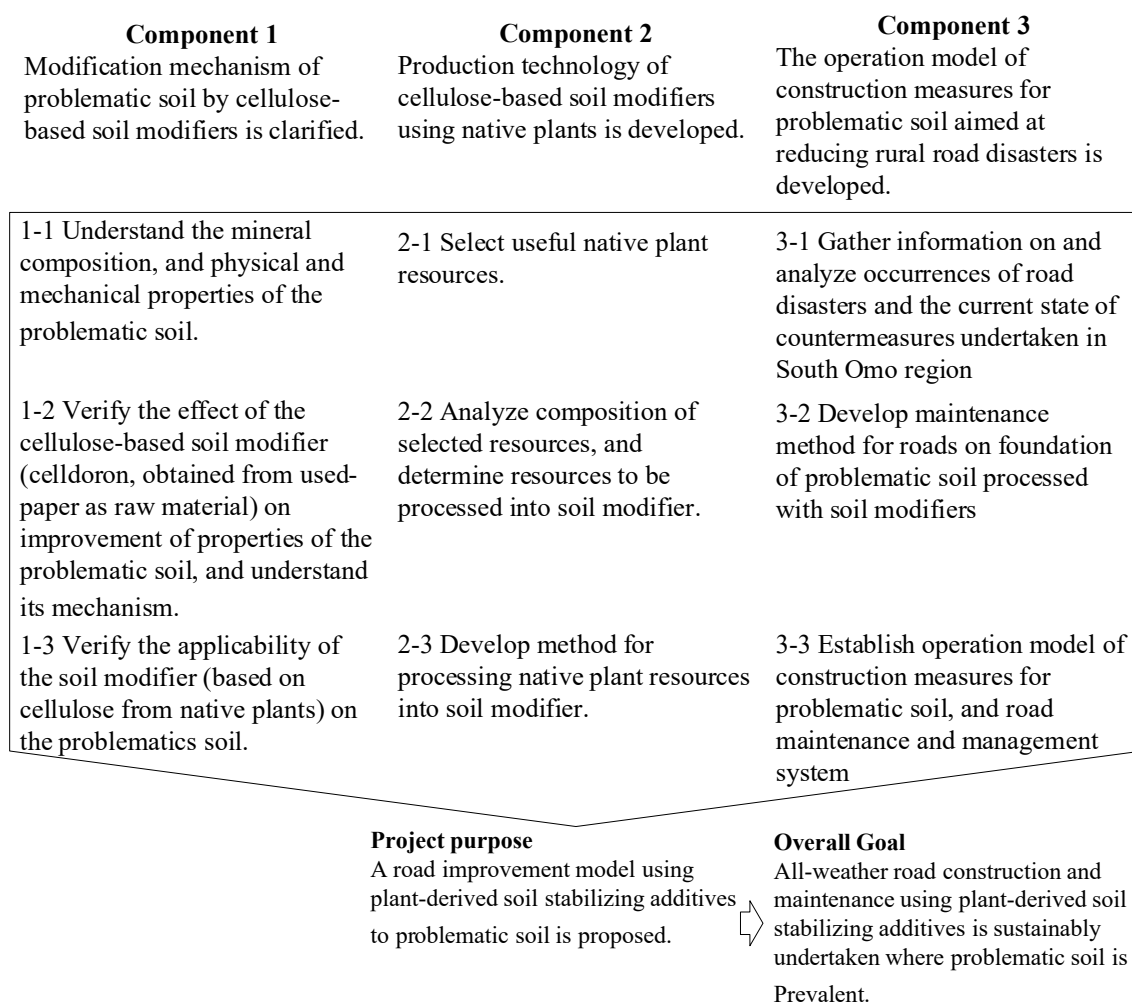
Figure 1 shows the components with the specific activities leading to the project purpose and overall goal achievement. Not only developing soil additives, but also the social and environmental impact generated through using the additives made from plants are considered. The operation model of road construction is one of the key components and activities of the project. Figure 2 shows the interdisciplinary project implementation structure. The practitioners in road engineering as well as local government officials worked together with the university researchers.

Capacity building

Capacity building and international cooperation formed one of the central pillars of the SATREPS project. The initiative placed significant emphasis on not only technical research and development but also on human resource development, institutional strengthening, and transnational academic collaboration. The overarching goal was to ensure that the innovations developed through the project would be sustained and further advanced by a network of capable professionals and organizations in both Ethiopia and Japan.

At the end of the project, about five staff members of the universities in Ethiopia have obtained doctoral degrees through long-term training engaged in rigorous coursework in geotechnical engineering, environmental science, and African area studies. These long-term fellowships did more than enhance technical expertise; they fostered a sense of international academic citizenship. Ethiopian scholars were exposed to interdisciplinary research cultures, built personal and professional networks, and were encouraged to critically apply new knowledge to local development contexts. Upon returning to Ethiopia, these graduates assumed leadership roles in university laboratories and regional development programs, thereby creating a multiplier effect of capacity enhancement.

► **Figure 1. Project overall goal, project purpose, components and activities.**



► **Figure 2. Project implementation structure.**

Components	Institutes in charge at Ethiopian side	Institutes in charge at Japanese side	Expetise
Component 1	AASTU ERA	Kyoto University Nagoya Institute of Technology University of Miyazaki	Civil/ Geotechnical engineers
Component 2	AASTU Jinka U ERA	Kyoto University Ehime University University of Miyazaki	Agronomists, Environmental scientists, Social anthropologists.
Component 3	AASTU Jinka U ERA SNNPR South Omo Zone	Kyoto University University of Miyazaki	Civil/ Geotechnical engineers Agronomists Environmental scientists Social anthropologists.

AASTU: Addis Ababa Science and Technology University

Jinka U: Jinka University

ERA: Ethiopian Roads Administration

SNNPR: Southern Nations, Nationalities, and People's Region

The SATREPS project also prioritized institutional capacity building. Laboratory facilities at AASTU and Jinka University were upgraded with equipment for soil testing, sample preparation, and microscopy. Importantly, the project facilitated the establishment of inter-university networks in Ethiopia. Regular coordination meetings, research exchange visits, and joint workshops helped build trust and technical collaboration between institutions that had previously operated independently with limited interaction. These networks laid the groundwork for future joint research proposals, publications, and staff exchange programs, enhancing the national research ecosystem in civil and environmental engineering.

In conclusion, the SATREPS project's approach to capacity building was both multidimensional and deeply embedded in the project's philosophy of sustainability and local ownership. By investing in people, institutions, and relationships, the project created a resilient foundation for the continued advancement of soil stabilization techniques in Ethiopia. These efforts represent a legacy of the Japan-Ethiopia partnership under the SATREPS framework and offer a model for integrated capacity building in science-driven development cooperation.

Summary of outcomes

Identification and Selection of local plant materials

A major component of the project was identifying local plant-based materials rich in cellulose that could function as effective soil stabilizers. Sometime, plant-based materials would be called cellulose-based material, as well. After extensive screening, over 20 native plant species were shortlisted. Detailed analysis focused on three materials, Ensete (*Ensete ventricosum*), an Ethiopian indigenous crop with fibrous leaves, Sugarcane bagasse, the fibrous by-product of sugar extraction, widely available, and coffee parchment, an agricultural residue from Ethiopia's coffee industry. The selection criteria included high cellulose content (30–50%), water absorption capacity, particle structure, ease of local processing, and availability. As control, the fine shredded paper, FSP, which product name is Celldron, was also utilized for investigating the modification effect of expansive soil. These material are shown in Figure 3.

► Figure 3. Candidate of cellulosic soil additives



Modification effect

To investigate the modification effect by mixing with additives from the local plant, the experiment design was established as shown in Table 1. It was important to understand the target class of road where the additives are applied, namely, traffic load, frequency and design period. The project targeted the community road, which is often categorised as an unclassified road and a low-volume road, where the volume of traffic is less than 300 vehicles per day. On the other hand, it is considered that it would be necessary to propose the wide application of plant-based additives, in combination with hydrated lime for enhancing sufficient bearing capacity for heavier traffic load. Mixing ratio was defined as the ratio of the dry mass of additives to the dry mass of the solid of the expansive soil. Considering the high water absorption capacity of cellulose-based additives, the original moisture contents of the expansive soil before mixing with additives were set relatively high, 60%. The optimum moisture content of the expansive soil was 39%.

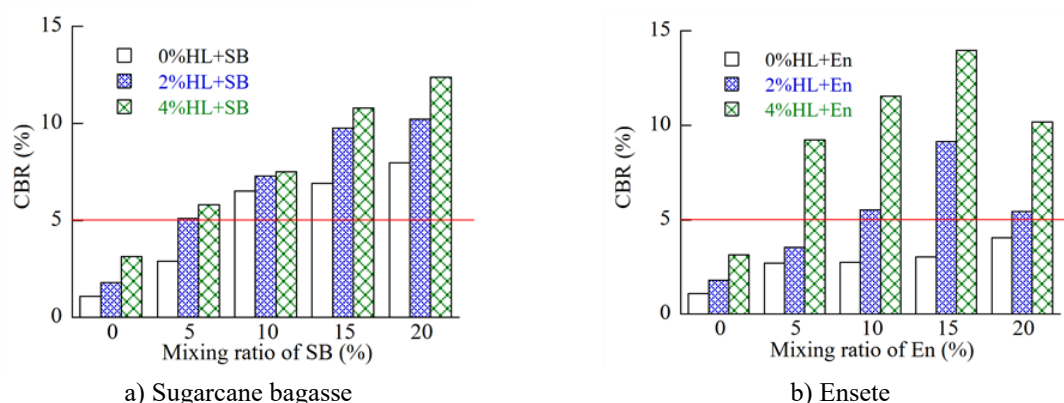
► TABLE 1. Experimental design.

Factors	Valuables					Target value
Cellulose-based additives dosage (%)	0	5	10	15	20	Plastic Index < 30 Free swell index < 20% CBR > 3, or 5
Particle size of additives (µm)	<300			300≤		
Lime dosage (%)	0		2	4		

According to the experimental design shown in Table 1, the Atterberg limit test, Free swell index test, Unconfined compression test, CBR (California Bearing Ratio) test, Permeability test, and Direct shear strength test have been conducted. In the case of the experiments on the specimen mixed with hydrated lime, the mixed sample was cured for seven days before they were subjected to the tests.

In this paper, the results of CBR tests are presented as shown in Figure 4, which determined that 10% ensete or 5% bagasse, combined with 2% hydrated lime, achieved the target $CBR \geq 5$. When mixed with 4% of hydrated lime, the CBR was less than 5. While reducing the mixing ratio of hydrated lime from 4% to 2% by replacing with 5% of sugarcane bagasse, the CBR exceeded 5, which showed the economical and environmental benefits.

► **Figure 4. CBR test results (En: Ensete, SB: sugarcane bagasse, HL: Hydrated lime).**



Field applicability assessment

Another key pillar of the SATREPS project was the development of locally sustainable methods for producing cellulose-based soil additives. Rather than relying on imported materials or equipment, the project sought to leverage indigenous plant resources and community-level capacity to develop a circular, low-cost, and scalable solution. Central to this goal was the transfer of knowledge and technology for processing raw agricultural residues, specifically ensete leaves and sugarcane bagasse, into usable soil additive powders.

The process began with the selection of appropriate local milling machines capable of breaking down fibrous plant materials into powder form for usage as soil additives. In rural Ethiopia, the teff crusher, which is commonly used for grinding grains was identified as machine for producing soil additives from the local plants (Figure 5). These machines were evaluated for their ability to shred plant material to an appropriate particle size, and parameters like rotor speed, blade configuration, and sieve mesh size were optimized to yield powders.

► **Figure 5 Locally available grinding machine for producing soil additives.**



► **Figure 6. Ground improvement work at Jinka University, a) Mixing additives with soil at the designated ratio, b) after the compaction of the demonstration field.**



a)



b)

► **Figure 7. Training for local officials.**



► **Figure 8. Repair work in cooperation with residents.**



In order to examine the practicability of mixing expansive soil with cellulose-based additives by labour and the bearing performance as a base course, and to propose the appropriate construction method, the full-size driving tests have been conducted in Jinka University of Ethiopia and in Japan (Figure 6). Uniformity of the mixes sample is key for quality control of the stabilization.

Community participation and institutional engagement

The SATREPS project placed strong emphasis on community participation, recognizing that the long-term sustainability of any rural infrastructure project depends on the knowledge, ownership, and engagement of local people. Community engagement efforts were deeply integrated into every stage of the project, from material preparation to road construction and post-trial evaluation.

Initial engagement began with consultations involving local leaders, road users, women's groups, and youth organisations (Figure 7 and 8). These dialogues helped tailor the project to community needs, ensuring that the demonstration road aligned with local priorities. The team explained the purpose of the project, the benefits of the technology, and the roles community members could play in implementation. This participatory approach built trust and active stakeholder engagement from the outset. The integration of this technology into the local setting was intended to be further facilitated by developing a business model for small-scale production. The project encouraged local entrepreneurs to view powder production not just as a road improvement initiative but as a microenterprise opportunity. Cost-benefit analyses showed that community-based milling could be sustained with modest initial investment, particularly when linked to government programs focused on rural infrastructure.

Conclusion

Summary of achievements

The SATREPS project succeeded in demonstrating a scientifically validated, community-friendly, and cost-effective method for improving expansive soils in rural Ethiopia. The major outcomes include;

1. Identification of ensete and sugarcane bagasse as effective stabilizers,
2. Development of locally adaptable production methods,
3. Field trials confirming performance under real conditions,
4. Capacity building for Ethiopian researchers, engineers, and villagers,
5. Enhanced understanding of soil-additive interaction at micro and macro levels.

It was demonstrated that expansive clay soil can be improved using *Celludron*, sugarcane bagasse, and *ensete*. These materials' fibrous cellulose content absorbs water and braces soil particles, leading to strength improvement and crack suppression. Sugarcane bagasse and *ensete* were identified as efficient and viable for mass production. Guidelines were formulated and endorsed by national authorities. In Jinka, a community-based disaster reduction model was successfully piloted, involving universities, government bodies, and local populations. The model was institutionalized through training courses at Jinka University.

Remaining challenges

1. Future efforts will focus on verifying long-term durability and proposing cross-sectional designs that take advantage of these characteristics.
2. The next step involves verifying productivity, cost-efficiency, and comparative advantage to other stabilizers to encourage nationwide implementation.
3. Next steps include validating the model's sustainability and applicability in other regions.
4. Technical Research needs to conduct additional trials to understand the effect of particle shape, size, and additive composition.
5. It would be necessary to advocate for inclusion of cellulose-based stabilization in national rural road design manuals for Policy Integration.
6. Support broader adoption through donor-funded programs and PPPs (public-private partnerships).
7. Long-term monitoring stations at demonstration sites needs to be established.

Broader Impact

Beyond the technical achievements, the SATREPS project serves as a model for international development cooperation grounded in science, local empowerment, and sustainability. Its interdisciplinary, locally rooted, and participatory nature positions it well for expansion not just in Ethiopia but across Sub-Saharan Africa.

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► Un développement local intégré qui va au-delà de la simple construction d'ouvrages

Étude de cas du village « Douar Ncham »

Riadh Safi

International Labour Organization (ILO), Country Office for Algeria, Libya, Morocco, Mauritania and Tunisia, Tunis, Tunisia

Résumé exécutif

Maximiser l'impact social du développement des infrastructures nécessite une approche intégrée qui va au-delà de la simple construction d'ouvrages. Cette approche doit assurer que les projets **soient inclusifs, durables et équitables**. En effet, l'implication active des communautés et l'intégration des principes de durabilité sont essentiels pour garantir que ces projets aient un impact positif à long terme sur le bien-être social. Pour garantir que les projets d'infrastructure ne se contentent pas de stimuler uniquement la croissance économique, ils doivent contribuer également au bien-être des communautés, à la réduction des inégalités et à la durabilité sociale à moyen-long terme.

L'étude de cas du **village « Douar Ncham »**, village forestier situé dans le Nord-Ouest de la Tunisie, vise à illustrer **un exemple concret chiffré** pour évaluer et valoriser l'impact social des travaux de désenclavement menés par l'OIT au profit de ce village.

Basées sur **une planification inclusive** centrée sur les besoins des habitants via une approche participative à travers des mécanismes permettant à ces derniers de participer activement au processus de décision, **les interventions menées** ne se sont pas limitées au désenclavement du village « Douar Ncham » via l'aménagement de pistes forestières, la création d'emplois directs/indirects locaux et le renforcement de leurs compétences par l'organisation de chantiers écoles sur le tas (sur les techniques de construction, les travaux forestiers, ...), mais aussi elles œuvrent pour soutenir les entreprises locales et la création de nouvelles structures économiques dans la région.

Par ailleurs, **les infrastructures réalisées** ont permis de réduire les inégalités géographiques et les écarts d'accès aux services de base (santé, éducation, transport, ...) des groupes vulnérables (en particulier les personnes handicapées, les personnes âgées, les femmes, et les enfants), de favoriser la fluidité de la circulation des personnes et des biens, et de stimuler les activités économiques basées sur la valorisation des ressources naturelles de la région comme les sous-produits de la forêt (les Plantes Aromatiques et Médicinales (PAM), le liège, ...) et les gisements d'argile existants.

En collaboration avec les autorités locales et pour maximiser l'impact social des infrastructures, le village « Douar Ncham » est devenu un site pilote pour la promotion des principales filières agro-forestières et l'éco-tourisme communautaire, surtout avec la mise en place d'un parc forestier écologique (destiné pour accueillir les visiteurs et commercialiser les produits locaux) et l'intégration du village dans un circuit d'écotourisme communautaire classé. En effet, on assiste à un exode inverse, avec un retour progressif des habitants dans leur village.

Introduction

En Tunisie, une partie de la population vit dans ou à proximité des forêts, en particulier dans les régions du nord et du nord-ouest du pays, où se trouvent les principales zones forestières. Ces forêts couvrent environ 6 % du territoire tunisien, soit environ 1,3 million d'hectares, et sont occupées par près d'un million d'habitants, qui représentent à peu près 10% de la population totale tunisienne (FAO, 2020). La population joue un rôle clé dans la préservation des écosystèmes forestiers, mais elle fait face à de nombreux défis socio-économiques. La vie dans les forêts tunisiennes est donc marquée par une dépendance aux ressources naturelles et des défis socio-économiques importants, nécessitant des efforts de développement rural et de préservation environnementale, qui fait face à des défis tels que la dégradation des ressources, les effets du changement climatique, la vulnérabilité des infrastructures et l'exode rurale.

Dans ce contexte, l'Organisation Internationale du Travail (OIT), à travers le projet « Initiative Pilote pour un Développement Local Intégré » (IPDLI), a intervenu au niveau du village forestier « Douar Ncham » en tant que maître d'ouvrage délégué de la commune de Hammam Bourguiba (gouvernorat de Jendouba) dans le cadre de l'appui du processus de la décentralisation en Tunisie.

En effet, le village « Douar Ncham » est situé dans une région au relief accidenté, proche de la frontière algérienne (3 km), et s'étend sur 100 hectares de forêts et 30 hectares de terres agricoles. Cependant, l'enclavement du village, accentué par l'absence d'infrastructure de base (piste forestière, eau potable, ...), a compliqué l'accès des habitants aux services essentiels. Par conséquent, le village a connu durant la dernière décennie un exode massif de la population, en particulier les jeunes, qui a réduit la population de 100 ménages en 2010 à 55 ménages actuellement, en absence d'opportunités économiques décentes malgré les potentiels agro-forestiers de la région.

Le choix du projet intégré de développement du village forestier « Douar Ncham » : une planification inclusive concertée

Selon le Code de Collectivités Locales (Loi organique n°2018-29 du 9 mai 2018), la commune Hammam Bourguiba, en tant que commune nouvellement constituée, était appelée de préparer son Plan de Développement Local (PDL) pour la période 2020-2022.

Le plan de développement local (Journal officiel de la république tunisienne, 2018), élaboré selon une méthode participative et avec l'appui des services de l'Etat, constitue le cadre de référence pour l'action et les interventions des collectivités locales et des organes qui en dépendent en matière de développement global.

Lors de la préparation du plan de développement local, il doit être tenu compte des capacités de la collectivité locale ainsi que du volume d'appui financier apporté par l'Etat et les différents intervenants dans le domaine du développement à quelque titre que ce soit.

Le plan de développement local s'emploie, avec l'appui de l'Etat, à consolider les avantages comparatifs de chaque collectivité locale ou à lui conférer des avantages attractifs pour promouvoir son développement et y encourager l'investissement.

Dans ce cadre, des ateliers de concertation ont été organisés en novembre 2018 au niveau de la commune Hammam Bourguiba pour planifier les interventions à mener. L'objectif de ces ateliers était d'aller vers une vision concertée du développement de la commune déclinée en des objectifs stratégiques, et ce afin de (i) répondre aux attentes des citoyens, (ii) procéder à la priorisation et la budgétisation des projets communaux, et (iii) planifier les investissements selon les conditions de financement en vigueur.

L'élaboration du PDL de la commune Hammam Bourguiba s'est basée sur une approche participative et inclusive, impliquant à la fois les acteurs locaux et régionaux, aussi bien institutionnels, de la société civile que du secteur privé, et la population locale. En concertation avec tous ces acteurs, des critères de priorisation des projets à exécuter ont été arrêtés sur la base d'une batterie d'indicateurs socio-économiques objectifs. A partir des scores calculés pour chaque projet proposé, c'est ainsi que le **projet intégré de développement du village forestier « Douar Ncham »** a été identifié et sélectionné comme projet prioritaire par la commune Hammam Bourguiba.

Objectifs du projet intégré de développement du village forestier « Douar Ncham »

Le projet intégré de développement du village forestier « Douar Ncham » visait principalement à mettre en place l'infrastructure de base nécessaire pour améliorer les conditions de vie de la population, et ce principalement pour :

- Désenclaver le village et connecter les logements au réseau routier
- Garantir l'approvisionnement en eau potable pour les ménages à partir des sources naturelles de la région
- Prévoir la gestion adéquate des eaux usées pour préserver l'écosystème forestier et réduire les risques sanitaires, en particulier les risques de contamination de la nappe et les impacts négatifs sur la faune et la flore
- Développer l'écosystème économique du village pour dynamiser et générer des activités génératrices de revenu pour les habitants

Démarche et approche adoptées pour la mise en place du projet intégré de développement du village forestier « Douar Ncham »

Afin de soutenir le processus de la décentralisation en Tunisie et dans le cadre de son appui à la commune Hammam Bourguiba, le projet OIT/IPDLI, en tant que maître d'ouvrage délégué, a identifié le projet intégré de développement du village forestier « Douar Ncham », figurant parmi les projets prioritaires dans le PDL de la commune, comme un modèle pilote de développement des villages forestiers.

Pour créer des dynamiques positives, améliorer les conditions de vie des populations et favoriser une croissance inclusive et durable, l'OIT/IPDLI a veillé à appliquer **l'approche HIMO (Haute Intensité de Main-d'Œuvre)** dans la mise en œuvre des interventions prévues en privilégiant l'emploi de la main-d'œuvre locale plutôt que l'utilisation intensive de machines et l'exploitation des ressources locales de la région, afin de permettre de maximiser la création d'emplois, de dynamiser l'économie locale et de renforcer les compétences des travailleurs. Par ailleurs, la gestion du projet s'est basée sur plusieurs atouts marquant la démarche suivie et adoptée par l'OIT/IPDLI, et se focalisant autour des axes suivants :

Gouvernance participative et inclusive

Le processus de concertation ne s'est pas limité à l'identification et la planification du projet de développement intégré du village « Douar Ncham » entre les acteurs locaux (autorités locales, société civile, secteur privé, citoyens), mais il s'est élargi aussi au niveau des phases de réalisation et de mise en place des infrastructures et des étapes de conception du modèle de développement de l'écosystème du village. En effet et en collaboration avec le conseil communal, plusieurs partenaires institutionnels techniques ont rejoint l'équipe de l'OIT/IPDLI, en particulier :

- Conseil régional du gouvernorat de Jendouba
- Direction Générale des Forêts du Ministère de l'Agriculture
- Services déconcentrés du Ministère de l'Agriculture
- Ministère de l'Équipement & de l'Habitat (Travaux Publics)
- Commune de Hammam Bourguiba du Ministère de l'Intérieur
- Office National de l'Assainissement (ONAS) du Ministère de l'Environnement
- Office National du Tourisme Tunisien (ONTT) du Ministère de Tourisme
- Office National de l'Artisanat Tunisien (ONAT) du Ministère de Tourisme

Plusieurs propositions techniques et observations ont été partagées et prises en compte dans l'exécution des travaux en concertation avec les bénéficiaires, ce qui permis d'ajuster et d'orienter dans des fois quelques décisions techniques.

Diagnostic territorial approfondi

Avant d'entamer les travaux, l'OIT/IPDLI a mené une enquête terrain de base auprès des ménages du village « Douar Ncham ». Le ratissage réalisé a permis de dresser un diagnostic approfondi et de dégager :

- Les caractéristiques socio-démographiques des habitants (selon la tranche d'âge, le sexe, l'état matrimonial, ...) : la composition démographique, le niveau de scolarisation, l'analphabétisation, la couverture sociale/ sanitaire, ...
- La situation économique des habitants : le taux de chômage, la force de travail, ...

- Les conditions de vie des habitants : les caractéristiques des logements, le transport vers le travail/ les établissements scolaires, ...
- Les activités agricoles des ménages : l'agriculture, l'élevage, ...
- Relation des habitants avec la forêt : l'activité pastorale, l'exploitation des ressources naturelles, les modes d'exploitation de la forêt, ...
- Les préoccupations et les attentes des habitants
- Etc.

Les résultats de l'enquête ont permis de comprendre le profil socioéconomique des habitants du village forestier « Douar Ncham », d'identifier leurs besoins, de découvrir leur mode de vie (sources de revenu, activités, ...), et les défis spécifiques du village.

Par ailleurs, des études techniques spécifiques ont été réalisées dans le site pour :

- Assurer la faisabilité technique des infrastructures : vérifier les technologies et matériaux disponibles, analyser les contraintes techniques et proposer des solutions adaptées, ...
- Garantir la viabilité économique et financière des activités économiques : Évaluer l'opportunité et la rentabilité, identifier les sources de financement et optimiser les ressources, ...
- Minimiser les impacts environnementaux : Analyser les effets potentiels sur l'environnement, proposer des mesures d'atténuation et des alternatives durables, ...
- Optimiser l'efficacité et la durabilité : Sélectionner les meilleures solutions techniques en fonction du contexte, prendre en compte l'entretien et la longévité des infrastructures, ...
- Respecter les normes et réglementations en vigueur : S'assurer de la conformité avec les normes nationales et internationales, intégrer les exigences légales et administratives, ...

Diversification et valorisation des ressources locales

La diversification et la valorisation des ressources locales sont des stratégies essentielles pour stimuler le développement économique, renforcer la résilience des territoires et favoriser un développement durable et inclusif. Elles permettent de maximiser le potentiel des ressources disponibles tout en créant de nouvelles opportunités économiques.

Dans ce cadre, l'OIT/IPDLI a soutenu les secteurs productifs locaux du village forestier « Douar Ncham » via l'appui d'activités génératrices de revenu de ses habitants tels que la promotion des travaux forestiers, des bonnes pratiques agricoles (en particulier l'élevage ovin/ caprins), de l'exploitation des plantes aromatiques médicinales de la région, de la poterie traditionnelle, et de l'écotourisme.

Infrastructures et services de base adaptés

Selon la typologie géographique et les conditions climatiques et culturelles du village, les infrastructures mises en place ont répondu au mieux aux attentes et aux besoins des habitants du village « Douar Ncham » : accès au réseau routier facile même pendant les périodes de neige, amélioration de la qualité de l'eau potable, traitement des eaux usées domestiques, mise en place d'espaces adéquats écotouristiques, aménagement d'espaces décents pour les activités économiques des artisans (points de vente, atelier de travail, ...), ...

Financement et mobilisation des ressources

Les actions entreprises dans le cadre du projet intégré de désenclavement du village forestier « Douar Ncham » repose sur une approche intégrée et partenariale. Cofinancé par la Délégation de l'Union européenne en Tunisie (DUE) et Confédération Suisse/ Direction du développement et de la coopération (DDC), l'OIT/IPDLI a veillé à impliquer dans le financement du projet les services de l'Etat en complémentarité avec les programmes existants,

comme le Programme Régional de Développement (PRD) pour exécuter quelques composantes (principalement pour le développement des infrastructures de base (Route & Eau)).

Par ailleurs, la coordination avec les services déconcentrés a permis aussi de mobiliser des ressources matérielles (les engins, les gîtes, la pierre locale, les remblais d'oued, la mise à disposition de lot de terrain, ...) et des ressources humaines qualifiées, en particulier à travers les directions du Ministère de l'Agriculture (notamment la Direction Générale des Forêts (DGF), l'Institut National de Recherches en Génie Rural, Eaux et Forêts (INGREF), le Génie Rural (GR), et la Direction des Ressources en Eau (DRE)), et la direction régionale de l'équipement de Jendouba du Ministère de l'équipement et de l'habitat.

Un financement complémentaire a été aussi accordé pour ce projet par l'UNICEF afin de consolider les aspects relatifs aux actions liées à l'eau, l'assainissement et l'hygiène (WASH) et celles soutenant les activités économiques locales (notamment par la construction de points de vente et d'un atelier artisanal).

Un Partenariat Public-Privé (PPP) a marqué aussi le montage financé du projet de développement du village « Douar Ncham » : la mise en œuvre de la station pilote de traitement et de valorisation des eaux usées a été assurée par le leader mondial en gestion des eaux non conventionnelles « Premier Tech Water and Environment ».

Renforcement des capacités locales

En tant que maître d'ouvrage délégué, l'équipe de l'OIT/IPDLI a assuré l'accompagnement institutionnel nécessaire pour les membres de la commune Hammam Bourguiba au niveau du traitement et la gestion administrative relatives au processus de passation de marché.

Sur site, la main d'œuvre locale impliquée dans l'exécution des infrastructures selon l'approche HIMO a bénéficié d'un apprentissage sur le tas via des chantiers écoles organisés pour la réalisation des pistes forestiers, des ouvrages de protection et des locaux construits.

Dans le cadre de renforcement des capacités locales pour améliorer les sources de revenu, plusieurs actions ont été achevées, en particulier :

- Un groupe de jeunes de la région a bénéficié d'une formation et d'un accompagnement dans le cadre de chantier école de travaux forestiers. Une formation complémentaire leur a été accordée sur la conception de Plan d'Affaire pour préparer ces jeunes à la vie professionnelle.
- Un groupe de femmes artisanes a bénéficié de plusieurs sessions de formation dans la poterie traditionnelle à travers des experts en la matière pour améliorer leurs pratiques et renforcer leurs compétences techniques

Un processus de validation d'apprentissage est assuré pour chaque apprenant en collaboration avec les structures de l'état pour assurer l'obtention des diplômes et des certifications nécessaires.

Protection de l'environnement et résilience climatique

Vu les spécificités du village « Douar Ncham », placé au cœur d'une dense forêt, des contraintes environnementales s'imposent devant les interventions prévues. La promotion d'une économie circulaire et respectueuse de l'environnement a été prise en considération pour minimiser l'impact écologique tout en répondant aux besoins sociaux et économiques. Elles intègrent des principes de durabilité, d'efficacité énergétique et de préservation des ressources naturelles afin de favoriser un développement harmonieux et résilient.

Dans ce contexte, un choix optimal a été respecté dans le trajet de la piste forestière et ses annexes pour éviter au mieux l'abattage d'arbres, préserver la nature et désenclaver le village « Douar Ncham ». L'éclairage de la piste a été assuré par des points lumineux autonomes photovoltaïques.

De même, la solution proposée pour le traitement des eaux usées domestiques est une solution écologique utilisant la technologie ECOFLO qui fait recours à des filtres végétaux à fragments de bourres de noix de coco : résidus naturels revalorisés, renouvelables, et compostables en agriculture ou jardinage. Le traitement se fait sans consommation d'énergie par une filtration naturelle et végétale.

Suivi-évaluation et ajustements

Afin de garantir la transparence et la redevabilité, mesurer les effets sur les bénéficiaires et vérifier que les activités mises en œuvre ont produit les effets escomptés, l'OIT/IPDLI a mis en place un système de suivi et d'évaluation sur mesure pour :

- Visualiser graphiquement le planning des tâches dans le temps, et organiser, suivre et coordonner les différentes étapes de la mise en place du projet
- Produire un tableau de bord des principaux indicateurs de performance :
 - Indicateurs d'entrée (ou de moyens) : Mesurent les ressources mobilisées pour le projet (Exemple : Budget alloué, nombre de personnes formées, matériel acheté, ...)
 - Indicateurs de processus (ou d'activités) : Suivent la mise en œuvre des activités du projet (Exemple : Nombre de sessions de formation organisées, taux d'exécution des tâches prévues, ...)
 - Indicateurs de production (ou de réalisations) : Évaluent les résultats directs des actions menées (Exemple : Nombre d'apprenants, nombre de certificats distribués, ...)
- Indicateurs de résultats : Mesurent les changements immédiats générés par le projet (Exemple : Nombre d'H/J généré, Nombre d'emplois, ...)

Composantes du projet de développement intégré du village « Douar Ncham » : un développement basé sur l'intégrité et la complémentarité des interventions

En termes de réalisations, le projet de développement intégré du village forestier « Douar Ncham » a permis de mettre en place plusieurs composantes :

Aménagement de la piste forestière principale

Afin de désenclaver le village et garantir sa connectivité aux réseaux routiers pour faciliter l'accès des habitants aux services de base (écoles, dispensaires, ...), l'OIT/IPDLI a aménagé la piste forestière principale (1.5 km) ainsi que les ouvrages de franchissements nécessaires vu la nature géographique du site et les ouvrages de protection. Le revêtement en tri-couche a été pris en charge par les fonds du Programme Régional de Développement (PRD).

Des solutions alternatives moins coûteuses pour le drainage des eaux pluviales (cassis submersibles, fossés latéraux, pente d'écoulement naturel, talus de drainage, ...) ont été appliquées.

Des points lumineux autonomes photovoltaïques ont été installés tout au long de la piste pour éclairer la vision pendant la nuit.

► **Figure 2. Aménagement de la piste forestière principale du village forestier « Douar Ncham »**



Aménagement des accès secondaires de la piste forestière

Afin de relier les ménages isolés et dispersés à la piste forestière principale, des accès secondaires ont été entrepris. Les travaux ont permis de réaliser près de (01) km de pistes forestières touchant environ 25 ménages. Des économies ont été réalisées tout en garantissant la qualité des travaux, grâce à l'application des principes de l'approche HIMO en insistant sur le recours aux ressources locales. D'autre part, une contribution significative de la part des structures de l'Etat a permis de réduire les coûts, notamment grâce à la Direction Régionale de l'Équipement de Jendouba qui a fourni les dalots pour le franchissement des cours d'eau, la Direction des

Ressources en Eau (DRE) du CRDA Jendouba qui a autorisé l'utilisation des déblais issus du curage de l'oued pour renforcer l'assise de la chaussée, et le Domaine de l'Etat qui a permis l'exploitation des déchets de marbre de la carrière de Chemtou pour la construction des ouvrages de protection.

► **Figure 3. Aménagement des accès secondaires de la piste forestière principale du village « Douar Ncham »**



Amélioration de l'approvisionnement en eau potable

Les ménages du village forestier « Douar Ncham » s'approvisionnaient en eau à travers une seule source d'eau naturelle. Malheureusement, cette source est exposée à plusieurs facteurs de contamination, vu qu'elle n'est pas protégée et exploitée aux animaux de la forêt, en particulier les sangliers. Selon les analyses bactériologiques, il s'avérait que l'eau n'est plus potable. Pour faire face à ces problématiques et améliorer les conditions d'approvisionnement en eau potable, l'OIT/IPDLI a collaboré avec le conseil régional du gouvernorat de Jendouba (à travers les fonds du Programme Régional de Développement) pour exécuter les travaux d'aménagement de la source d'eau et le raccordement des logements du village par l'eau potable.

L'aménagement d'une source d'eau naturelle permettra un meilleur accès à l'eau potable, essentielle pour faire face aux périodes de sécheresse.

Aménagement d'une station d'épuration écologique

Le système d'assainissement dans le village « Douar Ncham » était assuré à travers des fosses septiques individuelles, posant des risques sanitaires et environnementaux. Afin d'adopter une solution durable et écologique, le projet OIT/IPDLI a identifié une expertise internationale dans la gestion des eaux non conventionnelles à travers la société « Premier Tech Water and Environment » : c'est une initiative pilote de traitement et de valorisation des eaux usées domestiques dans un contexte forestier.

La station permettra le traitement tertiaire des eaux usées en utilisant la technologie ECOFLO : c'est un système d'assainissement autonome écoresponsable utilisant des biofiltres compacts pour le traitement des eaux usées. Pour la station pilote à « Douar Ncham », il s'agit du filtre végétal à fragments de bourres de noix de coco : résidus naturels revalorisés, renouvelables, et compostables en agriculture ou jardinage. Le traitement se fait sans consommation d'énergie par une filtration naturelle et végétale.

Aménagement d'une table d'hôte

En concertation avec les habitants, l'OIT/IPDLI a aménagé une table d'hôte dans le village « Douar Ncham », offrant un espace d'accueil pour les visiteurs, ainsi qu'un lieu adapté aux artisanes locales pour exposer leurs produits du terroir.

Cette table d'hôte comprend une cuisine équipée aux normes d'hygiène, une salle d'exposition avec cheminée, un bloc sanitaire et une terrasse aménagée pour profiter de la vue panoramique du paysage naturel.

La construction de la table d'hôte a mis en valeur l'utilisation de matériaux locaux et la préservation des savoir-faire traditionnels. Des éléments tels que le bois, la pierre, les tuiles, et les cheminées typiques de la région d'Ain Draham ont été intégrés.

► **Figure 4. Aménagement d'une table d'hôte au village forestier « Douar Ncham »**



Aménagement d'un parc forestier écologique

L'écotourisme communautaire est une nouvelle alternative qui séduit une clientèle de plus en plus importante et qui œuvre pour la protection et le respect de l'environnement surtout dans les zones intérieures du pays, qui sont riches en paysage naturel et en identité culturelle.

Dans ce cadre et en concertation avec les habitants, l'OIT/IPDLI a envisagé de mettre en place un circuit d'écotourisme communautaire au niveau du village « Douar Encham » suite à l'achèvement du désenclavement du village. Il a initié ainsi la mise en œuvre d'un parc forestier écologique dans ce village en collaboration avec la commune, la Direction Générale des Forêts, l'UNICEF.

D'ailleurs, chaque week-end une centaine de personnes se rendent au village forestier « Douar Ncham » pour pratiquer des activités de randonnée, camping ou des découvertes en plein nature. Toutefois, ces visiteurs n'ont pas accès à des espaces aménagés où se reposer après leurs activités, ce qui limite l'expérience touristique et empêche le village de tirer pleinement profit de ce potentiel. De plus certains habitants de Douar Ncham exercent des métiers liés aux ressources locales, comme la poterie, le bois, et la distillation d'huiles essentielles. Cependant, ils n'ont pas d'espaces adéquats pour travailler et exposer leurs produits dans des conditions optimales.

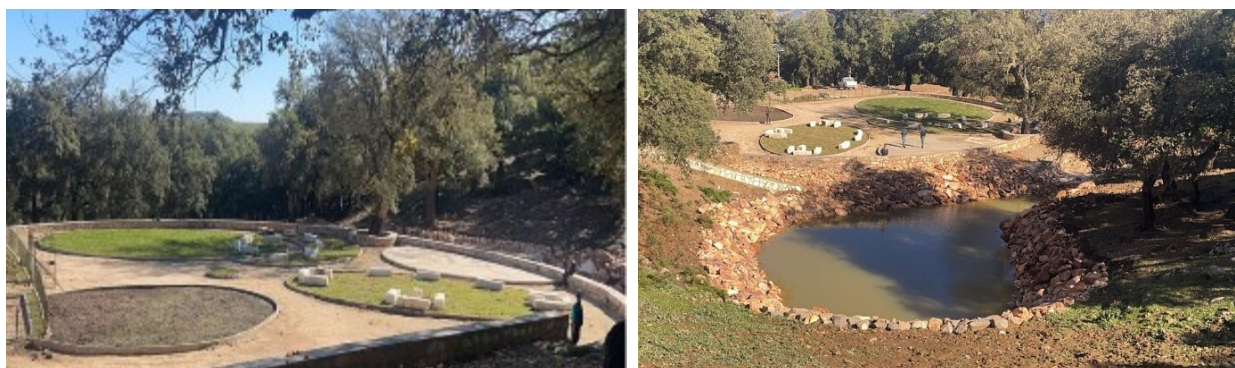
Dans ce cadre l'aménagement du parc forestier du Douar Ncham vise à répondre à ces besoins en créant un espace d'accueil pour les visiteurs et des infrastructures adaptées pour les artisans

L'emplacement du parc a été choisi en concertation avec les riverains et les acteurs locaux, notamment l'arrondissement des forêts d'Ain Draham, la commune de Hammam Bourguiba, et l'arrondissement de Conservation des Eaux et du Sol (CES). Il est à signaler que le site présente un patrimoine historique, ayant servi de lieu de rassemblement pour les résistants algériens durant la colonisation française.

Les principales composantes du parc impliquent :

- Construction d'un atelier de poterie traditionnelle en bois pour permettre aux artisans locaux de produire et vendre leurs produits sur site
- Construction de deux (02) points de vente des produits du terroir pour la vente de produits locaux tels que les produits forestiers non ligneux, les huiles essentielles, les objets artisanaux, etc.
- Construction d'un bloc sanitaire en bois (avec trois compartiments distincts (hommes, femmes et Personnes à Mobilité Réduite (PMR)) avec des installations adaptées aux besoins des visiteurs
- Construction d'une buvette en bois pour offrir aux visiteurs un espace de détente et de rafraîchissement au cœur du parc
- Installation d'un réservoir enterré de récupération des eaux pluviales en PEHD certifié alimentaire pour faciliter la collecte et l'utilisation des eaux dans l'irrigation des espaces verts, et les blocs sanitaires.
- Installation d'une fosse septique enterrée de traitement des eaux usées pour assurer un assainissement écologique, minimisant ainsi l'impact environnemental du parc
- Aménagement d'un bassin colinéaire dédiés à la rétention des eaux de pluie et des sources naturelles du site, offrant ainsi à la population une source d'irrigation pour leurs cultures pendant la période estivale, et une réserve préventive contre les incendies
- Aménagement d'une placette au cœur du parc servant de point de rassemblement pour accueillir les visiteurs dans un cadre agréable et reposant. C'est une placette polyvalente qui peut être utiliser pour organiser des événements locaux, des ateliers ou des petites manifestations culturelles
- Aménagement d'un parking pour les visiteurs arrivant en voiture ou en bus

► **Figure 5. Aménagement d'un parc forestier écologique**



Aménagement d'une unité de collecte des déchets plastiques

Une initiative personnelle d'un jeune résidant dans le village « Douar Ncham » a été lancée pour la collecte et la commercialisation des déchets plastiques. L'objectif de l'initiative était de générer un revenu pour lui et pour les ménages dans les agglomérations voisines.

Dans la cadre de la formalisation de son activité et de lui fournir l'assistance technique nécessaire, l'OIT/IPDLI a appuyé le jeune promoteur pour créer sa propre unité de collecte.

► **Figure 6. Aménagement d'une unité de collecte de déchets plastiques**

Organisation d'un chantier école en travaux forestiers

Devant la dégradation continue de nos forêts due aux effets des changements climatiques (sécheresse, incendies, ...), à la surexploitation, au surpâturage, au défrichement illégal et le manque d'acteurs spécialisés qualifiés pour assurer l'entretien des forêts, l'OIT/IPDLI a lancé un programme pilote de création de PME active dans le secteur forestier en collaboration avec la Direction Générale des forêts (DGF). En effet, un groupe de jeunes du village « Douar Ncham » a été initié sur les différents travaux forestiers et les modes de valorisation des produits forestiers, à savoir :

- Nettoyage de maquis
- Entretien des tranchées pare feu
- Conduite de peuplement du pin d'Alep
- Conduite de peuplement du chêne liège
- Démasclage ou de récolte de liège
- Reboisement et entretien des espaces verts (Y compris la plantation dans les établissement scolaire)
- Travaux de conservation des eaux et du sol (construction des gabions)

Ces jeunes ont été formés dans le cadre de chantiers écoles créés en collaboration avec les arrondissements des forêts de Jendouba et le centre de formation de l'état en activités forestières de Rimel.

► **Figure 7. Organisation d'un chantier école en travaux forestiers**

Mise en place du Programme Art et Artisanat en Tunisie (PAAT) en faveur des femmes artisanes

Afin d'améliorer les pratiques techniques des artisanes du village « Douar Ncham » dans le domaine de la poterie traditionnelle, l'OIT/IPDLI a intégré ces dernières dans un programme national « Programme Art et Artisanat en Tunisie (PAAT) ».

Ce programme vise à établir une réconciliation entre l'art et l'artisanat, et de prévoir les initiatives à entreprendre dans ce cadre pour créer une synergie entre les différents acteurs pour :

- Nouer des relations gagnant-gagnant entre les structures universitaires chargées des beaux arts et les artisanes
- Contribuer au désenclavement intellectuel des artisanes en mettant en place un programme de formation technique et artistique sous forme d'Ateliers Collectifs Locaux (ACL) supervisés par des artistes, des maîtres artisans et des experts

En parallèle, un appui institutionnel a été assuré pour organiser ces femmes sous forme de coopérative pour assurer la durabilité de l'activité.

► **Figure 8. Renforcement des capacités des femmes artisanes dans la poterie traditionnelle**



Impacts socio-économiques des infrastructures réalisées

Le cout total du projet de développement intégré du village « Douar Ncham » est estimé à 480 mille USD, dont 76% seulement par les fonds de l'OIT/IPDLI. La contribution des autres partenaires institutionnels et privés est de près 115 mille USD. Une grande partie des fonds dépensés ont resté dans la région. D'ailleurs, les interventions menées ont permis de générer près de 11300 Journées de travail, dont 96% par des mains d'œuvre de la région. Ces journées ont été assurées par environ 140 postes d'emploi.

Les infrastructures routières réalisées pour désenclaver le village forestier « Douar Ncham » ont permis de réduire les inégalités géographiques et les écarts d'accès aux services de base (santé, éducation, transport, ...), en particulier pour des groupes vulnérables (les personnes handicapées, les personnes âgées, les femmes, et les enfants), de favoriser la fluidité de la circulation des personnes et des biens, et de stimuler les activités économiques basées sur la valorisation des ressources naturelles de la région comme les sous-produits de la forêt (les Plantes Aromatiques et Médicinales (PAM), le liège, ...) et les gisements d'argile existants.

Selon la vision et les réalisations achevées, le projet de développement intégré du village forestier « Douar Ncham » ne s'est pas limité à l'infrastructure routière, mais s'est inscrit dans une vision de développement territorial intégré, visant à renforcer la résilience et l'adaptation des populations locales aux défis socio-économiques et environnementaux.

Ce pendant l'accès n'a pas servi uniquement pour les habitants mais aussi aux visiteurs du village via le tourisme local : la fréquence des groupes de visiteurs du village suit une courbe ascendante. L'éco-tourisme communautaire, surtout avec la mise en place du parc forestier écologique (destiné pour accueillir les visiteurs et commercialiser les produits locaux) et l'intégration du village dans un circuit d'écotourisme communautaire classé, a promu un exode inverse, avec un retour progressif des familles originaires vers leur village (de nouvelles constructions privées commencent à apparaître). Les autorités locales ont planifié des événements périodiques dans le parc ce qui va dynamiser le village et entraîner l'amélioration progressive des revenus des habitants.

Dans le cadre de développement des activités économiques de la population, le projet a permis à (10) jeunes demandeurs d'emploi sans qualification d'être formés et certifiés, tout en étant rémunérés, dans le cadre de la mise en œuvre des chantiers de travaux démonstratifs d'infrastructures, à travers un mécanisme d'accréditation national dans des techniques de construction alternatives, écologiques et intensif en emplois (à haute intensité de main-d'œuvre), basées sur l'utilisation des matériaux locaux, qui sont en abondance dans les territoires communaux et ont un énorme potentiel de développement économique et social.

Un groupe de (07) jeunes du village « Douar Ncham » ont suivi un cursus d'apprentissage certifiant via un chantier école sur les travaux forestiers et qui ont validé leur apprentissage à travers le dispositif de la formation professionnelle de l'état. Quelque uns ont déjà créé leur propre PME pour accéder aux marchés.

Pour stimuler les activités économiques basées sur la valorisation des ressources naturelles de la région comme les sous-produits de la forêt (les Plantes Aromatiques et Médicinales (PAM), le liège, ...) et les gisements d'argile existants, (10) femmes artisanes du village ont poursuivi le « Programme Art et Artisanat en Tunisie (PAAT) » et ont pu développé leurs compétences dans la poterie traditionnelle de Kroumirie, dont (07) ont été certifiées et (02) ont obtenu leurs cartes professionnelles. Les infrastructures réalisées leurs ont permises de les encourager à aller de l'avant, de développer leurs compétences, de diversifier leur production pour répondre aux nouvelles demandes du marché et de leur offrir l'opportunité de promouvoir et commercialiser leurs articles. Leurs revenus se sont nettement améliorés, qui a impacté positivement sur leurs conditions de vie.

La formalisation et la restructuration de l'activité du jeune collecteur des déchets plastiques leur ont permis d'améliorer ses revenus et d'engager d'autres jeunes avec lui. En moins de 2 ans, la superficie du point de collecte a doublé et le jeune entrepreneur a pu acquérir sa première camionnette pour transporter ses marchandises.

Sur le plan sanitaire et hygiène, la dissertation des logements en eau potable et la mise en place de la station d'épuration écologique vont pouvoir diminuer les risques de maladies hydriques (choléra, diarrhées, intoxications...), réduire l'impact sur les sols et les nappes phréatiques, et l'empreinte carbone (Moins d'énergie utilisée par rapport aux stations classiques), préserver la biodiversité, réutiliser l'eau traitée pour l'irrigation ou l'infiltration dans le sol.

Conclusion

Certes, le développement économique et social repose sur la création d'infrastructures (une meilleure infrastructure favorise le commerce et l'accès aux services). Cependant, si ces infrastructures ont été conçues en étroite concertation avec les bénéficiaires et dans une approche intégrée valorisant les ressources locales (humaines et naturelles), l'impact socioéconomique sera nettement meilleur et tangible. En effet, l'exemple du projet de développement intégré du village « Douar Ncham » en témoigne : En collaboration avec les autorités locales, le village « Douar Ncham » est devenu un site pilote pour la promotion des principales filières agro-forestières et l'éco-tourisme communautaire, surtout avec la mise en place d'un parc forestier écologique (destiné pour accueillir les visiteurs et commercialiser les produits locaux) et l'intégration du village dans un circuit d'écotourisme communautaire classé.

Le cas du village forestier « Douar Ncham » traduit bien que le développement local intégré va au-delà de la simple construction d'ouvrages, mais qui affirme que la voie vers le développement passe par le développement de la voie.

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► Green job creation and fair labor practices for women and youth in the Ethiopia's renewable energy sector

Descriptive case study

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Abstract

This paper explores the intersection of green job creation and fair labor practices within Ethiopia's rapidly expanding renewable energy sector, with a particular focus on Ethiopian Electric Power. As the country works toward universal electrification by 2030, major investments in hydropower, wind, solar, and geothermal infrastructure are generating significant employment opportunities. Grounded in the ILO's Just Transition Framework and Decent Work Agenda, the study evaluates how labor practices within the sector align with principles of inclusivity, equity, and sustainability-especially regarding women and youth participation. Ethiopia's renewable energy sector has emerged as a major job creator, generating between 20,000 and 30,000 green jobs. Notably, Ethiopian Electric Power has implemented a number of best practices and institutional initiatives aimed at enhancing inclusion, which have significantly contributed to improved representation and participation of underrepresented groups. Based on mixed-methods research-including data analysis, field visits, and stakeholder interviews-the paper identified best practices, gaps and offers actionable recommendations for policymakers, donors, civil society, and private actors to further promote equitable green job creation in the context of labor-intensive infrastructure development.

Key Words: Green Jobs, Decent Works, Fair labor practice, Women and Youth, Renewable energy.

Acronyms

AfDB	-	Africa Development Bank
EEP	-	Ethiopian Electric Power
KM	-	Kilometer
KV	-	Kilovolt
ILO	-	International labor Organization
IREA	-	International Renewable Energy Agency
MoWE	-	Ministry of Water and Energy
STEM	-	Science, technology, engineering and mathematics.

Background

Ethiopian Electric Power (EEP) is a central actor in Ethiopia's ambitious target to achieve universal electricity access by 2030. As the state-owned enterprise responsible for power generation and transmission, EEP leads the planning, construction, and operation of electricity infrastructure across the country. Its responsibilities span feasibility studies, system design and surveying, project oversight, and the leasing of transmission lines, in addition to managing substations and selling bulk electricity.

Ethiopia's electricity sector is undergoing rapid expansion, largely driven by the government's commitment to electrify 96% of the population through the national grid, with the remaining 4% to be served by off-grid solutions. This transformation is supported by a ten-year development plan aimed at boosting the country's generation capacity to 17,056 MW by 2030. Importantly, the strategy emphasizes a diversified energy mix, integrating hydropower with growing investments in solar, wind, and geothermal sources.

This strategic shift positions Ethiopia as a potential renewable energy hub in East Africa and creates a significant opportunity for green job creation. In the context of renewable energy, green jobs are defined as employment opportunities directly involved in the development, installation, operation, and maintenance of clean energy systems. These include both technical roles-such as wind turbine technicians, solar PV installers, and hydropower operators-and support functions in project management, policy, and planning. According to the International Renewable Energy Agency (IRENA, 2024), the global renewable energy sector supported over 16 million jobs as of 2023.

In Ethiopia, green job creation has the dual benefit of advancing low-carbon development and addressing socio-economic challenges such as unemployment and skills gaps. However, achieving equitable outcomes requires intentional efforts to ensure the inclusion of women and youth-groups historically underrepresented in the energy sector. Inclusive green growth not only supports social justice, but also strengthens workforce resilience and innovation.

EEP's ongoing investments in renewable energy infrastructure-particularly large-scale hydropower projects like the Grand Ethiopian Renaissance Dam, as well as solar and wind

developments-are already generating substantial employment across the energy value chain. These initiatives also open the door for implementing fair labor standards that align with the International Labour Organization's (ILO) Decent Work Agenda, which emphasizes rights at work, job creation, social protection, and social dialogue.

Against this backdrop, this paper explores the intersection of green job creation and fair labor practices in Ethiopia's renewable energy sector. Specifically, it seeks to answer the following research questions:

- To what extent is Ethiopia's renewable energy sector contributing to green job creation?
- What labor standards and practices are being applied in Ethiopia's renewable energy sector, and how do they align with international fair labor principles (e.g., ILO's Decent Work Agenda)?
- How inclusive is green job creation in terms of gender and youth participation, and what institutional mechanisms support or hinder this inclusiveness?
- What initiatives has Ethiopian Electric Power (EEP) implemented to promote fair labor practices and inclusion, and what impacts have these efforts had?
- What are the key challenges and opportunities for improving equitable and sustainable employment outcomes in the country's energy transition?

Scope

This study focuses on the role of Ethiopian Electric Power (EEP) in advancing green job creation and promoting fair labor practices within the renewable energy sector. It places particular emphasis on gender and youth inclusion, with a specific lens on the experiences and participation of female employees across the value chain. The scope covers employment linked to Ethiopia's major renewable energy initiatives, including hydropower, wind, and solar projects, and examines institutional practices, workforce composition, and policy alignment with inclusive labor standards.

Objective

1. Highlight the Green Job creation practice in the Ethiopian renewable energy.
2. Highlight the fair labor practices in the Ethiopian renewable energy sector.
3. Showcase the gender and youth inclusion landscape in Ethiopia's green energy workforce.
4. Identify persistent barriers and opportunities for inclusive green job creation.
5. Propose actionable recommendations for policymakers and stakeholders.

Methodology

This research employs a mixed-methods approach to provide a comprehensive understanding of green job creation and labor practices in Ethiopia's renewable energy sector. The methodology includes:

- **Secondary Data Analysis:** A review of existing literature, policy documents, labor market reports, and renewable energy project data from government and international sources (e.g., EEP, MoWE, ILO, IRENA).
- **Key Informant Interviews:** Semi-structured interviews with stakeholders including EEP officials, project managers, HR representatives, and policymakers, aimed at capturing expert perspectives on employment practices and inclusion efforts.
- **Focus Group Discussions (FGDs):** Targeted FGDs with female employees, youth trainees, and technical staff in selected renewable energy sites to explore lived experiences, challenges, and perceptions of inclusion in the sector.
- **Field Visits and Observations:** On-site visits to major renewable energy facilities (hydropower plants, solar parks, and wind farms) to observe working conditions, labor dynamics, and the integration of inclusive hiring and training practices

Brief literature review

Theoretical literature

The transition to a green economy presents an opportunity to generate employment while promoting environmental sustainability. The International Labour Organization (ILO) defines green jobs as positions that contribute to preserving or restoring environmental quality, including in sectors such as renewable energy, energy efficiency, and sustainable agriculture (ILO, 2015). This is grounded in sustainable development theory, which seeks the integration of environmental, economic, and social dimensions.

Ecological modernization theory provides additional grounding, suggesting that technological innovation and environmental reform can drive economic development without degrading ecological systems (Mol & Sonnenfeld, 2000). Within this framework, renewable energy infrastructure is seen as both a solution to climate change and a catalyst for employment.

The ILO's Decent Work Agenda emphasizes the importance of fair labor standards in green transitions. It frames decent work around four strategic pillars: employment creation, rights at work, social protection, and social dialogue (ILO, 2013). This is particularly relevant in labor-intensive infrastructure development in the Global South, where green jobs must also address informality, job precarity, and gender inequities (UNEP, 2008).

Empirical literature

Globally, renewable energy is emerging as a major source of employment. According to the International Renewable Energy Agency (IRENA, 2023), the sector supported over 13.7 million jobs worldwide in 2022, with solar photovoltaic and wind energy leading in job creation. However, empirical studies reveal significant regional disparities. In many African contexts, the growth of green jobs is hindered by a lack of skills development, poor enforcement of labor standards, and limited local value chain integration (Hafner et al., 2020).

The Ethiopian energy sector, dominated by hydropower, is undergoing a shift towards diversified renewable sources such as wind and solar (EEP, 2023). Projects like the Ashegoda Wind Farm and the Metehara Solar Plant have created short-term employment during construction, but concerns remain over job sustainability, local hiring practices, and the enforcement of occupational safety regulations (Guta et al., 2020).

An assessment by the Ethiopian Ministry of Labour and Skills (2022) found that many infrastructure projects in the energy sector suffer from irregular contracts, wage inconsistencies, and limited participation of women and marginalized communities. Nevertheless, donor-funded initiatives-such as the World Bank's support for decentralized solar mini-grids-have demonstrated the potential for more inclusive and regulated labor practices when labor conditions are integrated from the project design phase (World Bank, 2022).

Identified gaps

Despite Ethiopia's progress in expanding its renewable energy portfolio, empirical research on job quality, gender participation, and long-term employment outcomes remains limited. There is also a lack of disaggregated data to assess how "green" jobs are distributed and the extent to which they meet decent work criteria. Further research is required to understand the lifecycle of employment in green infrastructure projects, especially in the post-construction operation and maintenance phases.

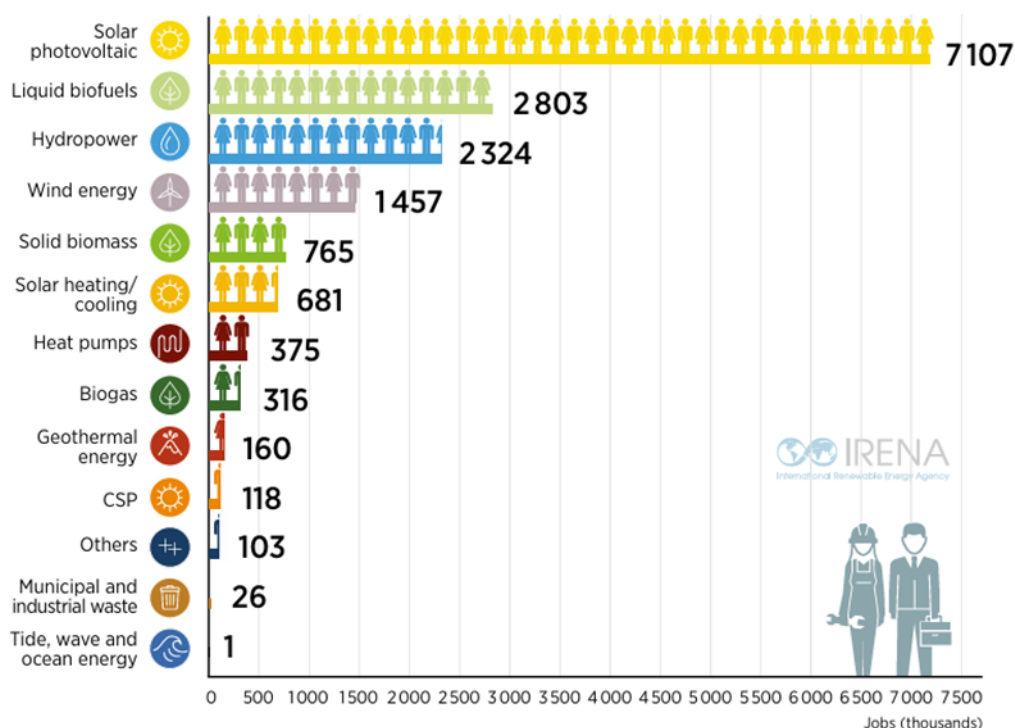
Findings

Grand feature in green job creation

As indicated below on Figure 4, the renewable energy sector saw substantial growth in 2023, with global renewable energy jobs reaching 16.2 million, up from 13.7 million in 2022 (IRENA & ILO, 2024). China alone accounted for 7.4 million jobs, or 46% of the global total. Other key regions include the European Union (EU) with 1.8 million jobs, Brazil with 1.6 million, and the United States and India each with slightly more than 1 million jobs (International Renewable Energy Agency and International Labour Organization, 2024).

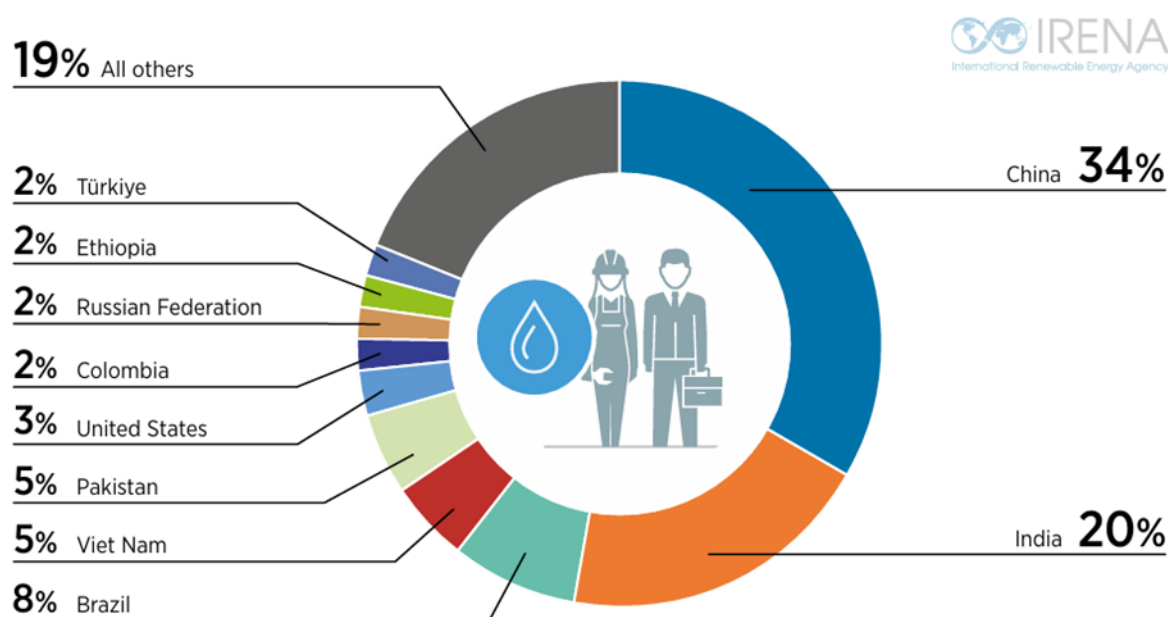
There were 2.3 million direct jobs in hydropower in 2023. As indicated in Figure 2 below, Ethiopia contributed 2% of the global hydropower plant-generated jobs (International Renewable Energy Agency and International Labour Organization, 2024).

► **Figure 1. Global renewable energy employment by technology. 2023**



Source: IRENA, 2024.

Ethiopian electric power generating plant is 100 % depends on renewable energy. In Ethiopia there are 16 hydro power generating plants, 3 wind power generating plants and 1 geothermal power generating plants.

► **Figure 2. Hydro power Generated at Global Level**

Source: IRENA, 2024.

► **Table 1. Hydropower Plants in Ethiopia**

Hydropower Plant	Capacity (MW)
Grand Ethiopian Renaissance Dam	6,450
Gibe III Dam	1,870
Tana Beles Hydroelectric Power Station	460
Fincha Hydroelectric Power Station	134
Koka Hydroelectric Power Station	43.2
Gilgel Gibe I	184
Gilgel Gibe II	420
Koyesha	2160
Tekeze Hydroelectric Power Station	300
Melkawakana	153
Tis-Abay I	11.4
Tis-Abay II	73
Awash II	32
Awash II	32
Genale Dawa	254
Fincha Amerti Neshe	97

This list includes both operational and under-construction hydropower plants. The Grand Ethiopian Renaissance Dam (GERO) is the largest, with a capacity of 6,450 MW (see Fig. 3 below). The second-largest hydropower plant in Ethiopia is Koyesha, as indicated in Fig. 4.

Other notable facilities include Gibe III (1,870 MW), Tana Beles (460 MW), and Gilgel Gibe II (420 MW). These plants make a substantial contribution to Ethiopia's hydropower generation capacity and are designed to positively impact both society and the surrounding environment.

► Fig 3. The Grand Ethiopian Renaissance Dam (GERD)



► Fig 4. The Koyesha Dam



Ethiopia is actively developing its geothermal energy sector, with several projects underway to harness the country's significant geothermal potential. Here's an overview of the major geothermal power plants and projects in Ethiopia.

► **Table 2. Geothermal Power Plants in Ethiopia**

Geothermal power plant	Installed capacity	Status	Notes
Aluto-Langano Geothermal Plant	7.3MW	Operational (limited)	Ethiopia's first geothermal power station, commissioned in 1998. Initially had a capacity of 8.5 MW, but currently operates at approximately 7.3 MW due to aging infrastructure. Plans are in place to expand capacity to 70-75 MW.
Tulu Moya Geothermal Project	50MW (Phase 1)	Under construction	
Corbetti Geothermal Project	500MW (Phase 1)	Under construction	Located in the Corbetti Caldera near Hawassa. Phase 1 aims for 10 MW, with plans to expand to 500 MW, and potentially up to 1,000 MW by 2030.

The geothermal plant projects are part of Ethiopia's broader strategy to diversify its energy mix and reduce reliance on hydropower, especially during periods of drought. The country aims to implement up to 17 geothermal projects, targeting a total installed capacity of 35,000 MW by 2037.

► **Fig 5. Aluto langano geothermal plant**

Ethiopia has made significant strides in harnessing wind energy, contributing to its renewable energy portfolio. Here's an overview of the major operational wind farms and planned projects:

Wind Farm	Installed Capacity (MW)	Status	Commissioning Year
Adama I	51	Operational	2012
Ashegoda	120	Operational	2012
Adama II	153	Operational	2014
Aysha II	120	Operational	2022
Assela I	100	Under Construction	-

Ethiopia's wind power generation capacity has high potential, with the operational plants contributing significantly to the national grid.

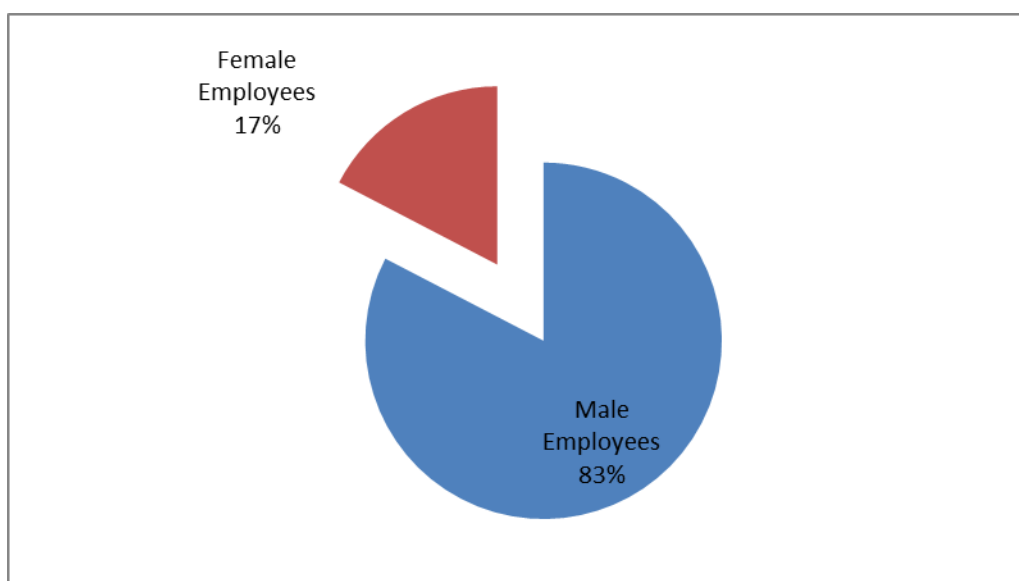
► **Figure 6. Adama Wind Power Plant**

To transport the generated power from the above mentioned plants EEP manages a transmission line lengthen more than 20,000 km with respective kilovolts (KV) that ranges from 132 KV to 500 KV. EEP manages a total of 192 Substations, all over the country.

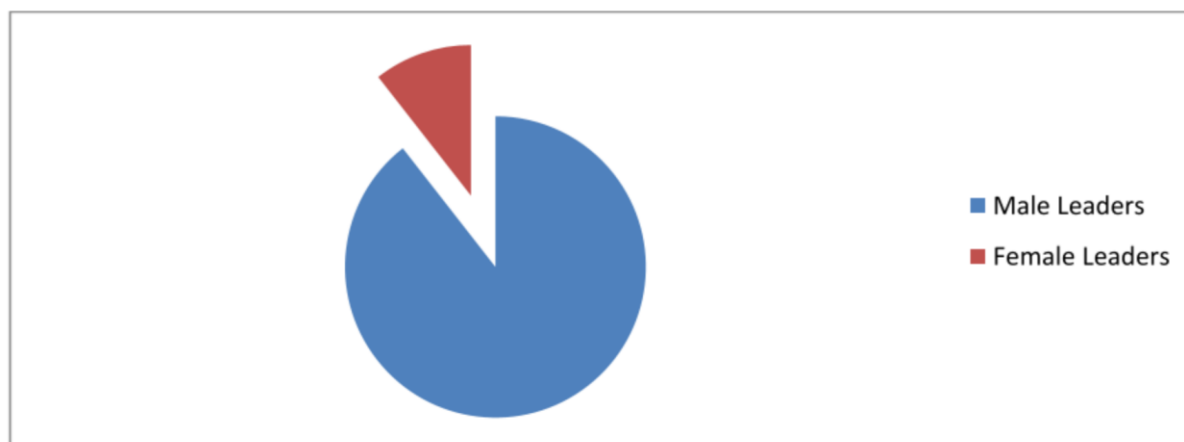
► **Figure 7. High voltage(500 KV) transmission line in Ethiopia.**

Ethiopia has significantly expanded its electricity export activities, leveraging its vast renewable energy resources- particularly hydropower- to enhance regional integration and generate foreign revenue. Currently, Ethiopia exports power to Djibouti, Sudan, Kenya, and Tanzania, aligning with its vision to become the renewable energy hub of East Africa. At present, Ethiopia exports approximately 95 MW of electricity to its neighboring countries, fostering regional integration and contributing to peace and sustainable development.

As indicated in chart 1, to construct, operate, maintain and administratively support the above mentioned power plants, transmission line and substation, currently, EEP has created a total of 8329 permanent job positions, among which 1447 jobs are taken by female employees. Currently EEP has a total of 2000 jobs in a contract bases (Male, 1700, Female 300. Moreover, EEP intermittently creates more than 10,000 daily laborer job positions in its renewable energy infrastructures.

► **Chart 1. EEP permanent staff gender composition**

In Ethiopian Electric Power there are 550 leadership positions with a role of leading the renewable energy infrastructure construction, operation and maintenance. As indicated in the chart below, the total composition of female took nearly 11 %.



Recently created permanent-direct green jobs

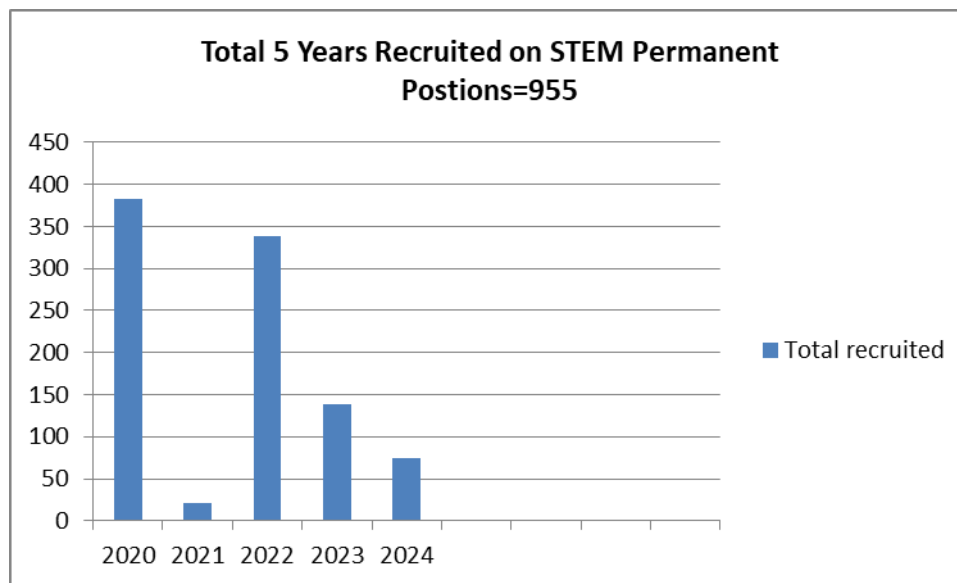
As indicated below in Table 3, EEP created a total of 894 permanent-direct green jobs in the recent three years.

► **Table 3. Total permanent direct green jobs created from 2023-2025 in EEP**

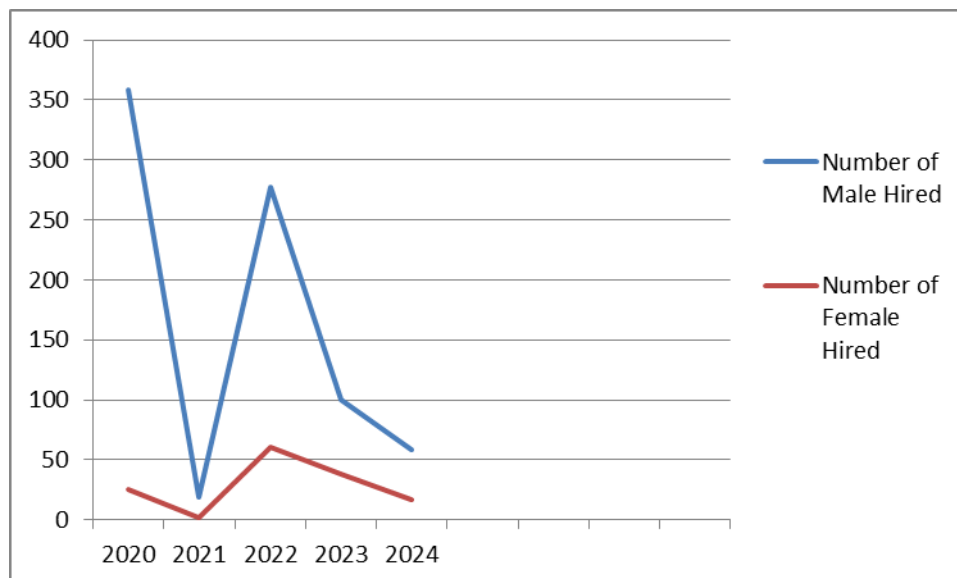
Year	Male Hired	Female Hired	% of Female Hired	Total
2023	366	97	0.21	463
2024	191	62	0.25	253
2025	124	54	0.30	178
Total	681	213	0.31	894

As indicated in Graph 1, Ethiopian Electric Power (EEP) has significantly contributed to creating employment opportunities in the green energy sector. Over the past five years, EEP has provided a direct-permanent employment for more than 955 youths in the STEM areas. Among these 143 green jobs are taken by female employees. These individuals are employed in various roles, including construction, operation, and maintenance for hydropower plants, transmission lines, and substations. As indicated in Graph 2, there is a steady decrease in the newly hired STEM positions of female.

► **Graph 1. Permanent job positions created on STEM fields in EEP for the past 5 years**



► **Graph 2. Gender composition on the newly hired STEM positions**



Fair labor practices in Ethiopia's renewable energy sector

Ethiopian Electric Power has made strides in ensuring fair labor practices in the hiring and management of green jobs. One of the fundamental policies guiding this practice is the collective agreement signed between EEP and the trade union. This agreement serves as a binding framework to guarantee fairness in Human Resources (HR) practices, particularly for women and youth, and to ensure that their rights are protected throughout their employment.

A critical aspect of the collective agreement is the inclusion of a Women and Youth Department during the negotiation process. This department plays an essential role in ensuring that the concerns of these social groups are adequately addressed. The department's involvement ensures that the hiring practices and work conditions are inclusive, equitable, and align with national policies on gender equality and youth empowerment (Federal Democratic Republic of Ethiopia, 2020).

Moreover, EEP has instituted a comprehensive fair labor practice policy, which outlines its commitment to diversity, equality, and inclusion in the workforce. Some of the key principles of this policy include: equal job opportunity, Grievance procedure to assure transparency and accountability, affirmative action and creation of conducive work environment for female employees. Let us look in a more detailed way each fair labor practices.

Equal employment opportunity at EEP

Ethiopian Electric Power (EEP) is committed to providing equal job opportunities for all individuals, regardless of gender, age, or background. This commitment is embedded in the organization's policies and operational practices, which promote non-discriminatory hiring and career development for both men and women.

To ensure equal employment opportunities, EEP follows a standardized job announcement and recruitment process whenever a position becomes vacant-whether for internal promotion or external hiring. Vacant positions are advertised through public media channels, EEP's official social media platforms, and other appropriate print or electronic outlets, ensuring broad accessibility and transparency.

Each job vacancy is accompanied by a detailed person specification that outlines the required qualifications and competencies necessary for the role. These criteria are clearly stated in the vacancy announcement to guide applicants.

EEP applies a standardized selection process, which includes written examinations and interviews. All applicants are informed of their assessment scores, reinforcing the principles of transparency and accountability. Furthermore, to ensure fairness and minimize bias, the entire selection process is carried out by a designated committee.

Grievance procedures

EEP has established a clear and transparent grievance procedure to address any concerns or complaints related to labor practices. This procedure is accessible to all employees, ensuring that any issues related to discrimination, unfair treatment, or workplace conditions are resolved in a fair and timely manner. The grievance mechanism allows both women and youth to raise concerns and seek redress, promoting a healthy and supportive work environment.

Affirmative action for female employees

EEP has implemented an affirmative action policy to enhance the inclusion of women in its workforce, particularly in recruitment and promotion processes. Under this initiative, 30% of qualified female applicants who meet the minimum hiring criteria are directly considered for recruitment. This policy has contributed significantly to improving the gender composition of the organization. Currently, women constitute approximately 17.37% of the total workforce, with 1,447 female employees across various departments. Among EEP's 615 leadership positions,

63 (or 11%) are held by women—a notable step toward improving gender representation in leadership roles within the green energy sector.

In terms of internal career progression, a total of 2,034 employees were promoted or transferred to higher-responsibility roles they had expressed interest in. Of these, women accounted for 19%, reflecting the positive influence of EEP's affirmative action, which also applies a 30% inclusion target in promotion vacancies. While these efforts have yielded measurable progress, challenges remain.

Despite the policy, the number of female applicants—both for internal promotions and external vacancies—continues to be low. This limits the pool of capable female candidates, particularly for science, technology, engineering, and mathematics (STEM) positions, where women's participation remains critically underrepresented. Addressing this gap will require complementary strategies such as targeted capacity building, outreach, and mentorship initiatives.

► **Table 4. Internally promoted/transferred employees**

Year	Male Promoted	Female Promoted	% of Female Promoted	Total
2023	741	133	0.15	874
2024	572	105	0.16	677
2025	402	84	0.17	486
Total	1715	322	0.19	2037

Creating conducive work environment for female employees

EEP governance structure for female employees advocacy

EEP has established a dedicated Women and Social Affairs Department, tasked with coordinating initiatives related to gender inclusion and ensuring that the concerns of women employees are adequately addressed. Given the scale and geographic spread of EEP's operations—spanning nearly every region of the country—it is not feasible to manage this function centrally. To address this, the organization has appointed gender focal representatives at each operational region and power plant. These representatives are responsible for implementing and monitoring gender-related activities at the local level.

EEP also has a standardized policy and set of operational procedures that guide the integration of gender perspectives into its work environment. These policies aim to create a supportive atmosphere that enhances the productivity and well-being of women employees. In addition, gender issues are regularly reviewed at the highest levels of leadership, demonstrating the organization's commitment to institutionalizing gender equity across all tiers of operation.

Support girls in their primary school

EEP has established and continues to finance primary schools at several of its power plants and major project sites. While these schools primarily serve the children of EEP employees, they are also open to children from the surrounding communities. This initiative reflects EEP's commitment to fulfilling its social responsibility and contributing to local development.

Importantly, these schools provide accessible education for girls who might otherwise be unable to attend school due to social or economic barriers, particularly the challenge of traveling long distances. The schools operate free of charge, helping to reduce educational inequality. Additionally, EEP employees—especially mothers—benefit from the psychological reassurance of having their children enrolled in safe, nearby schools, allowing them to focus more effectively on their work responsibilities. From Fig. 8 to Fig. 12, a pictorial depiction of those schools in Melkewakena and Gibe III hydropower plants are presented.

► **Figure 8. Gibe 3 EEP Sponsored Primary School**



► **Figure 9. Melkawakena HPP- EEP Sponsored Primary School**



► **Figure 10. Female students at Melkawakena HPP- EEP Sponsored Primary School**



► **Figure 11. Girls attending class at Melkawakena HPP- EEP Sponsored Primary School**► **Figure 12. A female student whose parents work at Melka Wakena Hydropower Plant, attending an EEP-sponsored primary school.**

Maternity Support

EEP provides maternity leave in accordance with the Ethiopian Labor Proclamation. In addition to meeting these minimum legal requirements, EEP offers a range of supportive measures to further assist its employees during maternity. These include coverage of medical expenses related to pregnancy and childbirth, as well as flexible work shift arrangements tailored to accommodate the needs of new mothers. These initiatives reflect EEP's commitment to fostering a supportive and inclusive workplace for women.

EEP has established daycare centers at various workplaces to support its female employees. These facilities allow mothers to focus on their responsibilities without the added concern of their children's well-being during working hours. The centers also provide mothers with the opportunity to breastfeed their children during the day, contributing to both child health and maternal comfort.

Recent feedback from female employees has been overwhelmingly positive, with many commending the initiative for ensuring their children's safety and creating a more supportive and inclusive work environment. A pictorial depiction of the day care centers indicated in Fig. 13 to Fig. 15, at the head quarter and In Awash Hydro power plant.

► **Figure 13. Child care center at EEP's Head Quarter**► **Figure 14. Child care center at Awash HPP**► **Figure 15. Child care center at Awash HPP**

EEP Female Employees Scholarship

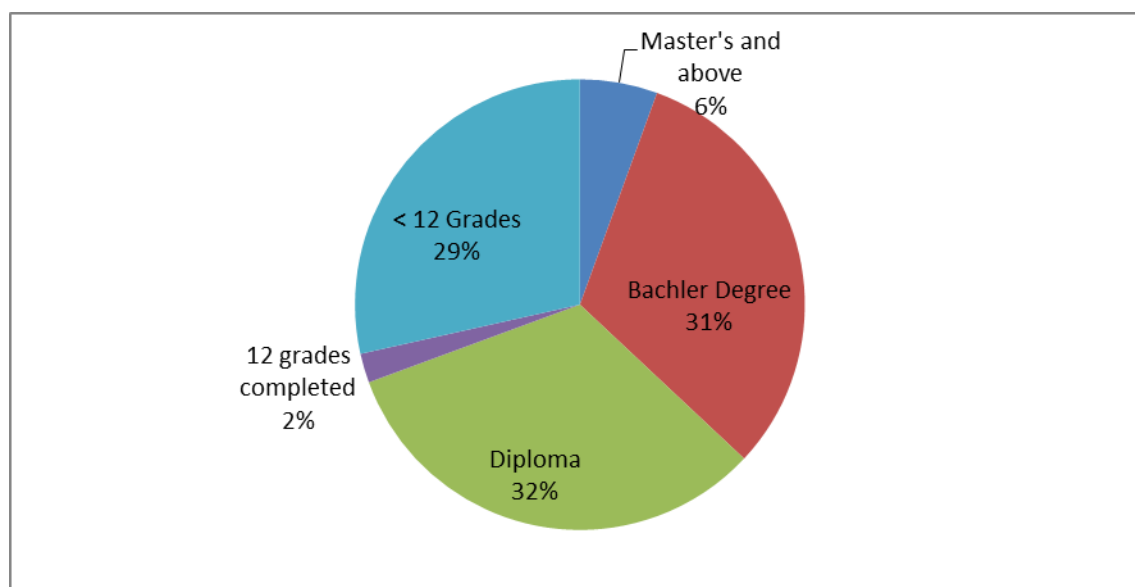
EEP has undertaken several strategic initiatives to enhance the educational qualifications of its workforce, with a particular focus on Science, Technology, Engineering, and Mathematics

{STEM) disciplines. Currently, six employees are pursuing postgraduate studies-both locally and internationally-on a full-time basis with EEP's financial and institutional support.

To further promote gender inclusion in technical fields, EEP launched the EEP Female Employees' Scholarship, an annual program that provides tuition support for up to 55 female staff members. Although the program has been available for the past three years, participation remains low, highlighting the need for greater outreach, mentorship, and institutional encouragement.

As shown in the figure below, only 6% of EEP's female employees currently hold a postgraduate degree. While this represents an improvement compared to previous years, the figure remains modest given the size of the female workforce. In response, EEP is planning to launch a tailored postgraduate program in collaboration with Addis Ababa University, focusing on power engineering and power economics. This initiative would be able to create a pipeline for skilled female professionals in leadership and technical roles within the renewable energy sector.

EEP female employees' education profile



Female Leaders Development

EEP implements a Female Leadership Development Program, conducted twice annually, with the aim of strengthening the leadership capabilities of its female leaders. This program is designed not only to build critical leadership skills but also to serve as a platform for open dialogue. It enables female leaders to share experiences and discuss the unique challenges they encounter in their leadership roles. By fostering peer learning and mentorship, the program contributes to empowering women leaders and enhancing gender representation in managerial and decision-making positions across the organization.

► Figure 16. EEP leadership development program



Female Employees Training

EEP provides a six-month pre-service training program designed to equip Technical and Vocational Education and Training (TVET) graduates with the core competencies required in the power sector. These trainees are considered the backbone of EEP's operational workforce, as they are primarily assigned to operate power plants and substations. Notably, the participation of female trainees in this program is higher than in STEM-based BSc programs, highlighting a relatively stronger representation of women at the technician level. As shown in Figure 17, a significant number of female electromechanical pre-service trainees have graduated and joined the workforce as technicians.

In recent years, behavioural training modules have also been integrated into the curriculum. These additions aim to strengthen the confidence and adaptability of female employees, enabling them to better handle professional challenges and advance in their careers.

Previously, EEP provides dormitory for its electromechanical trainees, but not now. Female trainees have repeatedly requested for dormitory service. Considering that, EEP has crafted a new project with the support of the French development bank (AFD) to construct a training facility that would accommodate dormitories, especially that would address female employees request.

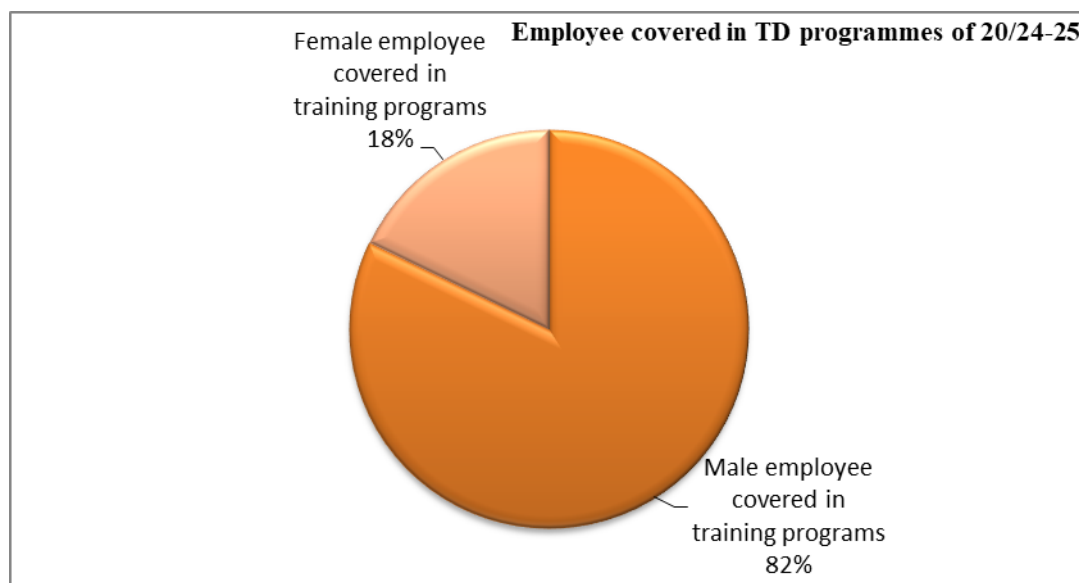
► **Figure 17. EEP Electro-mechanical graduates**



In-service Training

EEP actively encourages its female employees to participate in in-service training programs and makes a conscious effort to ensure gender representation in its capacity-building initiatives. In the first nine months of the 2024/25 fiscal year, a total of 2,091 employees took part in various training programs, of which 373 were female. This reflects a continuing upward trend in female participation compared to previous years.

In the 2023/24 fiscal year, 2,160 employees received in-service training across 105 training programs, with female participants accounting for 373 of the total. Notably, the same number of female employees had already participated in training within the first nine months of 2024/25, indicating the potential for a higher total by the end of the fiscal year. This sustained progress demonstrates EEP's commitment to promoting gender inclusion in professional development efforts.



Internship

EEP offers an internship program designed to enhance the employability of students pursuing careers in the power sector. Each year, approximately 300 students from across the country participate in this program. The internship provides hands-on exposure to various aspects of

EEP's operations, including power generation, transmission, substation construction, operation and maintenance, as well as administrative support functions.

Despite EEP's encouragement for greater female participation, only about 12% to 15% of the interns are female, highlighting a gender gap in participation. EEP actively engages with universities to encourage the nomination of more female students; however, many institutions cite the low enrolment of women in STEM fields as a key challenge in achieving greater gender balance.

Discussion

The global transition toward green energy is reshaping labor markets, offering opportunities for sustainable employment and socio-economic transformation. The International Renewable Energy Agency (IRENA) and the International Labour Organization (ILO) report that renewable energy jobs reached 16.2 million globally in 2023, up from 13.7 million in 2022, with significant contributions from hydropower, solar, wind, and geothermal energy (IRENA & ILO, 2024). Ethiopia, aiming to become the renewable energy hub of East Africa, is aligning its energy expansion strategy with green job creation initiatives.

Green jobs, as defined by ILO and IRENA, are those that reduce environmental impact and contribute to a low-carbon economy while improving energy access, livelihoods, and employment equity (IRENA, 2021). These include technical roles like hydropower technicians, solar PV installers, wind turbine engineers, and geothermal plant operators, as well as indirect roles in management, research, and policymaking. In Ethiopia, with its electricity generation nearly 100% dependent on renewable sources, the renewable energy sector represents a crucial avenue for sustainable and inclusive job creation.

Green jobs in the Ethiopian renewable energy sector

Globally, green jobs have emerged as a cornerstone of climate and development strategies. According to IRENA & ILO (2024), China holds 46% of global renewable energy jobs, followed by the EU, Brazil, the United States, and India. In the hydropower sub-sector alone, 2.3 million jobs were recorded worldwide in 2023. Ethiopia contributes 2% of this total, a remarkable feat for a low-income country.

At the national level, Ethiopia has aggressively pursued hydropower development through projects like the Grand Ethiopian Renaissance Dam (GERD), Koysha, and Gibe III. Wind and geothermal power plants, including Adama I & II, Ashegoda, and Aluto-Langano, further diversify the energy mix. This expansion has been accompanied by employment generation: over 8,000 permanent jobs and 10,000+ short-term positions, many in infrastructure construction, operation, and maintenance. These developments have anchored the role of EEP (Ethiopian Electric Power) as a key actor in advancing labor-intensive, low-carbon infrastructure.

Gender and youth inclusion

Although green jobs offer inclusive development potential, disparities remain. Globally, women represent about 32% of the renewable energy workforce (IRENA, 2021), but their presence is significantly lower in Ethiopia's energy sector. EEP has taken affirmative steps-such as reserving 30% of qualified positions for women, establishing female leadership development initiatives, and supporting female education through scholarships-to address structural inequalities. Still, only 11% of leadership roles in EEP are occupied by women, and fewer than 150 of over 950 STEM positions created in the last five years were filled by women.

Youth, while making up a large segment of Ethiopia's population, face barriers such as skills mismatch, limited access to technical training, and weak pathways into stable employment. EEP's internship programs and school sponsorships are part of a growing effort to address these challenges.

Fair labor practices and decent work

Green jobs must not only be environmentally sustainable but also socially just. EEP has institutionalized fair labor practices through collective agreements with trade unions, grievance redress mechanisms, and gender-responsive hiring policies. Its Fair Labor Policy ensures non-discriminatory recruitment, support for HIV-affected workers, and provisions for gender inclusion in policy formulation. These measures align with Ethiopia's broader national development plans.

The just transition framework

The Just Transition Guidelines developed by the International Labour Organization (ILO) provide an essential policy framework for navigating the shift to a green economy in a socially responsible way (ILO, 2015). A just transition ensures that labor policies account for both environmental and social sustainability by focusing on:

- Creation of decent jobs in green sectors;
- Worker protection, including fair wages and occupational safety;
- Social protection measures for displaced workers;
- Inclusion of women, youth, and marginalized groups;
- Social dialogue and participation of stakeholders in shaping transition strategies.

In the Ethiopian context, where employment equity challenges persist, the Just Transition Framework offers a roadmap for integrating climate action with labor rights. EEP's current initiatives-such as gender-focused training, affirmative hiring, and stakeholder engagement-can be viewed as early steps toward operationalizing this framework. However, further institutionalization is needed to scale impact and ensure that no worker is left behind in the renewable energy transition.

Conclusion

Ethiopia stands at a pivotal moment where its renewable energy ambitions can be leveraged not only to meet electrification goals but also to catalyze inclusive, decent employment opportunities. The country's significant investment in hydropower, solar, wind, and geothermal infrastructure-led primarily by Ethiopian Electric Power (EEP)-has already created thousands of green jobs. Yet, the distribution and quality of these jobs still reveal gaps in equity, participation, and sustainability, especially for women and youth.

While EEP has demonstrated notable progress through fair labor policies, gender-sensitive hiring practices, and community-oriented programs, much more is needed to align Ethiopia's energy transition with the ILO's Just Transition principles-ensuring that the move toward a green economy leaves no one behind. Challenges related to gender disparities, skill mismatches, and fair working conditions remain persistent and demand a coordinated, cross-sectoral response.

Going forward, maximizing the potential of the renewable energy sector will require proactive labor policies, targeted capacity-building, and meaningful inclusion mechanisms. A successful just transition in Ethiopia is not only an environmental imperative-it is a socio-economic necessity. By centering fairness, participation, and decent work in its green infrastructure rollout, Ethiopia can set a regional example for labor-intensive, inclusive, and sustainable development.

Recommendations

For government and policymakers (MoWIE, MoLS, MoF, Parliament):

- i. Adopt the ILO Just Transition Framework into national labor and climate policy, ensuring integration of environmental, social, and economic priorities.
- ii. Develop a National Green Jobs Strategy in collaboration with labor, environment, and education sectors.
- iii. Introduce incentives for private sector participation in skills development, local hiring, and inclusive employment in renewable energy.

For Ethiopian Electric Power (EEP) and public utilities:

- i. Institutionalize affirmative action in hiring, training, and promotion-particularly for women and youth in STEM and leadership.
- ii. Establish a dedicated Gender and Inclusion Unit with mandate, budget, and leadership backing.
- iii. Regularly publish labor audits and disaggregated employment reports, increasing transparency and public trust.

For development partners and donor agencies (e.g., ILO, IRENA, World Bank, AIDB):

- i. Align energy financing and infrastructure support with explicit job creation, gender equity, and labor rights indicators.
- ii. Provide technical and financial support to scale up TVET and STEM education for green energy sectors.
- iii. Support monitoring systems that track the socio-economic impact of renewable energy investments.

For labor unions and workers' associations:

- i. Ensure collective bargaining agreements fully address fair wages, occupational safety, job security, and grievance mechanisms.
- ii. Actively represent female and young workers, and ensure their inclusion in labor governance and negotiations.
- iii. Collaborate with EEP and the government on workplace trainings and legal literacy programs.

For the private sector (contractors, suppliers, energy startups):

- i. Implement decent work standards in project development and operations, including safety, non-discrimination, and fair compensation.
- ii. Partner with training institutions to offer internships, apprenticeships, and local hiring commitments.
- iii. Incorporate Environmental, Social, and Governance (ESG) criteria in all energy investments and contracts.

For civil society and academia:

- i. Conduct independent research and impact assessments on green job quality, gender dynamics, and labor inclusion in the sector.
- ii. Raise awareness at the community level on employment rights, vocational opportunities, and gender equity in energy projects.
- iii. Foster dialogue platforms for inclusive policy development involving youth, women, and marginalized groups.

For regional partners and REC institutions (e.g., IGAD, EAPP):

- i. Align cross-border energy trade with local job creation and labor mobility protocols.
- ii. Share best practices on inclusive green job frameworks and skills certification for regional labor integration.

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► Leveraging Employment Impact Assessments to maximize the social impact of infrastructure investments

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Abstract

Many investments (large and small) target infrastructure sectors all over the world, including in Africa. Directly and indirectly, intentionally and unintentionally, the construction and operation of such infrastructure has social impacts. At the same time, infrastructure investments are still frequently criticized for their lack of positive social impact. Simply increasing investments is not enough to ensure the creation of more and better jobs through those investments.

Employment Impact Assessments (EmpIAs) – as undertaken by the International Labour Organization (ILO) and other actors – offer key insights into how to strengthen such positive social impacts. Above all, this concerns the creation of more and better jobs that ILO EmpIA work is targeting. Several methods are available to measure quantitatively the jobs impact of infrastructure investments. They also point out qualitative issues that have already materialized or may do so in the future. EmpIAs therefore provide insights that can be leveraged to enhance the jobs impact of investments.

This paper outlines the basic principles, purpose and scope of Employment Impact Assessment as undertaken by the ILO as well as the commonly used tools and methodologies, including input-output-based multipliers, advanced modelling, geographic information systems methods, and surveys (of workers and companies during construction). The paper also showcases several examples of assessments undertaken recently as part of the ILO's STRENGTHEN2 project.

Employment impact assessments are generating insights leading to recommendations on how to enhance the positive employment effects and to mitigate less-desirable features of investments and policies. Knowledge of entry points to enhance the social impacts of infrastructure construction and operation are crucial for decision makers to fully leverage the potential of these investments. EmpIAs provide this information. Frequent recommendations include the consideration of specific measures to address biases against women and youth in the directly or indirectly created jobs, further analysis on inputs to be sourced domestically in order to retain more of the value added (and therefore job creation) in a given country, and assessing the suitability of employment-intensive approaches as these place job creation at the heart of infrastructure construction. The paper highlights some of these challenges and suggests mitigation measures that are supported by rational analytical works.

Finally, the paper outlines the institutional capacity required at the national and sectoral levels in order to systematically apply EmpIA to guide the decision making on major government spending, particularly on infrastructure, and to put in place processes and other organizational arrangements that ensure greater impact in terms of creating more and better jobs, skills and businesses opportunities. The paper cites some examples to showcase where this already takes place on the continent.

Introduction

Many investments (large and small) target infrastructure sectors all over the world, including in Africa. Directly and indirectly, intentionally and unintentionally, the construction and operation of such infrastructure has social impacts. At the same time, infrastructure investments are still frequently criticized for their lack of positive social impact. Employment Impact Assessments (EmpIAs) – as undertaken by ILO and other actors – offer key insights into how to strengthen such positive social impacts. Above all, this concerns the creation of more and better jobs that ILO EmpIA work is targeting.

EmpIAs can be understood as a systematic process to measure the employment effects (or their potential if conducted *ex ante*) of policies and investments; considering quantitative effects, like simply the number of jobs created or affected, and qualitative effects, like the types and quality of jobs created/affected. Several methods are available to measure quantitatively the jobs impact of infrastructure investments. They also provide insights that can be leveraged to further enhance the jobs impact of investments.

When it comes to employment-intensive approaches, EmpIA can be leveraged in two ways. First, they can estimate or measure the effects of investments that are implemented using employment-intensive approaches. ILO is doing so to report on the employment effects its related projects have had, but it can also be done beforehand to provide information about the effects a planned intervention may have. Second, EmpIA can help make the case for such approaches by showcasing how the effects may differ between an employment-intensive approach and an equipment-intensive approach, applied to the case of a specific set of (infrastructure) assets that should be created.

This paper is meant for a readership of generalists. Specific knowledge of the methodologies or macro-economics is not required. It serves the purpose to describe the general ideas underpinning Employment Impact Assessments: its purpose, principles and scope in the following section, the main methodologies used in section 3, some examples of recently undertaken assessments in section 4, and the challenges faced in conducting the assessments and general recommendations resulting from assessments carried out in the past four years in section 5. Section 6 concludes.

Purpose, principles and scope of Employment Impact Assessment

This paper builds on experiences gathered by the author from work undertaken as part of the International Labour Organization's STRENGTHEN2 project (www.ilo.org/strengthen2), which is a joint initiative with the European Union. The purpose served and principles followed by the assessments undertaken in this context are typical for ILO work in this area.

EmpIA serves the purpose of supporting the creation of more and better jobs: Generally and most frequently, EmpIAs are meant to support evidence-based decision making on investments and policies, aiming to support the creation of more and better jobs. Most important is therefore what comes after an EmpIA: Putting the results and insights gained to good use is the primary goal. ILO is making efforts to channel the findings to relevant decision makers. At the same time, there is usually at least one of two other goals that ILO pursues with an EmpIA: they either serve as concrete examples for future replication by others (national governments, international financial institutions, etc.) and are therefore also integral part of ILO awareness raising and capacity building activities; or they are testing novel methodologies in order to expand the knowledge base and thus the toolbox of EmpIA in the midterm.

Other institutions frequently use EmpIA tools for reporting purposes. Most prominently, international financial institutions (IFIs) report on the development effectiveness of the portfolio of their operations and among multiple other relevant outcome areas by quantitatively estimating their employment effects. More recently, they also start leveraging such methods to inform decisions on investments (many of them in infrastructure); i.e., using EmpIA ex ante, before implementation starts.

Two principles of ILO EmpIA work are worth mentioning: First, ILO is taking a flexible approach when it comes to the methodologies used. For one this means that the specific context and nature of an investment as well as the effects that are meant to be captured determine which methodologies are suitable and useful. It also means that frequently several methodologies are applied in one assessment. Second, quantity and quality matter: Employment impacts have not only a quantitative side, but also a multi-faceted qualitative one. ILO EmpIAs are looking at both, trying to paint a differentiated picture of employment effects.

The purpose of an EmpIA largely determines when it is undertaken relative to the life cycle of an investment project. Typical examples of assessments of an investment project are: Ex ante, the estimated employment effects provide information that can be taken into account in decisions on whether to implement a project or if there are measures to further improve it. During implementation, they help monitoring and give ideas for corrective measures. It is also during this phase that the most can be said about the qualitative aspects of employment effects. Ex post, the full actual impact can be measured, and findings will serve a learning function for future undertakings.

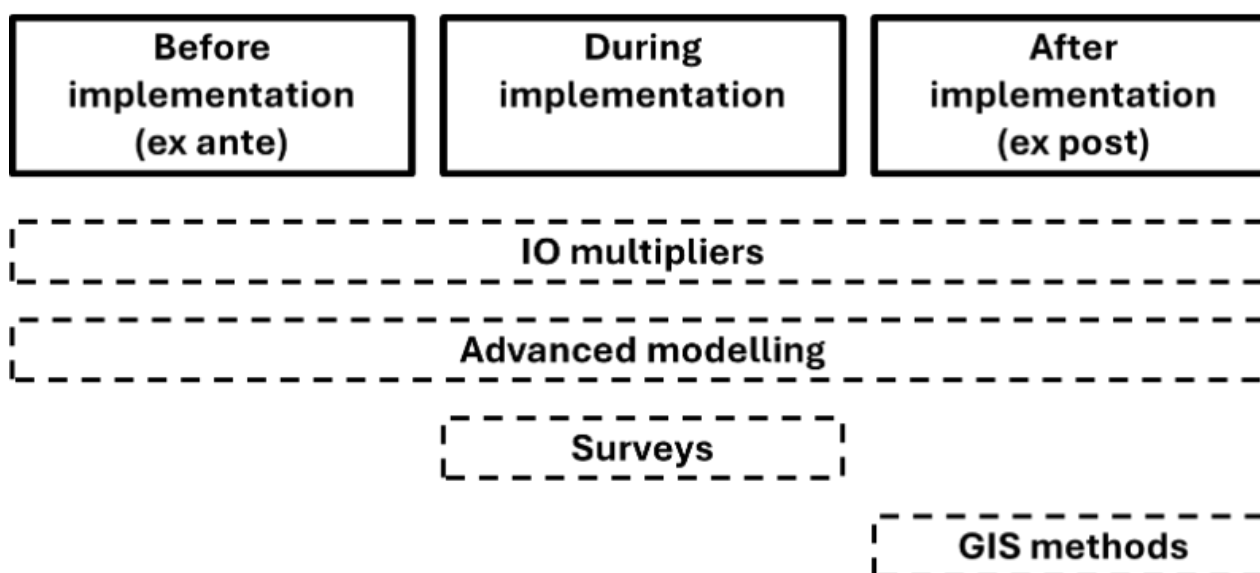
Somewhat related to the positioning along the investment project life cycle is which effects are being measured. The most important differentiation is between the short- to mid-term effects on the one hand and the long-term effects (also called permanent or enabled or capacity effects) on the other. Methodologies, with exceptions, usually concentrate on only one of these two.

Main methodologies used for EmplA

The second edition of the Reference guide on Employment Impact Assessment (1) provides a broader overview of methodologies used by the ILO, particularly the Employment Policy, Job Creation and Livelihoods Department. It covers 12 methodologies, including many that are not further described here, including Growth Accounting Decomposition, Local Multipliers, Sector Identification, Skills Anticipation, Experiments and Quasi-experiments, and Meta Analysis. All of them are being used by the ILO.

This section focuses on four methodologies that are being used to assess investment projects (almost all in infrastructure) as part of the STRENGTHEN2 project, which is the EmplA flagship project of the ILO. The main use of the four featured methodologies along the life cycle of an investment project are visualized in Figure 1.

► **Figure 1. Primary use of the main methodologies used by the STRENGTHEN2 project.**



Source: Own elaboration.

Multipliers based on input-output tables or social accounting matrices (IO / SAM multipliers) (2) (3): This methodology may be called the “workhorse” of EmplA when it comes to investment projects. It can be applied throughout the investment project life cycle (i.e., ex ante, during, or ex post). Many institutions like IFIs use them to describe the “jobs created” or “jobs supported” as a result of these investments. Working with IFIs and national stakeholders, the ILO has used them in recent assessments extensively as well. Based mostly on national accounts data; input-output tables (IOTs) and social accounting matrices (SAMs) provide a snapshot of the economic interactions between different sectors and actors within an economy. Based on them, estimations can be done of how a change in one sector impacts all other sectors.

They generally differentiate direct effects (in the sector where the investment takes place), indirect effects (along the supply chain) and induced effects (from spending of incomes (mostly salaries and wages) generated from direct and indirect effects). This methodology has the advantage that its level of sophistication is limited and therefore transparent and can be used by many, and that the required data is available for most countries. It comes with clear limitations as well: building its estimations on a static image of an economy, it does not allow for much dynamism, which would for instance happen if a new industry emerges in an economy (structural change). It is also prone to overestimation of effects as for instance price effects (e.g. high demand for inputs leading to price rises and substitution effects) are not taken into account. It also allows the estimation of short- to mid-term effects only. Taking the example of a road project, this would mean that it only captures the effects during the construction period, but it does not capture the long-term effects resulting from reduced time and cost of transport (the actual main purpose of the investment). The assessment of the *Programme national de développement participative* (PNDP) (see below) illustrates the application of this method.

Advanced modelling (2): To overcome some of the limitations of the multiplier approach, several institutions use more sophisticated macro-economic models like computable general-equilibrium models. The ILO is currently – among others – using the Structural Model for Sustainable Development (SMSD), which is a full-fledged simulation model for country specific studies, useful for policy and scenario simulations. If data, time and capacity allow, advanced modelling is preferable over IO / SAM multipliers (unless the project is small as then there is no advantage of advanced modelling). It can also be used all along the project/policy life cycle (i.e., ex ante, during, or ex post). Like the above multiplier method, it requires at least a social accounting matrix as basis, but is more elaborate in how this is used.

The SMSD can capture short- to mid-term effects, which it generally lumps together as ‘temporary’ and can also estimate the long-term effects (labelled as ‘permanent’). Advantages of the SMSD and other models include that they can be more flexible and produce more realistic results than IO / SAM multiplier analysis. On the downside, such models require the expertise of specialized macroeconomists and also frequently specific software to run them. They are also much less transparent as each model is differently structured and is only fully understood after sometimes very long familiarization. The SMSD has among others been used in the assessments of the Zambian Great North Road Upgrading project (see below).

Geographic information systems (GIS) methods (4): A fairly new approach to measuring employment and other effects. It makes use of data sources that include information on specific locations. This practice is emerging as a sub-set of EmpIA methods, which prominently includes the use of night-time lights and labour force survey data sets. Such methods can only be applied ex post and are (put in simple terms) a before-and-after comparison complemented by econometric efforts to filter out other influences. Night-time lights data allows for a somewhat cruder estimation of employment effects by providing a proxy for economic activity (during day and nighttime) and job creation, and is generally available for anywhere on the globe, so that only information about the location and timing of interventions are needed. For labour force survey data, the situation is different from one country to another, with much more effort needed to gain access due to data privacy issues.

Both kinds of GIS analysis provide information about the long-term effects of an investment in a specific geographical area. It therefore leaves out effects that materialize further away (e.g. economy-wide efficiency gains due to infrastructure like roads having been built). Giving a good idea about the long-term effects in a specific geographical area is also the main advantage of this method. It does require specialized skills though, which are not found everywhere and therefore these approaches are not widespread. The assessment of the National Feeder Roads Programme in Rwanda is a good example of GIS methods being applied (see below).

Surveys: Finally, in many instances, one of the above methods is complemented with specific surveys and structured interviews of implementing companies, workers and beneficiaries. These surveys are the most important tool to gather information on qualitative aspects of the jobs in question. Unlike the other methods, surveys are only feasible after implementation has started, ideally happening during the implementation phase as afterwards information may be hard to access. Typical aspects covered in such surveys are working times, contract duration and other working conditions, wages, or social protection coverage. Several of the examples below included the analysis of survey data that were collected for the assessment in question.

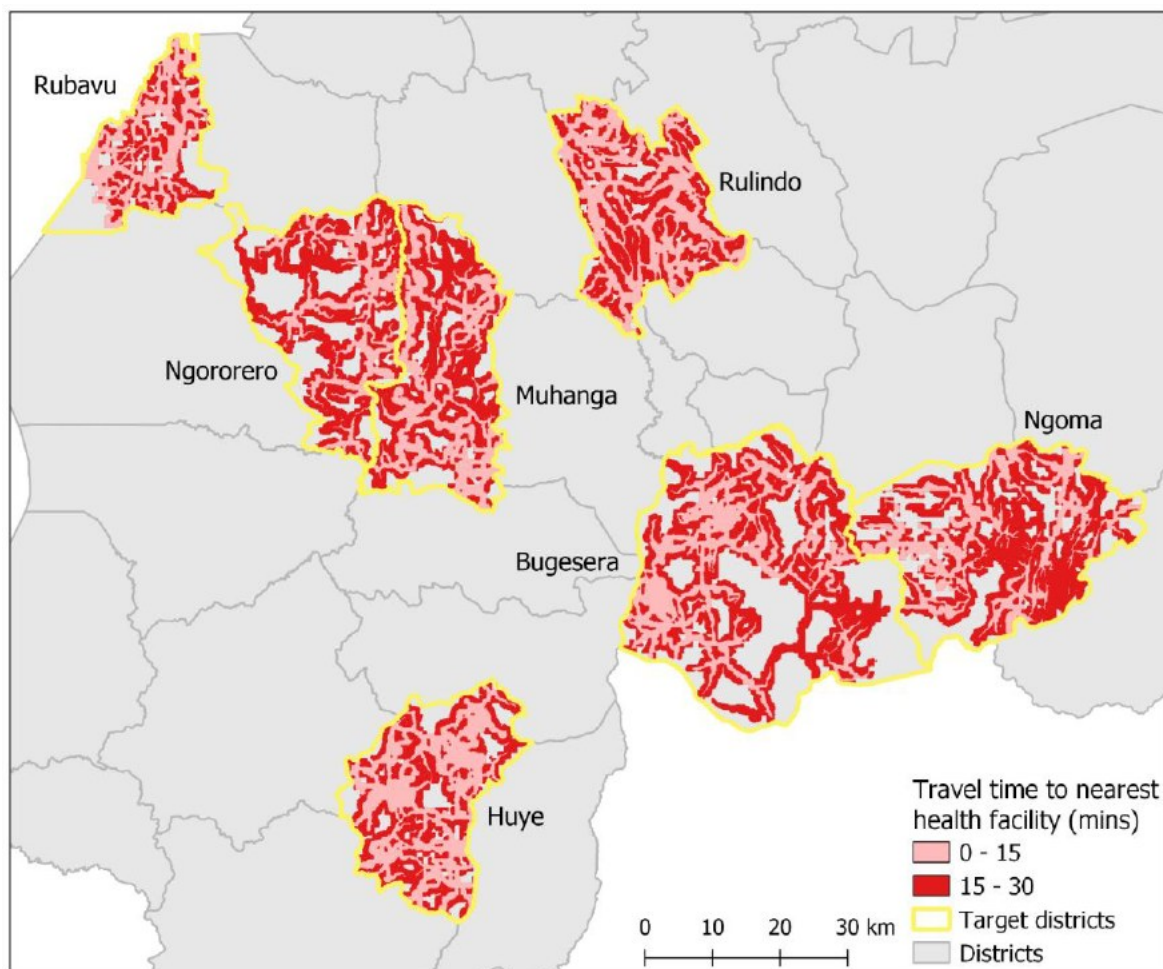
Examples of EmplA initiatives

The **National Feeder Roads Programme (NFRP)** in Rwanda, implemented between 2013 and 2017, aimed at rural economic development and rehabilitated 700 km of rural roads, maintaining another 500 km. The European Union and the Government of Rwanda jointly financed a part of the project worth EUR 40 million.

ILO has used both GIS methods described above to assess this project, documented in two separate reports. The first (5), using the night-time lights approach found that local employment along the road increased by 0.3-0.4 per cent during the four years following project completion, with a 2 km distance to the road being the area in which the population benefited. In the same assessment, a clear improvement of access to health and education facilities could be shown. Figure 2 visualizes the situation after the intervention.

The complementing assessment using labour force survey data (6) provides a detailed analysis of employment, sectoral shifts, wages, and working hours. It found that the overall effect on overall employment was modest. Benefitting areas showed an increase in agricultural and industrial employment, particularly among male workers. However, the overall employment effects remained statistically non-significant, hinting at the full benefits of such infrastructure projects may need longer to materialize. Wages were seen to increase, with male workers seeing the greatest gains, indicating improved productivity and access to higher-income opportunities. Gender disparities were evident in the outcomes of this project as well, with male workers benefiting more, particularly in industrial employment and wages. Also the findings of this assessment point towards the need for targeted interventions to ensure women do equally benefit from rural infrastructure investments.

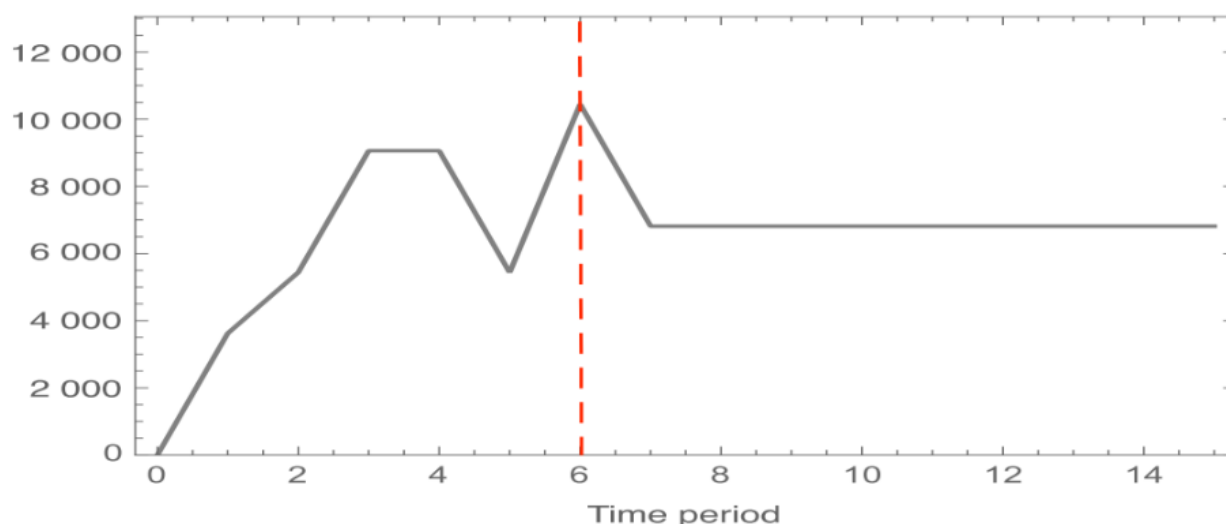
In terms of recommendations, it should not be assumed that the population living more than 2 km from a road are still benefitting; future road construction may be guided by this. The analysis also showed where there are gaps in access to health and education facilities.

► **Figure 2. Travel time to nearest health facility up to 30 minutes away.**

Source: (5): p27.

The **Zambian Great North Road Upgrading project**, at the time of the assessment not yet being implemented but planned to start in 2023 and stretch over four years, aimed at fostering regional integration and boosting economic growth through reduced time and cost of transport along a strategic regional transport corridor. A total of EUR 436 million is planned to be invested within Zambia alone.

The ILO performed an ex-ante EmpIA on the project (2), using the SMSD, building on data provided by a social accounting matrix the Zambia Statistics Agency and ILO had jointly produced. It was estimated that 36,200 (annualized) temporary jobs will be created, 27,600 of them in the construction sector. This means 83 jobs per EUR million invested. Only 13 per cent of the jobs are estimated to go to women, 13 per cent to youth, and 27 per cent may be formal. In the long run, 6,800 permanent jobs are likely to be created, of which 22 per cent women, 18 per cent youth, and 50 per cent formal. Figure 3 shows the distribution of employment creation over time. The significant gender bias should be addressed by making the hiring process more female-friendly and the workplace more gender sensitive in general. The bias against youth should also be addressed.

► **Figure 3. Total employment impacts, temporary and permanent (Zambian Great North Road Upgrading project).**

Source: (7): p.21.

The **Green Mini Grid Facility (GMG) programme** in Kenya, implemented between 2018 and 2023, aimed at improving access to electricity in areas off the national grid. Its second phase featured the construction of 33 mini-grid sites and contributed to the development of a market for private developers. The European Union funded this second phase with EUR 5.65 million.

In a first assessment (8), ILO has used structured interviews and surveys to gather information on the direct employment effects and used the SMSD, described above, to estimate the temporary and permanent employment effects. The intervention created a total of 4,400 jobs, with 3,750 being direct and only 650 indirect and induced (or temporary) jobs. Only about 90 permanent jobs were created in the operation and maintenance of the sites. In both categories, men made up more than 80 per cent of those employed and unskilled jobs had a similar share. Such high gender biases should be mitigated in similar future projects. In addition, the small number of non-direct jobs is a direct consequence of a high share of inputs being imported. Options should be explored to source more inputs locally, always keeping efficiency considerations in mind.

Another complementary assessment of the same project (9) looked at the long-term effects beyond the operation and maintenance of the mini grids by gathering information on the productive use of energy as a result of the project. For this small and medium enterprises at the sites were surveyed and focus group discussions held across 12 sites. It was found that 10 jobs (FTE) were on average created per site, with the majority of this workforce being skilled workers (70 per cent), most of them informal. Jobs were relatively equally distributed in terms of gender and 83 per cent of jobs went to youth. Wages were on average below the national minimum wage and women were paid significantly less than men. The results of the SME survey showed that they not only brought many people into employment, but also that their revenues and overall businesses are expanding since mini-grid operations started. Recommendations included the consideration of complementary measures to finance PUE appliances, which is a significant hurdle. Further efforts are also recommended to reduce business risks in this new area.

In Cameroon, the 11th European Development Fund's support for the **Programme national de développement participative (PNDP)** was assessed (10). PNDP is a portfolio of 460 micro projects that serve objectives of rural development, including prominently infrastructure construction, implementation of basic socio-economic infrastructure, and institutional capacity strengthening measures. Financing of FCFA 14.7 billion was provided by the World Bank, French development agency AFD and the European Union.

Surveys and group interviews were used to gather information on direct effects; and expenditure data was used to calculate indirect and induced effects using multipliers based on a social accounting matrix. A total of 6,600

jobs was created, including 1,500 indirect and induced ones; i.e. 42.5 jobs per every FCFA 100 million invested. Findings showed a very strong gender bias, with 93 per cent of jobs going to men. Recommendations called for accompanying support in terms of technical and/or vocational training to enable rural populations to benefit more from these investments, more closely monitor the national security coverage of temporary employees and more systematically integrate employment data collection in future endeavours to enable more systematic EmpIA.

The above and multiple other assessments were conducted as part of the ILO's STRENGTHEN2 project. They are listed in Table 1.

► **Table 1. EmpIA studies released until February 2025 by the ILO's STRENGTHEN2 project**

Project name	Methodologies applied
Road projects	
Logone Bridge, Cameroon	IO multipliers; SMSD; surveys
Luangwa-Mwami road, Zambia	GIS-NTL
M1 road rehabilitation project, Malawi	SMSD; surveys
Senoba – Ziguinchor – Mpack road, Senegal	IO multipliers; surveys
Great North Road Upgrading, Zambia	SMSD
National Feeder Roads Programme, Rwanda	a) GIS-NTL and b) GIS-LFS
Merille-Marsabit road, Isiolo-Moyale transport corridor, Kenya	GIS-NTL
Energy projects	
Mozambique-Malawi interconnector project, Malawi	SMSD; surveys
Productive use of energy of the GMG Facility, Kenya	Surveys; structured interviews
SMART GRID project, Senegal	IO multipliers
PASE II project, Senegal	IO multipliers
Green Mini-Grid (GMG) Facility, Kenya	SMSD; surveys
Green Mini-Grid (GMG) Facility, Additional sites, Kenya	SMSD; surveys
Elcer Ivoire project, Cote d'Ivoire	IO multipliers; surveys
Other projects	
Talaky Be project, Madagascar	IO multipliers; SMSD
NASIRA risk-sharing facility, Kenya and South Africa	IO multipliers
National Program for Participatory Development, Cameroon	IO multipliers; surveys
Credit guarantee schemes, MSME access to finance and labour productivity in Africa, Rwanda	IO multipliers; surveys

Source: Own compilation.

Note: All studies are available at www.ilo.org/strengthen2.

Challenges and general recommendations, with special emphasis on employment-intensive investment approaches

Frequently encountered **challenges** when undertaking EmpIAs as part of the STRENGTHEN2 project relate mostly to the accessibility of project expenditure data and availability of up-to-date macroeconomic data in the form of input-output tables or social accounting matrices.

Data accessibility on project expenditures and on direct employment on the construction sites are the most important challenges for undertaking EmpIAs as found in the assessments of the STRENGTHEN2 project. Particularly solid information on the expenditures of a project; i.e., on what the budget is spent and the information being provided in a format that can be made compatible with the sectors differentiated in an input-output table or social accounting matrix for the country that is underlying the estimations of non-direct effects, is often hard to come by.

Outdated macroeconomic data on country (input-output table or social accounting matrix) is also a challenge, but not an outright obstacle to assessing investment projects. In many countries, SAMs (the most frequently used kind of database) are quite old, sometimes a decade or more. In such cases, the quality of the results is surely less and the credibility of results maybe even more so. ILO is therefore frequently supporting statistical offices in creating up-to-date SAMs.

Outside the assessments themselves, two other challenges are noteworthy: For one, **resources for assessments are scarce** and only slowly more-and-more IFIs consider funding EmpIAs for their operations. When it comes to governments, the **institutionalization of EmpIA** is not only requiring a lot of time. It is also requiring political ownership, which is hard to find or promote and then difficult to sustain beyond legislative terms.

Based on the EmpIAs implemented by the STRENGTHEN2 project (19 as of April 2025), some **recommendations** have emerged as recurrent. The most prominent ones are about mitigating the bias against women and youth, complement investments in infrastructure with skill-building measures, explore further opportunities for local sourcing, be attentive towards social protection coverage of workers, implementers to gather data for future EmpIAs, and systematically explore which investments may be suitable for employment-intensive approaches that promise to address multiple of the preceding points.

More consideration should be given to specific **measures addressing biases against women** (and youth) in the directly or indirectly created jobs. This is to a large extent a result of the investment projects mostly involving construction of infrastructure and the construction sector being traditionally male dominated. The extent of this bias varies significantly though and there are measures that would create a more level playing field when it comes to enabling women to participate more (more female-friendly hiring processes and more gender-sensitive workplaces). In several instances, also youth was not found to benefit adequately from the employment generated; particularly in combination with the next recommendation, more youth-sensitive recruitment is advisable.

Skill-building measures are frequent recommendations of ILO EmpIAs. This stems from two sources: Either there were mentions of difficulties to find the right profiles (e.g. operators of necessary construction equipment) or there is generally a high share of unskilled labour used and the future prospects of these workers could be improved by accompanying skill-building measures. Particularly larger infrastructure investments should therefore consider a systematic link to on-the-job learning as well as technical and vocational training activities.

Many EmpIAs found a high share of imported inputs, which means that the production of these inputs created jobs, but abroad. Further **analysis** should therefore be undertaken **on inputs to be sourced domestically** in order to retain more of the value added (and therefore job creation) in the country. This would then likely require industrial policy interventions, which are a sensitive area as the prospects of industries, e.g. related to

construction materials, needs to be thoroughly analyzed to avoid creating internationally uncompetitive industries and companies, which will require continued protection and subsidies. Following an EmpIA or already in parallel, a detailed analysis of the construction sector and where it is sourcing inputs from can provide some further pointers which materials should be further explored in terms of options of local production. ILO has done this in a recent study on this sector in Cameroon (11).

Significant decent work deficits in terms of **social protection coverage of workers** is a common finding that can be addressed with measures to hold implementing companies to account to comply with existing regulation or conditionality (in the case of donor-funded investments).

To enable better and easier EmpIA, project implementers should be nudged to collect and report **information on project expenditures and direct employment** on a regular basis and in a form that can be utilized for future EmpIAs.

Finally, it is advisable when planning infrastructure investments, to **systematically assess the suitability of employment-intensive approaches**, as advocated by ILO's employment-intensive investment programme, in these undertakings as these place job creation at the heart of infrastructure construction, are a contribution to poverty alleviation through income generation, build workers marketable skills, and are not an additional cost, while creating high quality infrastructure assets.

Institutionalization of EmpIA

Countries already leveraging EmpIA for evidence-based decision-making on investments and policies have taken very different approaches. ILO work found three kinds (1) (12):

- A more general social monitoring and evaluation institution is tasked with undertaking EmpIA; e.g., the Central Bank in Portugal (together with partner institutions).
- Specialized entities are tasked as they hold specific expertise to conduct assessments; e.g., the Center for Employment Impact Assessment at the Korean Labor Institute. The Republic of Korea is considered to have the most comprehensive use of EmpIA. In the United Kingdom, the Department for Work and Pensions is evaluating national active and passive labour market policies. Germany's Institute for Employment Research undertakes research on labour market issues to provide advice to decision makers.
- EmpIAs are undertaken by a government agency taking the initiative. Examples include Peru (Ministry of Finance and Ministry of Labour), Rwanda (Ministry of Public Service and Labour), and Cameroon (Ministry of Economy, Planning and Land Planning).

Besides such efforts, many EmpIAs are undertaken on an ad-hoc basis and subject to the availability of funding for such initiatives.

It should be noted that the institutionalization of EmpIA in a country is a long-term effort, requiring many years. A phased approach is therefore advisable to not overstretch mandated entities. Besides a minimum level of technical capacity, the institutionalization also requires top officials to be aware and in support of EmpIA, and mechanisms being put in place to determine which investments to assess and who should act on the findings. In the mid-term, the institutional set-up should also include collaboration with academia to infuse EmpIA into their curricula and with the National Statistics Office to regularly update the necessary databases.

Within the STRENGTHEN2 project and beyond, the ILO supports its constituents, particularly governments, in evidence-based decision making through the insights generated from EmpIA. It is also strengthening their capacities for undertaking EmpIAs of their own and to put the institutional set-up in place that will allow them to leverage this important toolbox. EmpIA is still not very widespread and information on successful institutionalization is limited to few cases; some are described in ILO research (12).

Conclusion and way forward

Recent work from the STRENGTHEN2 project indicates that, while investments in infrastructure have substantial potential for decent job creation, this potential is not systematically leveraged. Employment Impact Assessments are a highly useful tool to help employment being considered more prominently in public investment decisions – infrastructure undertakings being the most prominent example. At this point, the ILO is supporting the use of EmpIA in multiple ways: By refining methodologies to make contributions to the advancement of the field; by demonstrating these methodologies through assessments and making the results part of the increasing knowledge base on EmpIA; by engaging with IFIs in how they measure their employment impacts and advancing technical discussions on methodology with them; by raising awareness in countries about how to use such methods; by providing technical training to specialists in countries; by providing advice on how to institutionalize EmpIA at a national level; and by supporting peer learning on EmpIA between countries.

Much has been achieved, but more still needs to be done. The preceding sections of this paper highlighted the general ideas underpinning Employment Impact Assessments: its purpose, principles and scope, the main methodologies used, some examples of recently undertaken assessments, the challenges faced in conducting the assessments and general recommendations resulting from assessments carried out in the past four years. Much progress has been made over this period, but much work still remains to be done. Immediate new avenues of action – for ILO and others – should be to further institutionalization at country level, linking EmpIA with related approaches, and brining EmpIA to bear on IFI operations.

Institutionalization is crucial. The experiences on which this paper is based clearly show that the institutionalization within a country is the most challenging part and crucial for the successful leveraging of the toolbox. Efforts to institutionalize EmpIA are requiring working closely with government and other stakeholders – something that may require in-country presence of the supporting organization. ILO is going to factor this into its assistance to countries, which may take the form of national support programmes.

Expenditure reviews and employment-based budgeting are closely related to EmpIA and these efforts need to be connected. All three are tools to bring out employment considerations more in public expenditures. EmpIA may be in a position to directly feed into employment-based budgeting exercises and this should be the starting point of further efforts when both approaches are pursued by a country.

IFIs are also making efforts to pay more attention to employment considerations. ILO is working particularly closely with the African Development Bank (AfDB) on this, and the example may be very well picked up by other IFIs that can learn from the example AfDB is setting. IFIs should also continue to collaborate on better measuring their employment impacts; there is particularly large potential in leveraging EmpIA for ex-ante estimations of employment impacts. IFIs' own experiences can be leveraged much more to advance; for instance, to leverage generic expenditure breakdowns (based on past experiences) when no good project-level information on expenditures is available before implementation starts.

All of these forward-looking actions will make employment considerations – as a major category of social aspects – being taken into account more prominently and will allow to strengthen the social impacts of infrastructure investments.

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► Decent Work in Nature-based Solutions 2024 report

Findings and implications for Africa

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Abstract

Nature-based solutions (NbS) are increasingly integrated into global agreements and are crucial for a just transition with the right policies. However, NbS do not guarantee decent work, and their potential employment impacts remain underexplored.

This paper builds upon the findings of the Decent Work in Nature-based Solutions 2024 report (hereafter: *2024 report*), jointly developed by the International Labour Organization (ILO), the United Nations Environment Programme (UNEP), and the International Union for Conservation of Nature (IUCN). In this paper, the findings of the 2024 report are further analysed within the African context.

Of the 60.5 – 63 million people currently working in NbS globally, Africa has a notable share, representing 1.9 million jobs, despite the limited data available for the region. Furthermore, increasing NbS investment to help achieve key targets in the three United Nations Rio Conventions¹ could create additional 20 – 32 million new jobs by 2030 with Africa contributing 4.8 – 6.5 million of them. Agriculture will remain the leading sector for NbS employment in the region, although its share is projected to decrease from 90 per cent to 35 per cent by 2030.

Nature-based infrastructure (NbI) is a sustainable solution to meet the high demand for infrastructure services in Africa. Utilizing nature to provide infrastructure services (“green”/“green-grey”/“hybrid” infrastructure), NbI can upgrade existing infrastructure in urban areas and develop new infrastructure by leveraging ecosystems. As infrastructure work is labour intensive in nature, NbI has significant job creation potential. To capitalize on the opportunity and ensure equitable benefits among people requires transformative strategies such as the inclusion of youth and women in infrastructure sectors, who will represent 20-21 per cent and 34-36 per cent of additional NbS employment by 2030 respectively in Africa, and skills development.

Further skills development is fundamental for effective NbS projects, as considerable gaps have been identified. The required skills vary depending on the occupation. In Africa, technical skills of particular importance include the application of ecosystems and biodiversity knowledge, followed by monitoring and evaluation of NbS benefits. Similarly, collaboration capabilities and project management should be prioritized in the region as core skills for the successful planning, implementation and evaluation of NbS projects. In parallel with increasing investments in skills, training programmes and their content should be tailored based on comprehensive needs assessments.

By continuously evaluating positive as well as negative actual and potential consequences of NbS and formulating national policies and frameworks as well as local level projects, NbS can substantially contribute to the decent work creation and a just transition. The high level of informality must also be addressed when scaling up NbS in Africa.

Introduction

Escalating crises—climate change, biodiversity loss, land degradation, and persistent socioeconomic challenges like conflict, poverty, and under/unemployment— necessitate urgent, innovative, and sustainable solutions. Nature-based solutions (NbS) are increasingly recognized as an effective approach to deploy to address many of these mutually reinforcing challenges. Their growing integration into multilateral frameworks like the three UN Rio Conventions², and national and local policies and initiatives underscores their potential. As NbS gain momentum, understanding their full implications, which include the creation of decent work³ and obstacles to be resolved, becomes crucial. For this reason, this paper specifically examines the role of NbS in creating and supporting decent work, with a particular focus on Africa. It draws on the Decent Work in Nature-based Solutions 2024 report (hereafter: *2024 report*), jointly developed by the International Labour Organization (ILO), the United Nations Environment Programme (UNEP), and the International Union for Conservation of Nature (IUCN) and analyzes potentials as well as challenges which must be addressed to ensure decent job creation through the increased use of NbS.

The paper consists of five more section, beginning with the introduction of the concept and a brief assessment of the current state of NbS. The third section provides estimates of current and future global employment in NbS in Africa. The fourth section specifically focuses on nature-based infrastructure (NbI), which is particularly relevant to many African countries experiencing increasingly frequent and intense natural disasters, exacerbated by climate change. The fifth section outlines skills gaps for NbS, and the final section provides the conclusion and recommendations. It also includes two African case studies on Jobs and NbS from the main report.

Unless otherwise stated, the contents, including data, are based on the 2024 report. For detailed information and data sources, please refer to the 2024 report and its annex.

Working towards wider use of nature-based solutions

Key concepts

Nature-based solutions (NbS) are defined as "actions to protect, conserve, restore, sustainably use and manage natural or modified terrestrial, freshwater, coastal and marine ecosystems, which address social, economic and environmental challenges effectively and adaptively, while simultaneously providing human well-being, ecosystem services, resilience and biodiversity benefits." To ensure NbS are effective and bring maximize benefits for biodiversity and ecosystem integrity, the International Union for Conservation of Nature (IUCN) Global Standard for Nature-based Solutions provides a framework for verifying, designing, and scaling up NbS, with eight criteria and 28 indicators. Those benefits can include decent job creation such as green works.

Development of NbS agenda

The NbS has progressively gaining more attention globally, especially at multilateral levels, with NbS being integrated into the three Rio Conventions. Remarkable achievement include the Sharm el-Sheikh Implementation Plan adopted at the 27th United Nations Climate Change conference (COP27) and its work program at the 28th United Nations Climate Change Conference to the UNFCCC (COP28), the launch of the ENACT (Enhancing Nature-based Solutions for an Accelerated Climate Transformation) initiative, the recognition of NbS in the Global Biodiversity Framework (GBF) adopted at the 27th United Nations Climate Change conference at the 15th United Nations Biodiversity Conference (COP15), and the inclusion of NbS in two resolutions of the sixth United Nations Environment Assembly (UNEA-6).

In parallel with the advancement of the agenda at the global level, growing number of countries have continued to integrate NbS into climate action plans, biodiversity strategies and other national policies to date. National Biodiversity Strategy and Action Plan (NBSAP), Nationally Determined Contribution (NDC), and National Adaptation Plan (NAP) can be effective instruments to integrate NbS into national policies and strategies, which should then be translated into sub-national/local policy. Cities are often well positioned to lead policy development, with Dar es Salaam in the United Republic of Tanzania providing a good example.

Many African countries have implemented NbS projects through global and regional and national-level initiatives. The World Restoration Flagship, part of the UN Decade on Ecosystem Restoration, includes large-scale initiatives in which multiple African countries have participated. One of the flagship initiatives aimed at transforming food systems, led by the NGO Trees for the Future, develops the skills of 228,000 farmers in sustainable agroforestry practices with the objective of also increasing their productivity to allow them to shift from subsistence to commercial farming. This initiative has also directly created 3,000 full-time and part-time jobs in capacity building in Kenya, Mali, Senegal, Tanzania, and Uganda. As another example, the Great Green Wall, launched by the African Union in 2007, has restored 15,920 thousand hectares and 10 million green jobs are expected to be created in the Sahel region by 2030⁴. Furthermore, the relevance of NbS in Africa is further underscored by the 31 African countries that have made pledges to the Bonn Challenge, a global initiative to restore 150 million hectares of degraded and deforested landscapes⁵. At a national level, to increase resilience against deforestation and land degradation, the Government of Kenya launched the National Landscape and Ecosystem Restoration Programme. One initiative within this programme, the 15 Billion Trees, aims to increase tree coverage and restore degraded land, while creating a significant number of jobs. Please refer to the Annex A of this paper for a full description of this case.

NbS offer a promising pathway for addressing Africa's pressing environmental and socio-economic challenges. These solutions involve preserving and restoring natural ecosystems to address issues such as climate change, biodiversity loss, and water scarcity, while simultaneously creating jobs and promoting just transitions towards environmentally sustainable economies and societies.

NbS investments

While investment in NbS has been rising, reaching approximately US\$200 billion globally in 2022, with 82 per cent coming from public funds, they still fall significantly short of the required amount to enable NbS to meet the 2030 targets in the Rio Conventions. UNEP has estimated that annual investments need to triple to US\$542 billion by 2030 to meet climate, biodiversity, and land degradation targets. Private sector investment in NbS faces remains limited due to the difficulties in quantifying returns on investment, the long payback periods of projects, and uncertain policy and regulatory landscape.

The funding gap for NbS is worsened by the disproportionate investment in harmful activities, which is estimated to reach nearly US\$7 trillion per year. This dwarfs NbS funding, with environmentally harmful subsidies alone totalling US\$1.7 trillion in 2022, a 55 per cent increase from 2021. It is critically important to shift both public and private investment towards NbS, which involves redirecting investment away from harmful subsidies and utilizing innovative financing mechanisms, such as green bonds.

NbS and decent work

Ecosystem services are crucial for global employment, with an estimated 1.2 billion jobs directly reliant on them. Therefore, environmental degradation poses a direct threat to these jobs and livelihoods of local communities, and necessitate further investment in NbS. However, even though NbS offer significant potential for employment generation and better living standards, particularly in sectors like agriculture, forestry, fisheries, and tourism, it's crucial to acknowledge that they can also bring about employment transitions and have temporary or lasting adverse impacts on certain jobs and livelihoods. For instance, measures to reduce overharvesting in forests can have unintended consequences for those whose livelihoods depend on the forestry sector. Thus, it is essential to conduct thorough assessments of the potential and actual positive and negative impacts of NbS on jobs before, during, and after project implementation. This will help ensure that the benefits of NbS are distributed equitably and any negative impacts are prevented, mitigated or compensated.

Indigenous peoples and local communities play a vital role in NbS, yet face complex questions regarding compensation for their contributions and the disproportionate impact of degraded ecosystems on their livelihoods. Traditional practices often differ from modern employment norms, raising questions about appropriate remuneration approaches that respects cultural values. Two perspectives on compensation exist: one based on conventional wages, and the other on valuing ecosystem services. The latter raises further questions around valuation, payment, and benefit-sharing. Ultimately, context-specific solutions are needed, as appropriate compensation depends on the specific NbS activity in a specific location. While successful examples exist, these complexities remain a barrier to wider NbS adoption.

Estimating current and future employment in nature-based solutions

The section delves into the current and future estimates of NbS employment globally and in Africa. The term "NbS employment" encompasses a broad spectrum, including direct employment from NbS spending, indirect employment resulting from NbS activities, and induced employment generated by further economic activity stemming from NbS expenditure.

It is important to acknowledge the challenges and limitations associated with these estimates. Coverage gaps in data may underestimate both expenditure and NbS employment. Available data doesn't capture all NbS activities, and informal employment data, especially in low-income countries, is limited. Public employment programmes (PEPs) and payments for ecosystem services (PES) data only include countries with known expenditure and employment data. For details on methodologies and data sources, see the 2024 report Annex and UNEP's State of Finance of Nature 2023 report.

Current NbS employment

Current estimates suggest that approximately 60.5-63 million people are undertaking work in NbS globally, representing 1.8 per cent of the total global workforce. These jobs are predominantly concentrated in the Asia-Pacific region, with a large majority found in low- and middle-income countries and is characterized by part-time or project-based work. Notably, Africa and Latin America also hold significant shares of the global NbS workforce, due in part to the higher labour intensity of sectors where NbS activities exist. Women comprise over one-third of the global NbS workforce, and youth are particularly well-represented in Africa, constituting 24 per cent of the NbS employment. This highlights the vital role of NbS in providing employment opportunities for young people.

While data on the use of NbS in Africa remains limited, current estimates suggest NbS generates between 1,918,000 and 1,933,000 employment (persons), which is equivalent to 631,000-642,000 FTEs⁶. It is estimated that approximately 452,000 of these FTE are generated through PEPs across the continent. The sustainable agriculture, forestry, fishing, and hunting sector accounts for the largest share of this employment, with 1,789,000 jobs, the agriculture sector contributes 90 per cent of total NbS employment in Africa. The majority of those employed are market-oriented skilled agricultural workers, subsistence farmers, fishers, hunters, and gatherers, followed by market-oriented skilled forestry, fishery and hunting workers. Nearly 60 per cent of NbS employment is carried out by skilled agricultural, forestry, and fishery workers.

The economic contribution of NbS remains limited. Globally, NbS accounts for an estimated 0.3 per cent of GDP, with the figure dropping to 0.1 per cent in Africa, highlighting both the limits on available data and use of NbS in the continent. In low-income countries, Official Development Assistance (ODA) plays a crucial role in supporting NbS and contributing to GDP.

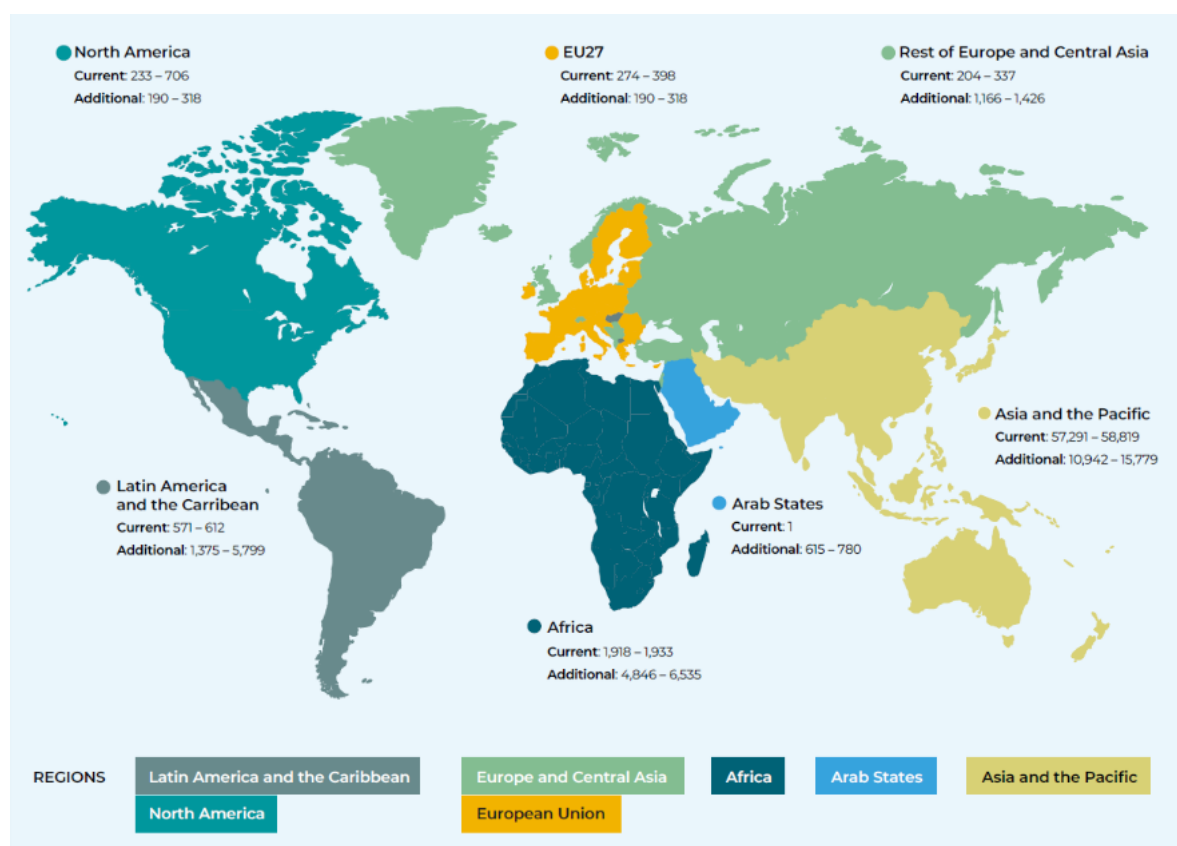
Future NbS employment

Future investment in NbS holds substantial potential for growth, particularly in achieving the targets outlined in the three Rio Conventions. This investment would be allocated over 13 NbS activities, which are grouped into three categories: protected areas / avoided conversion, restoration, and sustainable land management. It's projected that by 2030, the largest portion (52 per cent) of this expenditure will be allocated to restoration activities, with 19 per cent going towards protection efforts and the remaining 29 per cent focused on sustainable land management. It is estimated that to meet the Rio Conventions targets up to 12 per cent of global additional NbS investment in NbS in 2030 should take place in Africa. This would increase the NbS contribution to GDP in Africa to 1.1 per cent, generating the highest increase in GDP compared to the baseline when compared to regions.

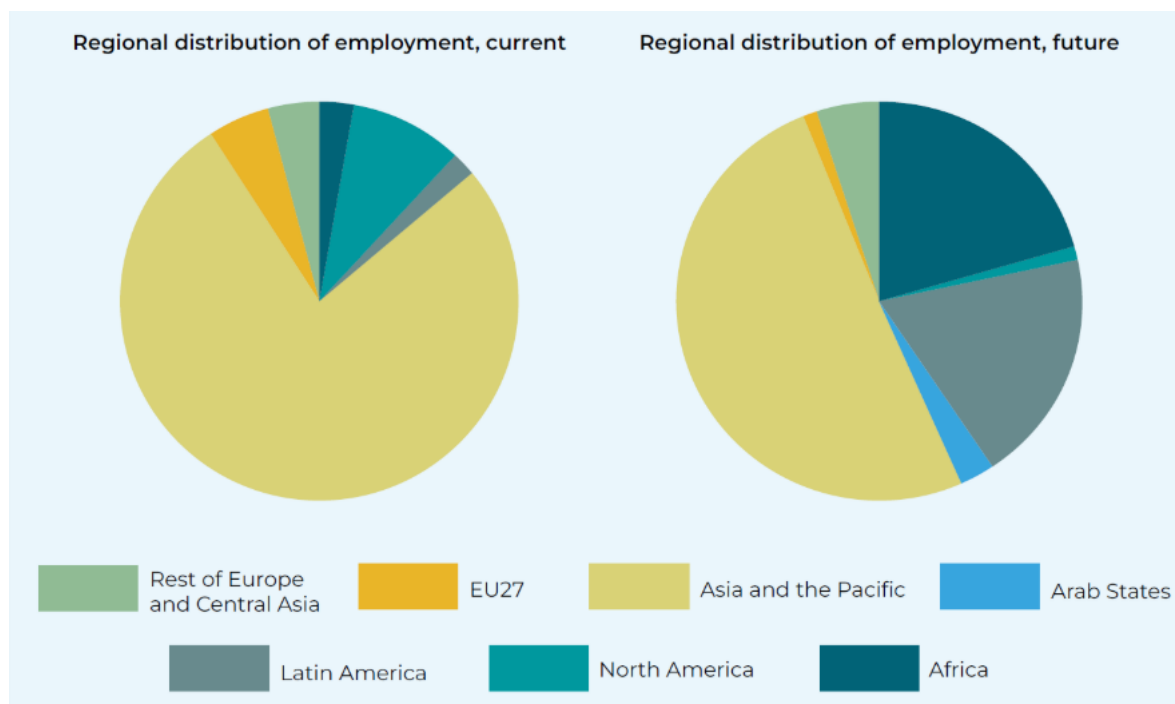
Globally, by 2030, these increased investments could result in the employment of 20–32 million people above current levels. Africa would be expected to see substantial employment growth in NbS, with projections indicating an additional 4,846,000 – 6,535,000 employment (persons)⁷, equivalent to 3,914,000–5,165,000 FTEs, by 2030. This would increase the share of total NbS employment in Africa from 3 per cent to 21 per cent. Of this additional employment, 20–21 per cent is projected to be youth (15–24 years old), and 34–36 per cent is expected to be women. Although the share of agriculture sector is estimated to decrease to 35 per cent from 90 per cent by 2030 in Africa, the top three NbS occupations are projected to remain the same: market-oriented skilled agricultural workers; subsistence farmers, fishers, hunters, and gatherers; and market-oriented skilled forestry, fishery, and hunting workers.

Increased investment in NbS is expected to drive a general upskilling of the workforce and enhance the quality of NbS jobs. Globally, the share of skilled agricultural, forestry, and fishery workers is projected to fall from over two-thirds to about one-third, while the share of high-skilled occupations is expected to increase substantially. This necessitates prioritizing skills development at the policy level to ensure a workforce ready for the higher-skilled jobs emerging in NbS.

► **Figure 1: Estimated current and additional employment by 2030, by geographical region (thousands of persons)**



► **Figure 2: Regional share of NbS employment, current and future (excluding PEPs)**



Employment in nature-based infrastructure - opportunities and challenges

This section explores the potential of nature-based infrastructure (NbI) to meet the demand for infrastructure services which are significant in Africa, being estimated at US\$130-170 billion a year⁸. It examines NbI benefits to create jobs and develop resilient infrastructure in the face of increasingly frequent natural disasters. NbI, as a type of NbS, involves protecting, conserving, restoring, and sustainably using and managing natural or modified ecosystems. These solutions can serve as alternatives to built infrastructure or be integrated with built infrastructure to develop green-grey or hybrid solutions.

NbI solutions can be integrated into diverse socioeconomic contexts, offering opportunities for countries at all income levels. While high-income countries may focus on upgrading existing infrastructure systems with NbI to enhance resilience, middle- and low-income countries have opportunities to 'leapfrog' traditional approaches. By adopting NbI and hybrid solutions, they can capitalize natural assets and abundant labour. Such potential is exemplified by a country-level initiative in Burkina Faso, where a cost-benefit analysis was conducted to evaluate three scenarios for a government-led restoration project aimed at combating ongoing land degradation and enhancing resilience against extreme weather events. These scenarios included an NbI intervention, a hybrid solution, and a grey infrastructure solution. For each scenario, the economic, environmental, and job-creation benefits were assessed. The results indicated that the hybrid solution would generate the highest net cost-benefits for this specific project. Please refer to the Annex B of this paper for full details of this case.

Implications of NbI on employment

Growing the application of NbI for infrastructure systems will shift employment. While jobs that have been generated by built infrastructure may be reduced, various type of jobs that deploy NbI solutions will increase because they can be applied to the entire cycle of NbI project: i.e. planning and design, construction and implementation, operation and maintenance to sustain the effectiveness of infrastructure. Additionally, decommission of existing built infrastructure generate jobs which require different technical skills.

NbI projects often involve labour-intensive activities, particularly in many rural areas in Africa where mechanization is limited. Employment-intensive approaches use local resource-based (LRB) methods which optimize the use of local resources including technologies and labour, ensuring decent work conditions and improving productivity and inclusive local economic and social outcomes. They have been and continue to be widely used in Africa. Such approaches are often applied as part of PEPs. The special attention is required to preventing and addressing actual and potential decent work deficits such as informality, low wages and insufficient working conditions.

The private sector is vital for implementing NbI and creating jobs, flexibly adjusting to the market trends. However, challenges that hinder their investment in NbI include the lack of evidence of returns on investment are particularly acute in Africa. To address this, appropriate policy and regulatory frameworks, economic incentives, and well-planned public-private partnerships can be considered. Additionally, the role of Development Finance Institutions (DFIs) and Multilateral Development Banks (MDBs) which can reduce financial risks and boost research and pilot programmes of NbI should be encouraged. The Great Green Wall Initiative which is supported by the African Development Bank is a good example.

Skills and training needs for decent work in NbI

NbI projects require interdisciplinary skill sets that merge traditional infrastructure expertise with other disciplines such as environmental and climate sciences and biodiversity. This interdisciplinary approach will require the collaboration with local communities who have traditional knowledge and the acquisition of new technical and core/foundational skills.

NbI projects offer a wide range of employment opportunities, from highly specialized technical roles during the planning phase to manual labour during the implementation stage. Advanced modelling, assessment, monitoring and research will be increasingly crucial for work such as designing of NbI and evidence-based performance evaluation.

Social Inclusion Opportunities in NbI

NbI can foster inclusion of women, indigenous peoples, local communities and other marginalized groups, by employing them in the implementation for them and developing infrastructure which is designed to benefit them. Currently, women hold only 10.9 per cent of formal construction sector jobs globally and this is likely to be even lower in Africa. As NbI projects directly and indirectly create diverse jobs which require different skills as explained above, accessibility to these opportunities should be improved for women. This requires adequate supports such as training, flexible working conditions, and a gender-inclusive environment, which governments can support through effective policies and incentives.

Likewise, indigenous peoples and local communities, whose livelihoods and cultures are deeply connected to nature, are well positioned to be actively involved in NbI projects. Here it is important to respect and protect their tenure rights but also to capitalize on their traditional restoration and conservation approaches to make NbS more effective. Participatory approaches at all stages of an NbI intervention, fair recruitment and wages, and social dialogue are crucial to realizing social inclusion and high integrity NbS.

Barriers to decent work creation through NbI

Realizing decent work through NbI requires addressing several challenges. These include raising awareness about the value of NbI compared to built infrastructure, improving data collection and quality on NbI performance on economy and society that bolster long-term investments, and bridging skills gaps. To ensure decent and sustainable employment in NbI projects, it's crucial to evaluate key risks to decent work such as informal and temporary employment, subcontracting arrangements, and heat stress, and identify and put in place necessary measures to address them.

Skills for nature-based solutions

As the momentum for NbS grows, the need for a skilled workforce capable of planning, implementing, and managing these solutions becomes increasingly critical. The successful implementation of NbS requires a diverse range of skills, from technical skills backed up with extensive expertise in areas such as ecosystem management, climate change, and biodiversity to core skills such as communication, collaboration, and project management. Investing in skills development, especially reskilling and upskilling, and training programmes tailored to the specific needs of NbS and corresponding sectors is crucial for building a capable workforce and ensuring that the transition to a green economy is just and inclusive.

A survey of 140 individuals involved in NbS projects, including those in Africa, was conducted to analyze main NbS occupations, core skill types and gaps, and in-demand future skills. Detailed methodology and results are explained in the 2024 NbS report and its Annex.

The survey identified key NbS occupations. In Africa, the top five NbS occupations reported were conservation workers, project managers, environmental specialists, participatory approach specialists, and community coordinators. The first three were also identified as key NbS occupations across regions. These occupations require different skills levels, and a mix of technical and core skills, taking an interdisciplinary approach. Skills of particular importance to these occupations are explained in the Figure 3 below. In Africa, the main technical skills required across occupations are identified as the application of ecosystems and biodiversity knowledge, followed by monitoring and evaluation of NbS benefits. Collaboration with stakeholders, project management, and training of community members are the critical core skills across occupations. These key technical and core skills are strongly relevant to the protection action.

► **Figure 3: Main technical and core skills required by the top three NbS occupations**

Conservation worker	Technical skills	Ecological restoration techniques Tree planting and growing Application of ecosystems/biodiversity knowledge
	Core skills	Collaboration with stakeholders Training of community members Effective communication
Project manager	Technical skills	Policy design and advocacy to support NbS initiatives Monitoring and evaluation of NbS benefits Data analysis
	Core skills	Project management Collaboration with stakeholders Effective communication
Environmental specialist	Technical skills	Data analysis Application of ecosystems/biodiversity knowledge Monitoring and evaluation of NbS benefits
	Core skills	Collaboration with stakeholders Effective communication Project management

While 71 per cent of respondents declared that workers in the main occupations have received some training in the past three years, with 40 per cent provided by their projects. In Africa, it is noteworthy that technical skills training which contribute to the Sustainable land management practices and tree planting is prioritized whose primary action is protection. The skills reported as high in-demand in the near future in Africa are ecological restoration techniques and the application of ecosystem/biodiversity knowledge (technical skills), along with collaboration with stakeholders and effective communication (core skills).

However, significant barriers remain on skills development opportunities. Globally, 66 per cent of respondents reported challenges in implementing NbS projects, which results in insufficient expertise in relevant technical areas, highlighting a need for targeted training. In Africa, this need is compounded by a lack of funding, being reported as a challenge by 82 per cent of the respondents. Solutions are needed to address this financial barrier.

What's needed for effective and skills development in NbS

A review of existing literature highlights a significant gap in targeted national and regional policies addressing NbS skills. Notably, only a handful of developed nations have implemented policies and strategies explicitly aimed at NbS skills development. This limited policy framework translates into a global shortage of training opportunities, particularly acute in low- and middle-income countries. Furthermore, existing training initiatives often lack the necessary tailoring and targeting to specific contexts and needs. The survey, in which respondents were asked to report up to three skills gaps, found that insufficient expertise in relevant technical areas as the most commonly selected issue. This hinders the successful implementation of NbS projects. Therefore, training content must be customized to the skills required for individual jobs.

At the same time, crucial element is ensuring equitable access to these opportunities, addressing historical disparities and fostering inclusivity for women, youth, indigenous peoples, and local communities. For example, a gendered approach to upskilling and reskilling is essential to rectify existing imbalances. In communities and sectors with a declining working-age population, it is urgent to highlight career pathways in NbS fields, demonstrating positive livelihood prospects and providing skills development opportunities for youth. The survey results emphasized this necessity, as the 61 per cent of the respondents highlighted the limited recognition of NbS as a viable career. Furthermore, lack of funding was found as one of the main barriers for NbS skills development in Africa, as 82 per cent of the respondents reported it in response to the question which asked respondents to identify up to three primary barriers hindering the skills development required for NbS projects.

To effectively bridge the skills gap while maximizing limited financial resources, a systematic approach is needed, starting with comprehensive skills needs assessments. These assessments, whether standalone or integrated within broader green jobs analyses, should identify the key occupations requiring upskilling and reskilling. Defining an exhaustive list of sector-specific NbS skills is a crucial first step, as exemplified by South Africa's Environmental Sector Skills Plan⁹, which identifies skills like coastal management which is relevant to NbS.

The results of the assessment should inform the development of targeted policies and strategies, leading to the establishment of both general NbS and specialized, job-ready skills training programmes which can include STEM (science, technology, engineering and mathematics) skills¹⁰. A variety of training modalities can be deployed such as government-led initiatives programmes and project-specific training by NbS implementation bodies. Expanding national-level curricula dedicated to NbS and provision of formal certification of the completion of training which increase employability should be considered. PEPs can play a role, as demonstrated by South Africa's Working for Water Program¹¹, which employs local workers in invasive species control using NbS.

Lastly, in parallel with these, establishing a robust data collection system is essential to monitor programme effectiveness, adapt to evolving needs, and ensure that investments in skills development translate into tangible outcomes.

Conclusions and recommendations

NbS are critical for sustainable development, offering significant potential for job creation and addressing a wide range of societal challenges beyond environmental concerns. NbS hold particular opportunities for investment in infrastructure services, especially in Africa. However, current investment and implementation are insufficient to fully realize this potential. Targeted investment in NbS, particularly in Africa, could significantly increase employment opportunities and improve job quality. Key challenges include the shortage of workers with the necessary skills, hindering the expansion and impact of NbS. The following recommendations can inform concrete actions to harness the full potential of NbS.

Strengthen and align national NbS policy frameworks to capitalize on progress made at the global-, regional- and national-level: Africa is particularly vulnerable to climate change, which exacerbate natural disasters and extreme weather events. They are increasingly impacting many occupations that are reliant on healthy ecosystems. Adaptation strategy is urgently needed for sustainable development, and NbS offer significant potentials, partly because Africa possesses a comparative advantage in terms of vast natural resources and an abundant labour supply. To maximize the return on investments in NbS, national governments can integrate NbS into country-level strategies such as Nationally Determined Contributions, Land Degradation Neutrality targets, and National Adaptation Plans. They should align with global and regional frameworks such as the IUCN Global Standard for Nature-based Solutions and African Union Biodiversity and Action Plan 2023-2030. To effectively mainstream NbS into these frameworks, collaboration across different sectors and disciplines among stakeholders is necessary. Additionally, governments can consider further incentivizing private sector involvement in NbS, fostering the creation of 'NbS employers'.

Invest in skills development and workforce training: Addressing current and future skills gaps in the NbS workforce requires a multi-level approach. International and regional collaboration among governments and organizations is vital to understand the demand for NbS-related skills, which should then be translated into country-level strategies. Compared to other regions, Africa has a large percentage of youth engaged in NbS employment. This demographic situation presents opportunities and necessitates investment in youth capacity building and empowerment, which enable them to envisage their career paths in NbS, providing stable livelihoods. At the national-level, countries should establish NbS training curricula and qualification systems which will increase employability and adjust existing programmes, such as those related to green jobs, and infrastructure development and management, to incorporate NbS competencies. Combining NbS training with entrepreneurship courses may also be useful to attract youth. At the local level, flexible training programmes are key. These should be tailored to regional needs and specific initiatives, encouraging communities to take ownership of NbS projects for long-term engagement and success. Involving youth in the design, implementation and evaluation of programmes is a useful methodology to make sure that they are aligned with their needs.

Promote rights and inclusivity in the NbS workforce: Promoting rights and inclusivity is crucial for a just and equitable NbS workforce. Governments must adopt and enforce labour laws and regulations, ensuring fundamental principles and rights at work along with ratified international labour conventions, to protect all workers engaged in NbS activities. Social dialogue and liaison with workers and their organizations are essential for promoting rights at work as well. Measures to realize an inclusive workforce should be tailored to local contexts, recognizing the diverse needs of women, youth, and indigenous communities. Informal employment, representing more than 80 percent of the total employment in Africa, is a particularly critical issue that must be addressed when scaling up NbS. Informality is often associated with poor working conditions, as well as a lack of entitlement to social protection and other employment benefits. Therefore, in parallel with collecting data on informal employment, which is currently largely missing, national and local policies, frameworks, and individual NbS initiatives should be developed and revised to promote the transition to formalization. Public works programmes (PWP) or PEPs and PES schemes can be effective to provide employment and income opportunities, whilst implementing NbS.

Strengthen research and data collection to better inform decision-making: To leverage NbS to create decent work, robust research and data are indispensable to analyze current and future landscapes of both NbS and employment. The data gap is particularly acute in Africa. To tackle this, a systematic methodology should be defined to collect comprehensive employment data, disaggregated by age, gender and social groups, including informal employment. Integrating NbS employment into national statistical systems is also recommended to improve data availability and accuracy in this regard. Robust research and analysis based on reliable data reveal hinderances to maximizing the potential of NbS to create jobs, such as skills gaps and insufficient capital, and inform effective policies to approach them. Additionally, collaboration between academic institutions, governments, and the private sector facilitates knowledge sharing, research expansion, and access to advanced data obtained through technologies like remote sensing and GIS (Geographic Information Systems), including geospatial data, for planning and monitoring NbS initiatives.

Job creation and livelihood improvement are significant benefits of NbS, offering immediate and tangible positive impacts for local communities. Strategic NbS investments in nature through decent work are vital for the successful implementation of NbS projects which combat and increase resilience against environmental challenges such as climate change, biodiversity loss and land degradation that have severely and disproportionately affected Africa. Ensuring communities' active participation in the actions and obtaining their long-term support for NbS are vital. However, it is also critically important to consider providing compensation for any potential income loss, as NbS could negatively affect communities reliant on activities that damage ecosystems for livelihoods. These potential and actual impacts, including those unintended consequences must not be overlooked. To ensure NbS deliver optimal societal as well as environmental and economic benefits, continuous and thorough evidence-based impact assessments are crucial.

Annex A: Case study - Kenya's 15 Billion Trees initiative

Background and context

Forests are vital to Kenya's economy, providing jobs, livelihoods and essential products to millions of people. Economically, forest ecosystems support not only the forestry sector but also other sectors like agriculture, water, energy, construction, manufacturing and tourism. Despite this importance, deforestation and land degradation threaten Kenya's environment and economy.

Project description

To address these challenges, in 2022 the Government of Kenya launched the National Landscape and Ecosystem Restoration Programme including the 15 Billion Trees (15BT) initiative. By planting 15 billion trees by 2032¹², the country aims to increase tree cover from 12.13 per cent to 30 per cent and restore 10.6 million ha of degraded land, increasing reforestation ambitions beyond what is in Kenya's 2020 NDC under the Paris Agreement¹³.

Because of its ambition, the 15BT initiative has the potential to transform Kenya's economy, society and environment by enhancing the productivity of the agriculture, fisheries, forestry, tourism and water sectors, while boosting other sectors further up the value chain. Once land is restored, ecosystem services like groundwater control, soil stability and fertility, pollination, and carbon sequestration will be greatly enhanced across Kenya. Another major benefit will be the increased resilience to climate change – needed urgently, as shown by the devastating impacts of the heavy rains and floods in May 2024.

Reforestation activities on degraded moist Kaptagat Forest, Uasin Gishu County, Kenya
© Copyright: Kenya Forestry Research Institute (KEFRI)



Potential of the 15BT initiative for job creation

The 15BT initiative has significant potential for immediate, large-scale job creation across Kenya. Many restoration activities are labour-intensive, potentially engaging hundreds of thousands of Kenyans. It is estimated that the initiative could create 400,000–1.1 million jobs each year as shown in Table 1.

► **Table 1: Employment estimate**

No.	INTERVENTION AREA	TEN-YEAR RESTORATION TARGET (HA)	EMPLOYMENT FACTOR FTE/HA	TOTAL EMPLOYMENT POTENTIAL FTE (MILLIONS)
1	Rehabilitation of degraded dryland landscapes	5,190,556	0.4-1.1	2-5.8
2	Growing of agroforestry trees on farmlands	3,000,000	0.25-0.375	0.75-1.125
3	Establishment of commercial private forests	750,000	0.4-1.1	0.3-0.825
4	Rehabilitation of degraded water towers, wetlands and riparian areas outside gazetted forests	500,000	0.4-1.1	0.125-0.55
5	Greening of infrastructure (roads, railway lines, dams) and tree-planting by corporates and Ministries, Departments and Agencies (MDAs)	450,000	0.4-1.1	0.18-0.495
6	Rehabilitation of degraded natural forests in gazetted forests and water towers	350,507	0.4-1.1	0.140-0.385
7	Establishment of bamboo	150,000	0.4	+/- 0.06
8	Rehabilitation of degraded mangrove ecosystems	14,000	1.4	+/- 0.196
9	Growing of fruit trees and woodlots in schools, colleges, universities and other institutions	70,000	0.4-1.1	0.028-0.77
10	Restocking of forest plantation in gazetted forests	54,000	0.4-1.1	0.0216-0.0594
11	Establishment of urban forests, arboretum, green spaces and roadside plantings in wards and sub-counties	50,000	1-5	0.05-0.25
Total (ten years)		10,579,063	n/a	3.85-10.5 million
Annual employment potential		n/a	n/a	0.385-1.05 million FTE per annum

SOURCE: Estimate by ILO based on productivity rates in ILO and WWF 2020.

The quantity and types of jobs created will vary depending on the implementation approach chosen. Whilst certain activities could be implemented by volunteers or through private sector mobilization, it will also be necessary to employ additional people. This could include direct employment through local cooperatives contracted for tree-planting or by establishing a 'green army' of young people to carry out reforestation and land restoration projects. Furthermore, the additional demand for forestry-related work could also contribute to improving the quality of employment in the forestry sector, which is currently characterized by high levels of informality.

Way forward

The 15BT initiative provides an immense opportunity for Kenya to harness NbS to drive largescale employment creation across the value chain. This is especially important given the high unemployment rate among youth and the continued negative social and economic impacts of degraded landscapes across Kenya. To maximize the benefits of the initiative, it is crucial to address the issue of informality, particularly prevalent in the forestry sector. A key next step is to strengthen the national implementation strategy, particularly on the job creation dimension. By doing so, the 15BT initiative could showcase how large-scale ecosystem restoration can combine job creation, economic growth and environmental restoration, thereby contributing to achieving the SDGs and global commitments under the Rio Conventions. The quantification of job creation in the forestry sector will also strengthen the national economy.

Annex B: Case study - Improving water security using NbI in Burkina Faso

Burkina Faso faces significant challenges related to climate change and land degradation. The increasing frequency of extreme weather events, such as flooding and severe droughts, exacerbates soil erosion and threatens agricultural productivity. Each year, approximately 105,000–250,000 ha of land succumb to degradation, reducing crop yields and undermining food security. This ongoing degradation impacts local communities and disposable incomes.

To address these issues, the Ministry of Agriculture and Irrigation Development along with the Ministry of Economy and Finance of Burkina Faso, in collaboration with the NDC Partnership, have proposed a land restoration project. This includes the development of landscape vegetation and facilitating natural regeneration. Alongside the objectives of improving the environment and local communities, the project also aims to directly benefit approximately 26,000 households by increasing employment and income opportunities.

The Nature-Based Infrastructure Global Resource Centre, led by the International Institute for Sustainable Development with support from the United Nations Industrial Development Organization and the Global Environment Facility, has assessed three project scenarios for land restoration: an NbI intervention, a hybrid solution, and a grey infrastructure solution. The NbI scenario focuses on integrating sustainable land management practices with infrastructure development. This involves tree planting, agro-silvo-pastoral (ASP) activities, promoting climate-smart agricultural practices, grasslands and livestock production. The focus is to reduce land erosion, increase agricultural productivity and retain water in the soil.

The hybrid scenario combines a nature-based approach with a solar-powered irrigation pumping system, incorporating soil restoration practices and climate-smart agriculture. This scenario aims to combat soil erosion, enhance water management and achieve higher agricultural yields and incomes. It also commits to ensuring food and nutrition security whilst minimizing environmental impact. Lastly, the grey infrastructure scenario combines a conventional water storage and irrigation approach. Overall, this project is part of a broader effort to improve food security, increase agricultural income and build resilience against climate-induced damages.

Regions with high levels of land degradation and low agricultural productivity face severe challenges related to employment opportunities, restricting the income-generating potential of local communities. In Burkina Faso, a significant part of the population relies on agriculture for their livelihoods. However, due to degraded lands and frequent extreme weather events, agricultural yields are often low, leading to unstable and insufficient income for many households. The NbI and hybrid scenarios aim to improve environmental and labour-related conditions.

The NbI and hybrid scenarios are expected to create jobs across various sectors. In the NbI scenario, silvo-pastoral activities generate an estimated US\$900 million in income, reflecting the substantial contribution of these practices to the local economy. Additionally, the overall employment and income generated from the NbI scenario are valued at US\$39.3 million, whereas the hybrid scenario generates US\$17.1 million. The hybrid scenario similarly contributes to economic growth, but with significant benefits to food security and nutrition.



As shown in Table 2, the NbI and hybrid infrastructure scenarios provide better economic returns compared to grey infrastructure. The NbI scenario yields net benefits of US\$1,655.8 million, while the hybrid scenario, which combines NbI with solar-powered irrigation, yields benefit of US\$2,093.3 million. Both scenarios offer significant environmental benefits, with the hybrid scenario achieving a higher net cost-benefit ratio due to the increased irrigation capacity from the solar pumps. This enhancement leads to higher agricultural yields, improving food security and nutrition, which naturally reduces malnutrition.

NbS in both the NbI and hybrid approaches not only boost agricultural productivity but also enhance carbon sequestration, demonstrating the ability of NbS to provide multiple benefits simultaneously. This mitigates climate change and creates opportunities for generating revenue through carbon credits. The findings also support integrating NbS into national and regional policies to promote sustainable development, highlighting their scalability and potential for replication in other regions facing similar environmental and socio-economic challenges.

This case study exemplifies how investing in nature-based and hybrid infrastructure can foster long-term resilience and sustainability, benefiting the environment, generating higher incomes and enhancing the labour market.

► **Table 2: Cost-benefit analysis of the various scenarios (undiscounted values)**

INDICATOR	NBI SCENARIO (US\$ MILLIONS)	HYBRID INFRASTRUCTURE (US\$ MILLIONS)	GREY INFRASTRUCTURE (US\$ MILLIONS)
Construction costs	21.0	31.2	14.5
O and M costs	99.4	117.7	26.1
Total costs	120.3	148.9	40.6
Food security and nutrition	754.3	1,242.6	244.2
ASP area income	900.0	900.0	0.0
Employment and income	39.3	17.1	1.8
Carbon sequestration	28.1	28.1	0.0
Crop income	54.3	54.3	0.0
Total benefits	1,776.1	2,242.2	245.9
Net benefits/costs	1,655.8	2,093.3	205.4
Cost-benefit ratio	14.8	15.1	6.1

► **L'expérience du programme Initiative Pilote pour un Développement Local Intégré « IPDLI » de l'Organisation internationale du Travail « OIT » dans le développement des infrastructures urbaines**

Une approche intégrée et résiliente

Kamel BOULEHMI

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Résumé

Aujourd'hui, 56 % de la population mondiale, soit 4,4 milliards d'habitants, vivent en ville. Cette tendance va se poursuivre : d'ici 2050, avec le doublement du nombre actuel de citadins, pratiquement sept personnes sur dix dans le monde vivront en milieu urbain¹.

Les villes générant plus de 80 % du PIB mondial, l'urbanisation peut, si elle est maîtrisée, favoriser une croissance durable en intensifiant la productivité et l'innovation.

En Tunisie, la majorité des tunisiens vivent dans des zones urbaines et la population urbaine du pays continue une croissance rapide. Le taux d'urbanisation en Tunisie est passé de 23% en 1956 à 70,53% en 2023. Soit de 2,7 millions à 5,4 millions. Aujourd'hui, environ 2 personnes sur 3 résident en milieu urbain, cette croissance rapide met sous pression les infrastructures urbaines et les ressources de la Tunisie.²

Depuis l'indépendance, la Tunisie a traversé plusieurs phases d'aménagement du territoire, visant à réduire les disparités régionales et à promouvoir un développement harmonieux. Les politiques d'urbanisme ont évolué pour répondre aux défis démographiques, économiques et environnementaux. Malgré que l'état Tunisien ait investi dans plusieurs projets d'infrastructure à caractère urbain, mais les défis demeurent et il reste encore beaucoup à faire pour promouvoir de manière durable l'urbanisation des villes tunisiennes.

Parmi les défis auxquels la Tunisie est confrontée, on peut citer la croissance rapide, le changement climatique et les inégalités sociales. La croissance rapide met à rude épreuve les infrastructures et les ressources de la Tunisie. Le changement climatique risque d'aggraver les défis de la croissance rapide, tels que les inondations, l'érosion côtière et les pénuries d'eau. Les inégalités sociales compliquent également l'accès équitable aux services essentiels et aux opportunités de développement.

Dans ce contexte complexe, où les régions du nord et du sud de la Tunisie font face à des challenges spécifiques souvent exacerbés par les effets dus aux changements climatiques, l'Instance Générale de Prospection et de l'Appui au Processus de Décentralisation (IPAPD) du Ministère de l'Intérieur en collaboration avec l'Organisation Internationale du Travail à travers le programme initiative pilote pour un développement local intégré (IPDLI) a initié des actions pilotes afin de promouvoir le développement local intégré et durable. Ce programme est financé par l'Union Européenne (UE) et la Direction du Développement et de la Coopération (DDC Suisse), vise à améliorer les conditions de vie par la réalisation des infrastructures résilientes ainsi que la création d'une dynamique économique locale génératrice d'emplois décents.

¹ World Bank : Développement urbain <https://www.banquemondiales.org/fr/topic/urbainedevelopment/overview#:~:text=Vue%20d'ensemble,-Contexte&text=Aujourd'hui%2C%2056%20%25%20de,monde%20vivront%20en%20milieu%20urbain>

²L'urbanisation en Tunisie : https://www.researchgate.net/publication/317054680_L'urbanisation_en_Tunisie_Croissance_urbaine_structuration_hierarchique_et_contenu_fonctionnel

Les infrastructures urbaines : un pilier fondamental de développement durable

La thématique « infrastructures urbaines » regroupe l'ensemble des projets, équipements et installations nécessaires pour assurer le bon fonctionnement et la qualité de vie dans les espaces urbains. Elle englobe plusieurs domaines essentiels, tels que les bâtiments civils, les logements, les réseaux de transport, les voiries, les espaces publics, les systèmes de gestion des eaux, les infrastructures économiques, énergétiques, ainsi que les équipements sanitaires, éducatifs et socio-collectifs.

En Tunisie les infrastructures urbaines contribuent au développement économique et social du pays. Elles permettent de soutenir la croissance démographique rapide et l'urbanisation, en particulier dans les grandes villes, et celles en cours de développement.

Entre 1985 et 2015, le pays a investi en moyenne 6,5 % de son PIB dans les infrastructures urbaines, un niveau comparable à celui des économies émergentes. Ces investissements ont généré une contribution annuelle moyenne de 0,5 % à la croissance du PIB par habitant, représentant environ 25 % de la croissance économique totale entre 2005 et 2015. Par ailleurs, la modernisation des infrastructures a contribué à réduire le taux de pauvreté national, qui est passé de 25 % en 2000 à 15 % en 2015.

Malgré ces progrès, des disparités persistent au niveau des régions intérieures de la Tunisie, notamment le Centre-Ouest et le Nord-Ouest, qui souffrent d'un accès limité aux infrastructures de base. Ces disparités se traduisent par une mobilité restreinte et un isolement économique qui freine le développement régional.

Défis & enjeux

Près de 70 % de la population tunisienne vit en milieu urbain, concentrée sur une fraction limitée du territoire. Ce phénomène a conduit à une forte expansion des zones urbaines, dont la superficie est passée de 130 km² en 1956 à environ 960 km² aujourd'hui, représentant 0,62 % du territoire national. Entre 1956 et 1988, l'espace urbain a progressé à un rythme de 4,45 % par an, contre une augmentation démographique de 3,71 %, accentuant la pression sur les infrastructures et les ressources urbaines.

Les déséquilibres régionaux constituent une autre problématique. Les régions littorales concentrent environ 75 % de la population urbaine. En revanche, les régions intérieures, notamment le Centre-Ouest et le Nord-Ouest, affichent un faible taux d'urbanisation (32,1 %), traduisant une marginalisation considérable. Ce contraste s'accompagne d'un accès inégal aux services, infrastructures et opportunités économiques, aggravant les disparités socio-économiques.

Parallèlement, l'essor de l'étalement urbain a amplifié la dépendance à la motorisation individuelle, augmentant les problèmes de congestion, de pollution et d'émissions de gaz à effet de serre. Les infrastructures de transport public, souvent sous-développées, ne peuvent pas répondre aux besoins croissants de mobilité, particulièrement dans les grandes agglomérations.

Le changement climatique constitue un autre défi majeur, avec des inondations de plus en plus fréquentes. Ces événements climatiques, comme les inondations de 2018 dans la région du Cap Bon ont causé 6 morts, endommagé plus de 2 500 maisons et entraîné des pertes économiques dépassant 100 millions de dollars. Chaque année, les inondations causent des pertes moyennes de 40 millions de dollars, soit 0,1 % du PIB, mettant à rude épreuve les infrastructures de drainage et affectant des milliers de familles.

Bien que le nombre de communes soit passé de 75 en 1956 à 350 aujourd'hui, cette multiplication n'a pas suffi à résoudre les déséquilibres régionaux ni à améliorer de manière significative la gestion urbaine. La centralisation excessive limite l'efficacité des politiques publiques, réduisant leur impact sur la qualité de vie en milieu urbain.

Ces enjeux nécessitent des réponses stratégiques intégrant la durabilité, une meilleure gouvernance et une redistribution équilibrée des ressources et des infrastructures entre les différentes régions.

Cadre réglementaire et juridiques

Le secteur de l'urbanisme en Tunisie s'appuie sur un cadre légal et institutionnel qui vise à organiser et à réguler l'aménagement du territoire et le développement urbain. Voici les principaux éléments de ce cadre :

Textes législatifs et réglementaires

- **Code de l'aménagement du territoire et de l'urbanisme (CATU):** Loi n° 94-122 de 1994, ce code constitue la pierre angulaire du système juridique de l'urbanisme en Tunisie. Il définit les principes fondamentaux de l'aménagement du territoire, les outils de planification urbaine (schémas d'aménagement, plans d'aménagement urbain), les règles de construction et les procédures d'autorisation
- **Lois sectorielles :** Divers lois complètent le CATU, notamment en matière de logement, d'environnement, de patrimoine, de transport, etc.
- **Décrets et arrêtés:** Des décrets et arrêtés d'application précisent les modalités d'application des lois et du code de l'urbanisme

Institutions

- **Ministère de l'Équipement, de l'Habitat et de l'Aménagement du Territoire (MEHAT):** Ce ministère est responsable de la politique nationale d'aménagement du territoire et d'urbanisme. Il élabore les stratégies et les plans nationaux, supervise les projets d'infrastructures et veille à l'application de la législation.
- **Agences d'urbanisme :** Des agences d'urbanisme existent au niveau régional et local. Elles assistent les collectivités locales dans l'élaboration et la mise en œuvre des documents d'urbanisme.
- **Communes :** Les communes jouent un rôle essentiel dans la gestion urbaine. Elles délivrent les permis de construire, gèrent les espaces publics et participent à la planification locale.
- **Autres acteurs :** Divers autres acteurs interviennent dans le secteur de l'urbanisme, notamment les promoteurs immobiliers, les architectes, les bureaux d'études, les associations de citoyens, etc.

Instruments de planification

- **Schéma Directeur d'Aménagement du Territoire National (SDATN) :** Ce document définit les grandes orientations de l'aménagement du territoire à l'échelle nationale.
- **Plans d'aménagement (PAU):** sont les principaux instruments de planification urbaines ils fixent les orientations d'aménagement des espaces urbains et semi-urbains à l'échelle régionale ou locale
- **Le Plan de Développement Local (PDL) :** est un outil essentiel pour orienter le développement économique, social et environnemental à l'échelle locale. Il identifie les priorités de développement dans les communes, en fonction des besoins spécifiques de la population

Expérience du programme IPDLI de l'OIT dans le développement des infrastructures urbaines : Une approche intégrée et résiliente

Dans le cadre de l'appui des partenaires internationaux au processus de décentralisation initié par les autorités tunisiennes en 2014, le programme Initiative Pilote pour un Développement Local Intégré « IPDLI » mis en œuvre par l'Organisation Internationale du travail (OIT), et cofinancé par l'Union Européenne (UE), la Direction du Développement et de la Coopération (DDC Suisse) et l'UNICEF, pour un budget total de 19,3 millions d'euros et pour une durée de 8 ans (2018-2025), s'inscrit dans la continuité du projet Appui aux Zones Défavorisées « AZD » (2012-2017), en capitalisant sur les résultats enregistrés en matière de développement local.

L'objectif étant de soutenir le développement local et de créer une dynamique économique locale génératrice d'emplois décents dans les 19 communes dans 06 gouvernorats à savoir : Jendouba, Béja, Kasserine, Gafsa Kébili et Tataouine.

Le programme IPDLI à travers ses 10 ans d'expérience en Tunisie, a démontré les bénéfices substantiels de l'intégration d'approches socialement inclusives, écologiquement durables et à haute intensité de main-d'œuvre, avec un soutien au renforcement des capacités à tous les niveaux. À ce jour, 72 projets réalisés ont permis d'améliorer les conditions de vie de 400 000 habitants.

Une approche intégrée et résiliente du développement d'infrastructures urbaines :

Étant donné le coût élevé des investissements dans les infrastructures urbaines, le programme IPDLI a adopté une approche intégrée et participative pour le développement de ces infrastructures, en mettant l'accent sur la résilience, la cohésion sociale et économique, tout en s'alignant avec les objectifs de développement durable de l'agenda 2030.

En intégrant planification participative, l'implication des acteurs locaux, la mobilisation des ressources pour des infrastructures durables, la recherche et le développement, ainsi que l'intégration de solutions écologiques et la mise en œuvre des programmes de renforcement des capacités. Le programme IPDLI a permis de développer des actions durables et résilientes adaptées aux spécificités de chaque contexte ce qui a amélioré la qualité de vie des populations dans les zones ciblées.

Étapes clés pour le développement des infrastructures urbaines intégrés et résilientes

Planification participative : Comprendre ensemble pour mieux agir

Elaboration des plans de développement locaux (PDL)

Le Plan de Développement Local (PDL), introduit par le Code des Collectivités Locales (CCL), est un outil novateur de planification territoriale, mais son application a été entravée par l'absence de textes réglementaires clairs. Face à cette ambiguïté, l'OIT, à travers le programme IPDLI, a mobilisé son expertise en développement pour concevoir en 2018 une démarche unique, destinée à accompagner les communes pilotes dans l'élaboration de leurs PDL, conformément aux exigences du CCL. Cette méthodologie, fondée sur le dialogue social, reflète l'engagement de l'OIT à promouvoir une gouvernance locale inclusive et durable.

Le processus d'élaboration des plans de développement local comprend des ateliers de réflexion stratégique, au cours desquels les différents acteurs locaux échangent, analysent et convergent vers un consensus sur les enjeux et opportunités locales, ainsi que sur la vision et les orientations de développement du territoire. Ces éléments permettent d'élaborer un plan d'action pour le développement local, ainsi qu'une stratégie de mise en œuvre et de suivi-évaluation en réponse aux préoccupations des habitants.

Compilation avec les instruments de planification communale (PDL et PAU)

Bien que le Code des Collectivités Locales (CCL) en 2018 ait posé les bases d'une gouvernance locale, l'absence de textes d'application clairs pour articuler les différents instruments de planification reste un obstacle majeur.

Grâce à son approche unique le programme IPDLI a contribué à surmonter ces défis par l'introduction des mécanismes de coordination et de gouvernance participative, le projet a impliqué les citoyens, les communes, les services techniques, les autorités locales & régionales, ainsi que les services déconcentrés, afin d'aligner les priorités locales avec les orientations des PAU. De plus la proposition des solutions adaptées pour résoudre les contraintes foncières et faciliter la mise en œuvre des projets.

Production des données statistiques : Enquête ménage « Population & Emploi des jeunes »

Dans le cadre de la mise en œuvre du processus de décentralisation et de développement territorial, chaque commune est demandée d'élaborer un Plan de Développement Local (PDL), en se basant sur le diagnostic de la réalité du territoire. Le programme IPDLI a mené une enquête ménage sur la « Population & emploi des jeunes » dans 77 communes. L'objectif de cette enquête est de mieux connaître les conditions de vie et les caractéristiques sociodémographiques et éducatives des habitants de la commune, en particulier les jeunes.

Cartographie des structures installées sur le territoire communal

Afin d'orienter les stratégies de développement local de la commune en tenant compte des potentiels structurels existants (économiques, éducatifs, culturels, sportifs, ...) d'une part, et d'orienter les types d'interventions appropriées pour contribuer à l'amélioration de l'employabilité des jeunes d'autre part, le programme IPDLI par le biais des Systèmes Informatisés Géographiques (SIG) a développé une application pour identifier et localiser les différentes structures de la commune (coordonnées GPS) qui permet de générer une base de données dédiée.

Cartographie des richesses naturelles pour exploiter le plein potentiel des substances utiles dans les zones d'intervention

Une étude d'identification des substances utiles a été menée dans les 12 communes d'intervention du programme IPDLI. Ainsi, chaque site a fait l'objet d'un inventaire exhaustif des principales substances utiles (argiles, sables, gypses et carbonates).

Les résultats de cette mission ont servi comme support de base et un document d'aide à la décision dans l'élaboration des plans de développement locaux concernant les axes de valorisation du potentiel identifié. En outre, ces données locales détaillées ont enrichi les bases de données nationales sur les substances utiles, tout en permettant aux concepteurs de projets d'infrastructures de prendre en compte l'existence de matériaux locaux lors de la planification et de la conception dans les régions concernées.

Collecte et exploitation des données sectorielles

Afin d'enrichir le diagnostic et de mieux comprendre les besoins spécifiques du territoire, le programme IPDLI, en partenariat avec les services déconcentrés régionaux et les acteurs locaux, a procédé à la collecte et à l'exploitation des données sectorielles. Cette démarche a permis de rassembler des informations essentielles sur divers secteurs, tels que les infrastructures routières, les équipements publics, les conditions socio-économiques des populations, etc... Elle a également fourni une vue d'ensemble des projets et programmes planifiés par les différents secteurs de l'État dans la région, facilitant leur intégration dans le processus de planification.

Maîtrise et déblocage de la situation foncière

En Tunisie, le blocage au niveau de démarrage et la mise en œuvre de projets publics constitue un obstacle majeur au développement économique et social du pays. Selon le président de la Fédération Nationale des Entrepreneurs de Bâtiment et des Travaux publics (FNEBTP), plus de 4 000 projets publics dans le secteur du BTP sont bloqués depuis plusieurs années, représentant une valeur totale de 17 milliards de dinars tunisiens soit 5 milliards de dollars américains.

Parmi les principales causes de ces blocages figurent les problèmes fonciers. Les litiges liés à la propriété des terrains, les difficultés d'expropriation et les retards dans l'obtention des autorisations nécessaires ralentissent considérablement l'avancement des projets. Ces retards entraînent des pertes financières importantes pour l'État, notamment à cause des surcoûts liés à l'inflation, à la dépréciation des matériaux et aux délais prolongés. En plus de freiner le développement des infrastructures, ces blocages limitent la création d'emplois et la relance économique.

Les communes tunisiennes sont également touchées par cet obstacle dans nombreux projets municipaux. Cette situation engendre, dans certains cas, des tensions sociales, notamment lorsque les infrastructures attendues tardent à être réalisées ou restent inachevées.

Face à ces défis, et dans le cadre de sa mission d'accompagnement des nouvelles communes dans la maîtrise d'ouvrage, le programme IPDLI a appuyé ces collectivités locales dans la mise en œuvre de leurs projets issus du programme d'investissement local, par la réalisation de chantiers écoles démonstratifs, visant à renforcer leurs compétences en gestion des conflits et en résolution des problématiques foncières.

Cette approche de l'apprentissage par l'action a permis à ces communes de mieux comprendre et gérer les problématiques foncières et les conflits potentiels, des défis auxquels elles sont fréquemment confrontées dans des projets similaires. De plus cet exercice pratique les a conduits à maîtriser le processus de déblocage foncier par la collaboration, avec les intervenants publics et privés, ainsi de les doter d'outils opérationnels pour accélérer l'exécution de leurs plans de développement et d'investissement local.

Montage technique des projets d'infrastructures : Un équilibre entre faisabilité, coût et impact socio-économique

Le montage technique des projets d'infrastructures constitue une phase déterminante qui, au-delà de la simple traduction des ambitions en plans et en solutions techniques, nécessite une démarche méthodique afin de trouver un juste équilibre entre faisabilité technique, maîtrise des coûts et impact socio-économique.

Pour le programme IPDLI, le montage technique n'est pas une fin en soi, mais un outil au service d'un développement local intégré. Il inclut de manière indissociable la dimension humaine, les exigences techniques et financières, les enjeux environnementaux et l'objectif de générer un véritable dynamisme socio-économique. Cette perspective globale requiert une ingénierie inventive et adaptée, capable de répondre aux spécificités de chaque territoire, une meilleure optimisation des ressources, et une application de l'approche HIMO lorsque celle-ci est techniquement faisable et économiquement rentable.

En privilégiant cet équilibre, le programme IPDLI a permis de réaliser des projets d'infrastructures fonctionnelles, rentables et durables, mais également porteuses de progrès social, de dynamisation économique et de renforcement de la résilience des territoires.

Dimension participative dans le montage technique des projets d'infrastructures

L'élaboration des études de projets d'infrastructures est souvent perçue comme un processus purement technique, déconnecté des réalités et des attentes des populations concernées. Pour dépasser cette logique obsolète et favoriser une approche collaborative, inclusive et véritablement centrée sur les besoins et les aspirations des populations bénéficiaires, le programme IPDLI a intégré la dimension participative tout au long du processus, depuis la phase de planification jusqu'à la mise en œuvre et à l'exploitation du projet.

Les études de base : un état des lieux nécessaire

Avant d'initier tout projet d'infrastructure, il est indispensable de mener des études de base afin d'établir un état des lieux détaillé et objectif.

Cette phase initiale repose sur la collecte et l'analyse des données techniques, socio-économiques et environnementales afin d'identifier les contraintes, les opportunités et les priorités d'intervention. Cette étape est déterminante pour orienter les choix techniques, optimiser les investissements et minimiser des risques.

Définition des solutions architecturales et techniques adaptées

Il s'agit de définir les solutions architecturales et techniques qui soient adaptées aux spécificités du projet, en tenant compte des réalités du terrain, des contraintes environnementales et des attentes des bénéficiaires. Cette adaptation se décline selon plusieurs dimensions :

- Adaptation au contexte territorial et environnemental
- Adaptation aux besoins et aux usages locaux par une compréhension fine des usages prévus, des modes de vie, des pratiques culturelles, des besoins spécifiques des différents groupes sociaux (femmes, jeunes, personnes âgées, personnes en situation de handicap)
- Adaptation aux capacités locales et aux ressources disponibles

- L'optimisation des coûts et des ressources pour assurer un équilibre entre qualité et maîtrise budgétaire, par l'identification des solutions les plus économiquement rentables tout en garantissant une infrastructure fiable et durable, évitant ainsi des coûts d'entretien excessifs à long terme.
- Intégration des mesures de durabilité et de résilience pour répondre aux défis du changement climatique, de l'urbanisation croissante et de la raréfaction des ressources.
- Favoriser les solutions techniques qui contribuent à la durabilité sociale et économique des projets, par la conception des infrastructures qui favorisent l'inclusion sociale, l'équité, l'accès aux services pour tous, la création d'emplois locaux, la valorisation du patrimoine local et le renforcement du tissu social.

Innovation dans le montage technique

La recherche des solutions innovantes au cœur de la logique d'intervention du programme IPDLI, visant à améliorer la qualité, la durabilité et l'impact des infrastructures tout en exploitant au mieux les ressources disponibles localement et en apportant de la valeur ajoutée.

Avant d'être appliquée, les solutions innovantes proposées par le programme IPDLI ont été soumises à une vérification rigoureuse afin d'assurer leur conformité aux normes en vigueur. En concertation avec les instituts nationaux comme le Centre Technique des Matériaux de Construction, de la Céramique et du Verre (CTMCCV), Centre d'Essais et des Techniques de la Construction (CETEC), des laboratoires d'analyse des matériaux privés et d'autres établissements, des essais ont été réalisés pour évaluer leur performance en matière de durabilité, de résistance et d'adaptabilité aux conditions locales.

Parmi les solutions employées, dans le secteur routier est la technologie de l'enrobé coulé à froid (ECF) pour l'entretien des chaussées revêtues, offrant une solution écologique plus rapide à mettre en œuvre et plus économe en énergie que les techniques traditionnelles. En parallèle, des solutions innovantes ont été intégrées pour la gestion des eaux pluviales, notamment l'installation de filtres dans les regards à grille pour réduire les risques d'inondations et de préserver l'environnement.

Pour l'éclairage public, l'application de la technologie LED (Light-Emitting Diode) a considérablement réduit la consommation d'électricité, permettant ainsi une diminution des dépenses publiques liées à l'éclairage.

En ce qui concerne le secteur du bâtiment, le choix des matériaux locaux comme le plâtre pour les enduits ainsi que des plaques de plâtre pour la séparation des espaces a été privilégié pour sa facilité de mise en œuvre et sa meilleure résistance thermique et acoustique.

Montage financier : Mobilisation des ressources et coordination des interventions

La Tunisie traverse une conjoncture socio-économique marquée par une série de défis interconnectés, exacerbés par l'instabilité politique et économique post-révolution, la crise sanitaire de la COVID-19, les répercussions économiques des conflits internationaux, et l'impact croissant du changement climatique. Ces facteurs combinés ont limité les capacités financières et institutionnelles du pays à répondre aux besoins croissants de développement et en infrastructures.

Selon la Banque Mondiale, la Tunisie a besoin des investissements estimés à environ 35 milliards de dinars tunisiens (soit 11,5 milliards de dollars) pour le développement des infrastructures routières, alors que la modernisation des infrastructures hydriques et la lutte contre le changement climatique nécessitent des investissements annuels estimés à environ 4,5 milliards de dinars par an (soit 1,5 milliards de dollars), un défi que les communes tunisiennes partagent pleinement.

Les communes, en tant que premiers interlocuteurs des citoyens dans la fourniture des services et des infrastructures de base, elles sont confrontées à des défis majeurs des investissements. Ces défis incluent les contraintes financières dues à des budgets limités et parfois mal gérés, ainsi qu'un manque des ressources humaines qualifiées pour planifier et mettre en œuvre des projets d'infrastructure. L'absence de mécanismes de coordination entre les différents secteurs et acteurs, freine également l'intégration des interventions et la cohérence des projets.

Par ailleurs, les problèmes fonciers tels que les conflits d'usage, les lenteurs administratives et le manque de visibilité sur les propriétés foncières retardent considérablement la réalisation des projets programmés. À cela s'ajoute l'impact de l'inflation, qui fait grimper les coûts des matières premières et complique davantage la réalisation des projets en cours et programmés. Enfin, la vulnérabilité du territoire aux risques naturels, tels que les sécheresses et les inondations, nécessite des investissements importants pour renforcer la résilience des infrastructures existantes et planifiées.

Dans le cadre de sa principale mission d'appui au processus de décentralisation et de développement territorial, le programme IPDLI a développé des nouveaux mécanismes de financement et d'investissement pour des projets d'infrastructures durables et intégrés. Cette démarche repose essentiellement sur :

- L'amélioration de la gestion communale (financière et technique)
- La mobilisation de fonds à tous les niveaux (régional, national et international)
- La promotion des partenariats multi-acteurs (public-privée-société civile)
- La mobilisation des ressources matérielles des intervenants locaux (engins, outils, équipements)
- Le recours à l'utilisation intensive des matériaux locaux pour réduire les coûts
- La mobilisation des ressources humaines (expertise auprès des services déconcentrés, recours aux PME et main-d'œuvre locale)
- La coordination avec les différents intervenants dans le territoire communal afin d'aligner les investissements sur les priorités définies dans les PDL, de garantir la complémentarité avec les programmes sectoriels, et surmonter les obstacles liés à la planification et au problème foncier.

Réalisations concrètes : De la planification à l'action

En adoptant une approche intégrée et résiliente, fondée sur la méthodologie HIMO, le programme IPDLI a permis de mettre en œuvre des projets d'infrastructures résilientes aux changements climatiques, adaptées aux besoins locaux tout en minimisant les impacts négatifs sur l'environnement.

Pour illustrer ce passage de la planification à l'action et la concrétisation de l'approche adoptée par le programme IPDLI, les études de cas suivantes présentent des exemples de projets réalisés dans divers contextes et pour différents types d'infrastructures :

Etude de cas n°1 : Projet palais municipal de Tataouine Sud - premier bâtiment civil durable en Tunisie

Conformément à son cadre logique, le programme IPDLI a appuyé la commune de Tataouine Sud dans la mise en œuvre de leur Programme d'Investissement Communal (PIC) notamment le projet de construction du palais municipal. Ce bâtiment administratif, conçu comme un modèle durable, introduit une nouvelle approche de la construction publique amie de l'environnement « **Eco-friendly** » et bénéfique pour l'écosystème, la nature, et l'humanité. Ce projet est considéré comme le premier bâtiment administratif durable en Tunisie, avec pour ambition de servir de prototype à dupliquer.

Comme d'autres régions du sud de la Tunisie, la commune de Tataouine Sud est confrontée à des défis liés à des conditions climatiques difficiles, notamment des températures élevées, des sécheresses fréquentes, des tempêtes de sable ainsi qu'une pénurie croissante de ressources en eau.

Dans ce contexte, la conception du palais municipal de Tataouine Sud a suivi une démarche innovante et intégrée. Le processus a débuté par une préparation du programme fonctionnel participatif, en identifiant les besoins spécifiques de la commune en termes de services administratifs.

Sur le plan conceptuel, trois axes principaux ont guidé la réalisation du projet : **Fonctionnalité, Architecture Bioclimatique, et Esthétique.**

Sur la base du programme fonctionnel, l'approche fonctionnelle a été développée pour optimiser l'utilisation des espaces et garantir une fluidité dans les services administratifs, afin de répondre aux attentes des citoyens et des usagers.

► Figure 9 : Approche fonctionnelle

APPROCHE FONCTIONNELLE

Programme spatio-fonctionnel



Plan Rez de chaussée



LEGENDE

	Office		Bureau d'ordre central
	Salle de réunion		Espaces verts
	Circulation horizontale		Circulation verticale
	Zone sanitaire h/f		Service administratif et financier
	Hall d'attente avec guiche et SAS		Eau & Assainissement

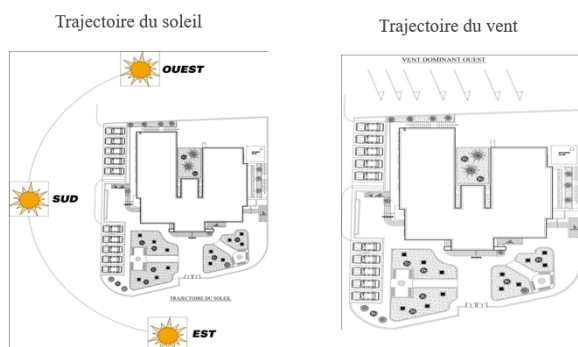
Dans un environnement aride comme Tataouine Sud, l'architecture bioclimatique, a intégré des solutions durables et innovantes pour réduire l'impact environnemental du bâtiment. L'orientation et la conception du bâtiment a permis de maximiser l'éclairage naturel et réduire la consommation énergétique. L'utilisation de matériaux locaux (pierre, chaux, enduit en plâtre) pour améliorer l'isolation thermique et acoustique. Le recours aux panneaux solaires permet d'alimenter le palais municipal en énergie renouvelable, et de diminuer les dépenses d'éclairage public. Des brise-soleils ont été construits au niveau des fenêtres pour limiter les gains thermiques et améliorer le confort intérieur, tandis que la végétation a été utilisée comme barrière naturelle pour atténuer l'effet du vent dominant venant de l'ouest.

En matière de gestion des ressources en eau, le programme IPDLI a contribué par l'installation de deux réservoirs enterrés certifiés alimentaires : l'un pour la récupération des eaux pluviales, et l'autre pour le stockage des eaux potables (en raison des coupures successives de l'eau potable). Une mini-station autonome de traitement et valorisation des eaux usées également sera mise en place pour l'irrigation des espaces verts.

► **Figure 10 Approche bioclimatique et écologique**

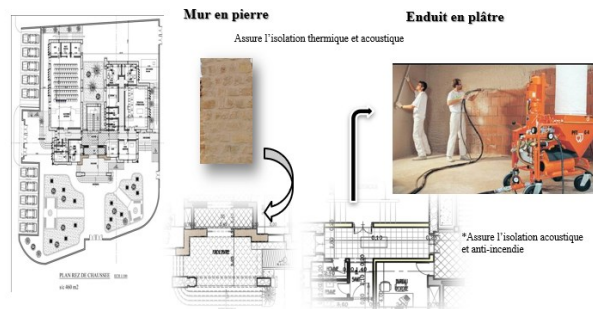
APPROCHE **BIOCLIMATIQUE** et **ÉCOLOGIQUE**

Orientation du bâtiment



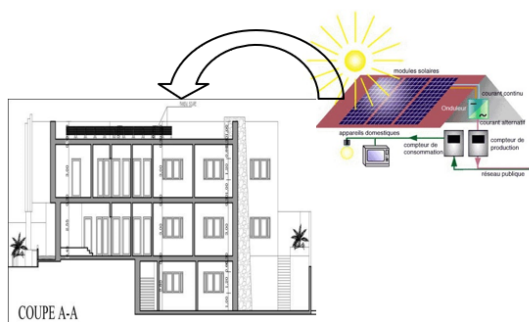
APPROCHE **BIOCLIMATIQUE** et **ÉCOLOGIQUE**

Matériaux locaux



APPROCHE **BIOCLIMATIQUE** et **ÉCOLOGIQUE**

Energie renouvelable



APPROCHE **BIOCLIMATIQUE** et **ÉCOLOGIQUE**

Eau & Assainissement



Enfin, l'esthétique architecturale a été pensée pour refléter l'identité culturelle de la région, avec une conception harmonieuse et moderne.

► Figure 11 : Approche esthétique

APPROCHE ESTHÉTIQUE



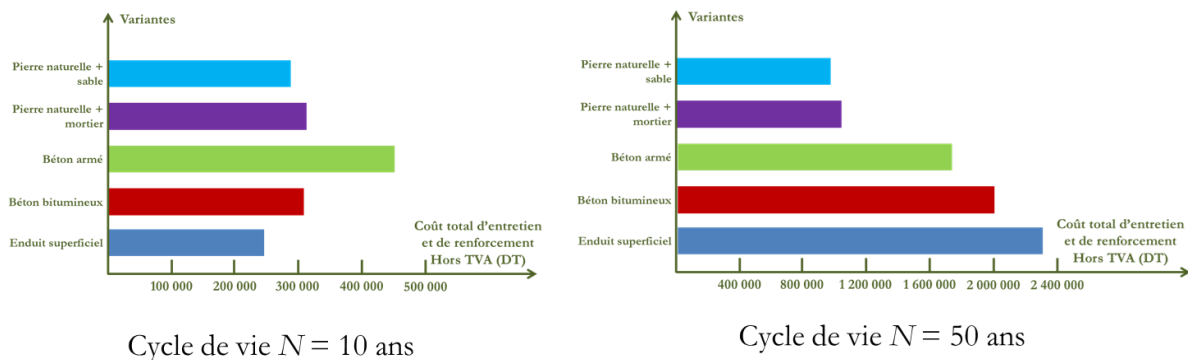
Etude de cas n°02 : Projet d'aménagement des voiries urbaines en pavée de pierre naturelle à joint sec aux villes de Gafsa, Thala, Tejerouine et El Kef

Durant les interventions du projet « Appui aux Zones Défavorisées (AZD) 2012-2017 » une nouvelle filière dans le secteur du revêtement routier a été initiée. Cette filière est basée sur l'utilisation des pavés de pierre naturelle posés sur lit de sable à joints secs (sans mortier de ciment). Cette méthode a permis de répondre à des besoins techniques, économiques et environnementaux tout en valorisant les ressources locales, telles que les carrières de pierre et de marbre, largement disponibles dans les gouvernorats de l'intérieur et permet de créer un grand nombre d'emplois, en carrière et sur chantier.

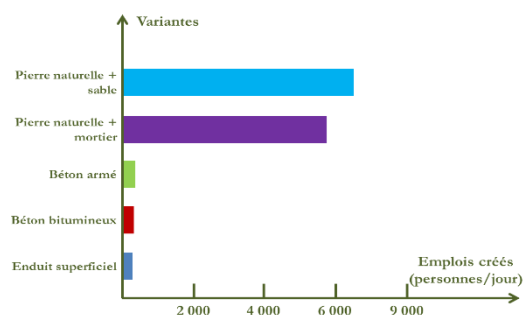
Une étude technico-économique comparative sur les revêtements de voiries urbaines utilisé en Tunisie, réalisée dans le cadre du projet AZD a confirmé la pertinence de cette méthode. Inspirés des techniques romaines, les revêtements en pavés de pierre naturelle offre une excellente durabilité face aux charges routières et aux conditions climatiques, tout en réduisant les coûts d'entretien à long terme. De plus, la structure à joints secs améliore le drainage des eaux pluviales, limitant ainsi les problèmes de stagnation et d'inondation dans les espaces urbains. Cette technique contribue également au développement économique local en générant des opportunités d'emplois décents. En outre, leur aspect naturel valorise le patrimoine local et améliore l'attractivité des espaces publics.

Résultats pour une voie urbaine de longueur 1 km et de largeur carrossable égale à 6 m

► **Figure 12 : Résultats de comparaison : coûts avec prise en compte de l'entretien structurel et du renforcement**



► **Figure 13 : Résultats de comparaison : emplois créés**



Le programme IPDLI a repris cette technique en consolidant son application et en démontrant ses avantages multiples à travers des chantiers -école démonstratifs réalisés dans les villes de Gafsa, Thala, Tejerouine et Elkef.

► **Figure 14 : Travaux d'aménagement des voiries urbaines en pavée de pierre naturelle à joint sec**



Etude de cas n°03 : Installation de filtres dans les regards d'évacuation des eaux pluviales des rues des communes d'intervention du programme IPDLI

Les inondations dans les zones urbaines représentent un défi majeur en Tunisie, qui sont causées par plusieurs facteurs, notamment en raison du colmatage des réseaux d'assainissement et de drainage des eaux pluviales, les fortes précipitations liées aux changements climatiques, et de l'urbanisation croissante.

Face à cette situation, et dans le cadre de son engagement continu à trouver de solutions durables et innovantes, le programme IPDLI a lancé un chantier-école démonstratif pour l'installation de filtres dans les regards à grille, en collaboration avec la startup tunisienne ZIGOFILTRE, ces travaux ont été réalisés dans les rues identifiées des 7 communes partenaires du programme IPDLI (Galâa-Mâaden-Forgsan (Jendouba) ; Testour (Béja) ; Thala (Kasserine) ; Bouzghem (Kasserine) ; Gafsa (Gafsa) ; Sidi Bouzid (Sidi Bouzid) ; Tataouine (Tataouine), dont l'objectif est d'améliorer le drainage des eaux pluviales, de réduire les risques d'inondations et de préserver l'environnement.

Au total, 350 filtres ont été installés dans les regards d'évacuation des eaux pluviales, ce qui a permis de protéger 100 km de canalisations contre les bouchages, de réduire 40 % des coûts de d'entretien des réseaux et de retenir plus de 5 tonnes de déchets solides, contribuant à la réduction des risques d'inondation dans les zones concernées.

► **Figure 15 : Installation de filtres dans les regards d'évacuation des eaux pluviales**



Etude de cas n°04 : Projet d'aménagement de station de transport terrestre à Testour

L'un des problèmes majeurs rencontrés quotidiennement par les habitants de la ville de Testour (Gouvernorat de Beja) et les usagers de la route nationale n°5 (reliant la capitale Tunis au gouvernorat du Kef), est le trafic routier causé par l'absence d'infrastructures dédiées à la gestion du stationnement et de la circulation des véhicules de transport privé (louages), dont le nombre s'élève à 60 voitures (17 voitures de transport provisoire et 43 voitures de transport permanent) assurant la mobilité de près de 30 mille habitants de la commune de Testour.

Cette station, dépourvue d'infrastructures adéquates, provoquait une congestion significative aux heures de pointe et engendrait des problèmes de sécurité tels que des actes de vol et d'agression, provoquant ainsi des retards et des perturbations pour les passagers et les conducteurs.

En réponse à ces problématiques, le programme IPDLI a appuyé la commune de Testour pour l'aménagement d'une station de transport urbain permettant de répondre aux besoins des citoyens de Testour et aux usagers de cette station, en leur offrant un espace moderne, fonctionnel et sécurisé. Ce projet a également contribué à

l'amélioration de l'infrastructure de transport de la région, en favorisant la fluidification de la circulation et la réduction des embouteillages.

Cette nouvelle station dispose d'une aire de stationnement pour 80 véhicules de transport privé (louages), d'un bloc sanitaire accessible à tous (hommes, femmes et PMR), un poste police permanent, un guichet et un espace d'accueil. Des infrastructures telles que des clôtures de protection, des abris légers, des garde-corps, et des banquettes ont été mises en place. Le projet intègre aussi des éléments durables, comme les éclairages photovoltaïques et un espace vert, ainsi que deux kiosques en bois dédiés à une buvette et à un point de vente.

Afin d'assurer l'exploitation et la gestion durable de cette station, un partenariat public-privé (PPP) a été établi entre la commune de Testour en tant que maître d'ouvrage, et les représentants des chauffeurs des véhicules de transport privé, regroupés au sein de la chambre syndicale affiliée à l'UTICA.

► **Figure 16 : Station de transport terrestre à Testour**



Etude de cas n°05 : Projet d'aménagement du complexe de la jeunesse et de l'enfance de Ksar Ouled Dabeb

La localité de Ksar Ouled Debbab, située dans la commune de Tataouine Sud (gouvernorat de Tataouine) et compte environ 3000 habitants, souffrait depuis une décennie d'un manque d'espaces dédiés au divertissement et aux loisirs. Le seul lieu disponible pour les jeunes était un ancien terrain de sport en terre situé à proximité d'un abattoir désaffecté. Cependant, cet espace était en état de ruine et n'offrait plus les conditions adéquates pour une exploitation sécurisée et fonctionnelle.

Face à cette situation, une démarche de concertation participative a été initiée, impliquant activement les citoyens, les représentants des autorités locales et les services déconcentrés de la région ainsi que les experts techniques. Ces acteurs ont exprimé leurs besoins et leurs attentes, de plus ils ont contribué à l'élaboration du programme fonctionnel ainsi qu'à la conception du projet, à travers des plans collaboratifs, qui traduisent leurs aspirations et leurs visions pour l'aménagement de cet espace.

► **Figure 17 : Démarche participative adaptée à l'élaboration du programme fonctionnel et à la conception du projet du complexe de la jeunesse et de l'enfance de Ksar Ouled Dabeb**



À l'issue de cet exercice collectif, un consensus s'est dégagé autour de la nécessité d'aménager un complexe intégré dédié à la jeunesse et à l'enfance, comprenant un terrain de sport, un espace vert polyvalent (avec buvette, sanitaires, amphithéâtre, zone de détente, aire de jeux et parking), et un jardin d'enfants.

En réponse à ce besoin et grâce à une collaboration exemplaire entre le Conseil régional du gouvernorat de Tataouine, le Commissariat régional de la femme, de la famille et de l'enfance, le Commissariat de la jeunesse et des sports, le Commissariat régional de la culture, la commune de Tataouine Sud et le programme IPDLI, le complexe de la jeunesse et de l'enfance de Ksar Ouled Debbab a été réalisé, offrant un nouvel espace de loisir pour les familles, les enfants et les jeunes de la région.

► **Figure 18 : Projet du complexe de la jeunesse et de l'enfance de Ksar Ouled Dabeb**



Etude de cas n°06 : Projet d'embellissement de la ville de Galâa et d'aménagement de l'esplanade devant l'école de Sidi Belgacem

En accord avec les attributions de la commune de Gâlaa-Mâaden-Forgasen du gouvernorat de Jendouba incitant cette dernière à créer des espaces verts, des jardins publics, et à embellir les villes pour les rendre des lieux de vie décentes, agréables et durables, le programme IPDLI a entamé en 2023 les travaux d'embellissement de l'entrée de la ville de Galâa et d'aménagement de l'esplanade de l'école primaire Sidi Belgacem, par un cofinancement de la part de l'UNICEF et en collaboration avec les différents partenaires (Commune, ministère de l'éducation, ministère de la culture (Institut National du Patrimoine), acteurs locaux, ...).

En effet, l'école primaire Sidi Belgacem, accueillant près de 480 élèves, se trouvait dans un état de dégradation préoccupant. Son emplacement à l'entrée de la ville de Galaâ présentait des menaces vu l'absence des moyens de sécurité routière et la prévalence de la contrebande du carburant dans les proximités. Malgré la richesse historique de la région, le patrimoine local est sous-évalué et les ruines romaines ainsi que le plus ancien pont romain d'Afrique (Thuburnica), datant de 2000 ans, ne sont pas valorisés.

Malgré les défis rencontrés, tels que les contraintes foncières complexes, les difficultés administratives et du terrain, le projet d'embellissement de la ville de Galâa et d'aménagement de l'esplanade devant l'école de Sidi Belgacem a permis de réaliser un ensemble d'interventions significatives, contribuant à l'amélioration de l'environnement extérieur, et de la qualité de vie des élèves, des enseignants, et des habitants de la commune. Cette intervention a permis également de renforcer la connaissance du lieu et la valorisation du patrimoine local.

► **Figure 19 : Projet d'embellissement de la ville de Galâa et d'aménagement de l'esplanade devant l'école de Sidi Belgacem**



Etude de cas n°07 : Projet de construction du marché central à Sidi Bouzid

Le gouvernorat de Sidi Bouzid, situé au sud de Tunis, est une région principalement agricole avec un taux de chômage élevé, notamment parmi les jeunes diplômés. C'est dans cette ville, symbole de la révolution tunisienne de 2011, que l'OIT à travers le programme IPDLI (AZD) a mis en œuvre un projet pilote visant à favoriser l'emploi local. Un marché couvert a ainsi été construit selon l'approche HIMO, privilégiant l'utilisation des ressources locales et le développement économique. Cette infrastructure a permis aux commerçants, y compris les vendeurs ambulants, de travailler dans de meilleures conditions, mettant fin à l'occupation désordonnée des rues du centre-ville. Le projet s'est appuyé sur des entrepreneurs et ouvriers locaux, utilisant principalement des matériaux issus des carrières de la région.

► **Figure 20 : Projet du marché central de Sidi Bouzid**



Proposition des modèles de gestion et d'exploitation durable des projets infrastructures réalisés

Afin d'assurer la fonctionnalité et la durabilité des infrastructures réalisés, des modèles de gestion et d'exploitation durables ont été proposés pour chaque projet. Ces modèles ont été élaborés en conformité avec le cadre institutionnel et juridique Tunisien, ainsi que les compétences communales, tout en tenant compte des spécificités de chaque projet et des contextes socio-économiques locaux. Pour une appropriation et une application transparente, ces modèles ont été concertés et validés avec les bénéficiaires directs.

► From organic waste to agrifood value

Appropriate technologies for circular economy and job creation

Daniele Epifanio and Christoph Ernst

List of abbreviations

AGRA - Alliance for a Green Revolution in Africa
 ASH - Africa Sun Holdings
 BSF - Black Soldier Fly
 C40 - C40 Cities Climate Leadership Group
 CRCs - Carbon Removal Certificates
 ESCAP - United Nations Economic and Social Commission for Asia and the Pacific
 FAO - Food and Agriculture Organization of the United Nations
 GAMA - Greater Accra Metropolitan Area
 GHGs - Greenhouse Gases
 ha - Hectare
 ICIPE - International Centre of Insect Physiology and Ecology
 IFAD - International Fund for Agricultural Development
 ILO - International Labour Organization
 IRRC - Integrated Resource Recovery Centre
 ISWM - Integrated Solid Waste Management
 ITDG - Intermediate Technology Development Group (now Practical Action)
 KII - Key Informant Interview
 MEFT - Ministry of Environment, Forestry and Tourism of Namibia
 MSWM - Municipal Solid Waste Management
 NEET - Not in Employment, Education, or Training
 OECD - Organisation for Economic Co-operation and Development
 Tn - Metric Ton
 TPY - Tonnes Per Year
 UNDP - United Nations Development Programme
 UNECA - United Nations Economic Commission for Africa
 UNEP - United Nations Environment Programme
 WIEGO - Women in Informal Employment: Globalizing and Organizing

Executive summary

This document presents examples of appropriate technologies for transforming organic waste into inputs for food production within a circular economy framework, oriented towards their replicability and potential to generate sustainable employment in African countries. The research applies a qualitative methodology, integrating a desk review with key informant interviews. The selection criteria of the examples emphasise technologies that utilise agricultural organic waste to create value-added products linked to agrifood systems, are resource-efficient and scalable, and apply to major agricultural value chains in Africa.

Identified examples lead to the conclusion that waste-to-agrifood technologies exist along a continuum, ranging from farm-enhancing practices that improve soil health and reduce input costs to income-generating activities that create market opportunities and employment. Composting, biochar production, and black soldier fly farming, among others, illustrate how organic waste can be repurposed into fertilisers, animal feed, and bioenergy, addressing environmental and economic challenges. The scalability and employment impact of these technologies depends on market conditions, policy incentives, and investment in infrastructure and workforce development.

In international development, an appropriate technologies approach can play a key role in making organic waste solutions accessible and adaptable to diverse local contexts. At smaller scales, they provide direct benefits to smallholder farmers and decentralised communities, while at commercial levels, they create job opportunities downstream and upstream the value chains, from waste collection and processing to specialized roles in biotechnology or logistics. Ultimately, the study underscores the need for enabling policies, financial access, and strategic partnerships to fully harness the potential of waste valorisation in strengthening agrifood systems, fostering green jobs, and contributing to sustainable development in Africa

Introduction

Agriculture and jobs in Africa

Status of the employment

Africa's economic development continues to face structural challenges, including working poverty, climate change, and security risks. According to the ILO, 145 million people in Sub-Saharan Africa are in extreme working poverty as of 2023 (ILO, 2024b). Climate-related disasters, conflict, and limited fiscal space further constrain economic resilience, particularly in fragile regions like the Sahel. Additionally, the continent's population is growing rapidly, with projections indicating an increase of nearly 950 million people by 2050 (UNECA, 2024); by 2030, African youth are expected to reach 200 million.

Employment trends across Africa reflect stark regional disparities. In North Africa, labour force participation rates are low, particularly among women, with female participation at just 20 per cent in 2023—49 percentage points lower than that of men (ILO, 2024b). The overall employment-to-population ratio in the region was 40 per cent, significantly lower than in Sub-Saharan Africa, where rapid labour force growth added 53 million workers between 2019 and 2023 (ILO, 2024b). However, informal employment dominates in at 86.5 per cent, and underemployment is widespread, with many workers in precarious self-employment and limited access to stable jobs. Youth employment challenges are particularly pressing in Sub-Saharan Africa, where the NEET (Not in Employment, Education, or Training) rate stood at almost one out of every four youth in 2023 (ILO, 2024a). Although youth unemployment rates have slightly declined since the COVID-19 pandemic, young women continue to face greater barriers to employment than men. Furthermore, political instability and conflict exacerbate these vulnerabilities, with 8.9 million young people living close to conflict zones in 2022.

The mismatch between labour market demands and workforce skills poses a major challenge to job creation, including in the food and agricultural sectors. Approximately two-thirds of youth employed in this sector work in jobs that do not correspond to their educational qualifications, with 40 per cent underqualified and 24 per cent overqualified (OECD, 2021). Moreover, rural settings face a critical deficit in soft skills, which are equally important as technical expertise in building economic resilience. Addressing this gap is a policy priority and requires interventions that equip rural youth with both technical know-how and skills that enable them to contribute meaningfully to transforming agrifood systems, and creating productive and decent employment.

A focus on the agriculture and waste management sectors

Agriculture is a pillar of Africa's economy and a crucial sector for employment, poverty alleviation, and food security. It contributes significantly to Gross Domestic Product and livelihoods, with agrifood systems employing approximately 1.23 billion people globally and sustaining 3.83 billion people who live in households that depend on agriculture (Davis, B. et al., 2023). In Africa, smallholder farmers dominate the sector, with 33 million smallholder farmers producing up to 70 per cent of the continent's food supply (IFAD, n.d.). However, the sector faces systemic challenges, including low productivity, limited access to modern technologies, and insufficient infrastructure for managing agricultural waste. These limitations contribute to Africa's food systems' inability to deliver sustainable and healthy diets, with over 257 million people—more than 20 per cent of the continent's population—suffering from undernourishment (FAO and ECA, 2018).

Multiple factors contribute to the underperformance of Africa's agricultural sector, including climate change, economic instability, and outdated farming practices. The Africa Agriculture Status Report 2023 highlights that *'outdated farming practices and the low adoption rate of improved agricultural technologies contribute to low productivity. Issues such as monoculture, lack of crop rotation, and poor soil management are still prevalent across the continent. Poor infrastructure in terms of roads, storage, and processing facilities limits access to markets and increases post-harvest losses. Moreover, many African farmers and other food systems-related businesses lack access to finance and credit facilities that would enable them to invest in improved agricultural technologies and inputs'* (AGRA, 2023).

Alongside the agricultural sector, waste management presents a challenging yet critical avenue for employment generation and economic sustainability in Africa. In urban environments, waste pickers play an essential but largely unrecognised role in recycling and waste management. Globally, between 19 and 24 million people work in waste collection and recycling, yet only 4 million are formally employed (ILO, 2013). Many of these ‘*unseen green jobs*’, as defined by the World Bank (The World Bank, 2024), belong to the most vulnerable groups, including women, children, the elderly, and persons with disabilities. Despite their contribution to reducing carbon emissions and promoting circular economies, they operate under hazardous conditions (UNDP, 2023), with little to no access to protective equipment or fair wages. Reliable statistical data on waste pickers remain scarce, as many live and work outside the reach of traditional surveys (WIEGO, n.d.). Recognising waste pickers as key actors in the green economy is crucial for ensuring their integration into formal waste management systems and improving their working conditions.

In both agriculture and waste management, Africa faces the challenge of creating employment opportunities while ensuring environmental sustainability. Addressing this requires integrated approaches that leverage innovations in agrifood systems and waste valorisation. This study examines the role of appropriate technologies in processing and reutilising agricultural and urban organic waste, highlighting their potential impact on job creation and livelihoods. By exploring scalable solutions such as composting, biochar production, and insect-based recycling, the research aims to identify pathways that strengthen circular economy dynamics and expand livelihood opportunities in African countries. It investigates how these technologies can transition from farm-enhancing to income-generating applications, particularly for smallholder farmers, urban waste systems, and decentralised community initiatives. In doing so it seeks to highlight how technological choices, policy support, and skill development can foster sustainable employment while addressing Africa’s growing waste management challenges.

Organic waste in agriculture: opportunities and challenges

“Waste is essentially the unintended by-product of consumption and production.” (UNEP, 2024)

Agricultural waste and the organic fraction of urban solid waste are the two main sources of organic waste deriving from human activities and are interconnected. As Africa’s population expands, the demand for food increases, leading to greater agricultural production and, consequently, more agricultural residues such as crop stalks, husks, manure, post-harvest food losses, and food waste. In Sub-Saharan Africa, post-harvest losses can be very acute, reaching up to 40 per cent for perishables and 20–25 per cent for cereals, due to inadequate storage, transport infrastructure and logistics, and lacking processing facilities (World Bank, 2025). Sub-Saharan Africa’s storage capacity is less than 10 per cent of its food production.

Simultaneously, urban waste streams, particularly in low- and middle-income countries, contain a high proportion of organic waste, including food scraps and green waste (ESCAP, 2017). According to the World Bank, in 2016, Sub-Saharan Africa generated 174 million tonnes of waste, with organic waste making up 40 per cent of the total and alarming future trends. Collection rates remain low at 44 per cent on average, with rural areas particularly underserved, leading to two-thirds of waste being openly dumped (World Bank, 2018).

Agricultural waste includes residues from crops and livestock and which are not suitable for human nutrition and represent a significant yet underutilised resource. Although no estimate is available on the quantities of available agricultural waste, studies suggest that nearly half of all cultivated agricultural biomass, such leaves or stems, is not fit for human consumption and is discarded (EU, 2018).¹ Farm households, rural communities, and industries are major generators of agricultural waste through their daily activities, in the form of manure, crop residues, or mixed solid wastes. The improper disposal of this waste leads to air and water pollution, exacerbates soil degradation, and creates public health risks, as well as a missed opportunity for sustainable reuse. Uncontrolled decomposition of organic waste generates methane and ammonia, contributing to climate change and air pollution, while untreated waste attracts disease-carrying pests and contaminates water sources.

¹ Estimates refer to a study conducted on the agricultural production of the 28 European countries and its results might not apply to other geographical areas.

Agricultural waste holds enormous potential for sustainable reuse. Organic residues can be transformed into valuable inputs such as biofertilisers, biogas, and animal feed, offering a dual advantage of waste reduction and resource efficiency. Proper management of agricultural waste can reduce dependence on chemical inputs, improve soil health, and generate additional jobs and income for rural communities. Such practices align with the principles of the circular economy, which emphasise resource efficiency, environmental sustainability, and economic inclusivity. Addressing inefficiencies in agricultural waste management presents an opportunity for developing countries to strengthen their agrifood value chains while mitigating environmental and health impacts and creating decent jobs. By adopting context-appropriate technologies, these countries can leverage agricultural waste as a resource rather than a liability, contributing to economic growth and environmental resilience.

Waste streams in cities from the Global South are heavily composed of food and organic waste, typically accounting for 50 to 80 per cent of total municipal waste (ESCAP, 2017). With rapid urban expansion, waste generation is projected to triple by 2050 (World Bank, 2018), placing additional pressure on already inadequate waste management systems. Organic waste is a significant contributor to urban emissions, making up as much as 35 per cent of citywide emissions, primarily through methane release and water-polluting leachate from landfills and incineration (C40 Cities & Accra Metropolitan Assembly, 2024). The failure to implement efficient waste collection and treatment systems leads to greater economic costs, as the negative health and environmental impacts of uncollected waste often exceed the cost of proper waste management (C40 Cities Climate Leadership Group, 2019a). In many cities, where formal collection services are limited or nonexistent, waste is dumped in unauthorised sites, clogging sewers and rivers, or openly burned, further exacerbating air and water pollution, increasing health risks, and degrading land values. These consequences disproportionately affect vulnerable populations.

Incineration of organic waste has proven to be an inefficient and costly option, with significant environmental, social, and economic drawbacks (C40 Cities Climate Leadership Group, 2019b). Food waste is composed of about 70 per cent water and requires more energy compared to other waste to burn (M. Brown, 2015); in particular, waste in developing countries is higher in moisture content compared to wealthier economies (ESCAP, 2017). Moreover, incineration for energy recovery is highly uneconomical, costing nearly four times more than solar and onshore wind energy and twice as much as fossil gas (Zero Waste Europe, 2023).

In addition to its inefficiencies, incineration and landfilling generate fewer jobs than other waste management strategies (C40 Cities Climate Leadership Group, 2019b). Landfilling is the poorest job generator out of all of the waste management processes considered and creates between 1 and 2.8 jobs/10,000 Tonnes Per Year (TPY) of waste handled;² on the other hand, waste incineration has a job creation potential of 1.7 jobs/10,000 TPY on average (Ribeiro-Broomhead, J. et al., 2021). Combined, landfilling and incineration generate 1.8 jobs/10,000 TPY, almost four times lower than composting when focusing on the organic fraction of urban waste. In addition, waste incineration systems are complex and require skilled staff to ensure their optimal performance and maintenance of plants, which are not always available in cities of the global south. Despite being framed as a modern waste treatment solution, incineration does not qualify as a "green" job sector, as it neither promotes sustainability nor aligns with clean energy principles.

Although governments worldwide and in Africa are increasingly supporting better municipal waste services, institutional and regulatory frameworks remain weak (World Bank, 2018). This underscores the need to prioritise organic waste valorisation strategies, some of which will be presented in the next paragraphs.

² Range depends on the methodology of the assessment and on whether jobs in collecting and transporting waste to landfill sites are included.

Principles of appropriate technology

In recent discussions on development economics, the focus has shifted away from the sheer quantity of growth to its qualitative aspects, particularly productive transformation and the dynamics of the growth process. Structural and technological change, along with the development of social capabilities, plays a crucial role in driving productivity, income growth, job creation, the transition to formality, and poverty reduction. The experience of successful emerging economies in Asia demonstrates that high and sustained growth can be achieved through a structural transformation oriented towards employment creation, and rapid technological learning within the labour force (Nübler and Ernst, 2013).

The word *technology* encompasses more than the physical "hardware" used to produce goods or services. Technology should be understood as a 'combination of tools (the equipment required to produce goods or services); of techniques (the knowledge, skills and facilities required to operate those tools); of organisation (the processes by which techniques are marshalled); and of products -the goods and services which result from this process' (Practical Action, n.d.).

In international development, importing modern, efficient, and often capital-intensive technologies from industrialised nations does not guarantee their effectiveness or suitability. Technologies are inherently shaped by and adapted to their specific social, cultural, and economic contexts in order to enhance a development process. When these contextual factors are overlooked, technology transfer from its original environment to another setting is prone to failure. In cases where a society lacks the requisite skills, knowledge, and organisational frameworks to operate and sustain a given technology, and no skills development strategy is in place, such technology must be deemed inappropriate for that context. But if it is accompanied by such a strategy, it could lead to capability development and later on to structural transformation. Through this process a country could reach a more diversified and complex economy and a higher level of development.

The concept of *appropriate technology* emerged as a response to these challenges. It refers to technologies that are adequate-scale, energy-efficient, environmentally sound, labour-intensive, and accessible to local communities, enabling them to manage and maintain these systems independently (Barrett, H. et al., 2003). The term was first popularized by E. F. Schumacher in his book *Small is Beautiful* (1974); it was then adopted by the Intermediate Technology Development Group (ITDG), now called Practical Action,³ of which Schumacher was a founder (Baron, C.G., 1978).

However, the appropriate technology theory has also been criticised. There is a risk in considering any technology as ultimately appropriate, that is, when a technology could suit a specific context, any alternative technology would become inappropriate (Hollick, M., 1982). From the international development standpoint, there is a risk of prescribing solutions based on values that some communities might regard as undesirable, even though the prescription would be rooted in the appropriate technology definition. For these reasons, any international development initiative centred on technology should not be detached from the underlying political, social, and economic causes of poverty and inequality. The identification and implementation of appropriate technologies must go hand in hand with broader efforts to tackle these structural challenges. The process of identification of the appropriate technology should be grounded in a broad consensus and welcomed and promoted by the recipients of the innovation.

Research on technology choices has mostly focused on efficiency looking at the factor endowment only of a country, while neglecting opportunities for capability development. *"Appropriate technology choices guarantee that the development may trigger a learning and thus a capability development process, be more inclusive, or human-centred in ILO terms, and create more and better jobs for the most excluded from the labour market, the informal workers"* (Ernst, C. et al., p.27, 2023). Traditional local technologies with high potential for capability development and innovation have often not been taken into account. According to the International Labour Organization (ILO), appropriate technology should be rooted in social dialogue and should reflect the economic reality, address the basic needs of local communities, and foster income generation, and foster the transition to formal just while respecting the environment.

³ Practical Action website is available at: <https://practicalaction.org/>

Often, in developing countries with labour-abundant capital-scarce economies, appropriate technologies are often rather labour-intensive. The use of labour-intensive methods, however, is only

appropriate when these are technically and economically competitive, therefore the importance of feasibility and cost-effectiveness of appropriate technologies.

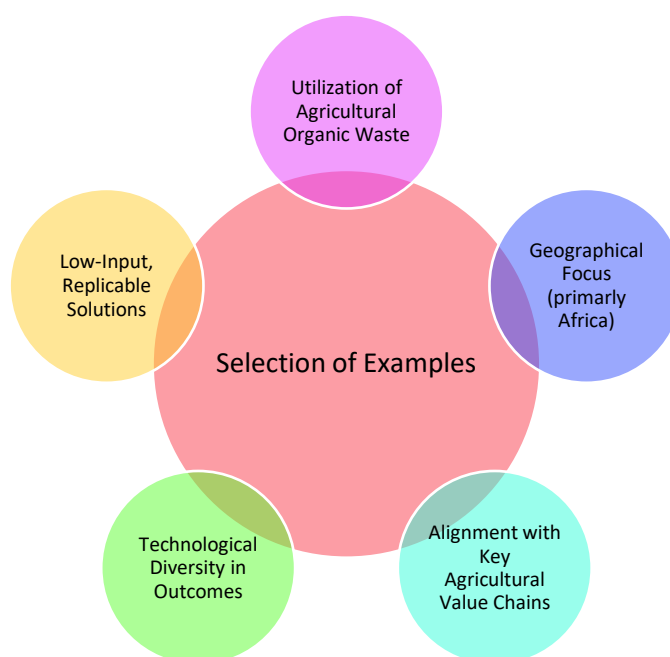
The new concept of appropriate technologies looks into suitable technological alternatives with greater labour-intensity, higher local learning effect and higher feasibility to be taken over by local, mostly, but not exclusively, informal workers. But the aim is to strike a balance between productivity and labor absorption for the process of capability development. e.g. the balanced use of intermediate or improved labour-intensive methods with a high learning potential with capital-intensive ones (Ernst et al., 2023).

In the case of agricultural waste reutilization, particularly for smallholder farmers in rural Africa, it is important to clarify that maximal recycling of farm waste and the addition of composted material from non-farm sources is a common practice. Smallholder farmers often practice regenerative, green practices, although many might lack the expertise on how to maximize the efficiency of these methods. Understanding the local context and which [additional] regenerative, climate-smart practices for agricultural waste use can be easily applied for sustainable production and long-term adoption without disrupting local agricultural traditions should represent a key goal of interventions.

Research methodology

The objective of this research is to identify and analyse appropriate technologies for transforming organic waste into direct and indirect inputs for food production within a circular economy framework. A particular emphasis is placed on their potential to create green jobs complying with the Decent Work Agenda in African countries. A qualitative research methodology was used, integrating desk review of relevant literature and documented best practices with Key Informant Interviews (KII). The technology examples were identified among peer-reviewed literature, technical reports, case study documentation, and grey literature from international organizations such as ILO, FAO, UNDP, news, as well as websites and news. The selection was guided by the following criteria (selection framework) to ensure alignment with the research objectives (Figure 1): a) identify technologies that utilise agricultural organic waste to generate value-added products or services; b) identify alternative technological solutions for organic waste transformation; c) select predominantly examples from African countries; d) select examples of technologies that are resource-efficient, low-cost, and have the potential to be scalable or replicable (appropriate technology); e) focus on technologies that are linked to Africa major agricultural value chains. For the selection of case studies, appropriate technologies linked to the main African agricultural activities and their main sub-categories have been prioritised according to FAO statistics on total production (tn) and total cultivated land (ha) in 2023 (FAO, n.d.) including cereal, legumes/pulses, animal waste, oilseed, root and tuber waste.

► **Figure 21: criteria for the selection of the examples**



To analyse and categorize case studies of organic waste transformation technologies, a set of guiding criteria was adopted and complemented with KIIs. Table 1 was used as a guiding instrument to identify key aspects related to each technology across various dimensions, including material availability, economic feasibility, environmental suitability, social and cultural acceptance, and technological readiness. This research establishes a categorization of technologies about their contextual relevance and does not intend to evaluate whether case studies represent examples of appropriate technology. Case studies and examples were further developed and complemented with KIIs. Out of 23 contacted, a total of 9 Key Informants from UN Agencies, Private Sector, and Academia were interviewed.

► **Table 1: Categories utilised for case study evaluation**

Type	Category	Details
Inputs/ Outputs	Category of final product	Animal feed, compost, bioenergy, etc.
	Types and availability of organic waste utilised	List specific types (e.g., crop residues, food waste) and assess local availability
	Scale of the production	Smallholder scale, small/medium commercial scale, or industrial scale
	Transport and storage requirements	Infrastructure needed (e.g., cold chains, fermentation plots, biodigesters)
Technological	Type of technology	Specific tools, machines, or systems required, including water and electricity
	Maintenance and Spare Parts	Availability and accessibility of spare parts and technical support at local and country level
Economic	Market Demand	Presence of a market for the technology's outputs (e.g., biofertilisers, bioenergy)
	Cost-Effectiveness	Affordability and observed return on investment
Human Resources	Skillset needs	Required skills to operate the technology (e.g., university education, vocational training)
	Skills transfer potential	Opportunities for skills transfers to local workforce
	Skillset availability	Availability of skilled labour in the area/ country
	Employment creation	# of workers required relative to the scale of the system
Climatic/ Environmental	Climatic Suitability	Optimal climatic conditions for the technology (e.g., temperature, humidity, rainfall)
	Ecological Impact	Effects on local ecology, including biodiversity, carbon footprint, and potential introduction of non-native species
Social/ Cultural	Community Acceptance	Alignment with local culture, habits, and willingness to adopt the technology
	Compatibility with existing waste transformation practices	Extent of alignment or conflict with existing waste transformation practices
	Social Inclusion	Opportunities to involve marginalized groups, youth, and women in the technology's operations
Knowledge/ Information	Educational Resources	Availability of training programs, materials, and knowledge-sharing platforms
Policy/ Regulatory	Regulatory Compliance	Adherence to regulations including safety, health, and environmental standards

Examples of appropriate technologies for organic waste management

The urban waste challenge: an untapped resource

Identifying appropriate solutions for Municipal Solid Waste Management (MSWM) is key and should be context specific. Urban organic waste is mostly treated using either composting or anaerobic digestion at different scales and characteristics or a combination of them. If properly implemented, these technologies have the potential to create green jobs along waste collection, transport, disposal, and improved resourcing activities and support local agriculture, urban greening, and forestry while reducing emissions (C40 Cities Climate Leadership Group, n.d.) and generating profits, as the global food waste management market is projected to reach around USD 121.8 billion in 2033 (Future Market Insights, 2023).

Composting is a simpler and cheaper process (see the section on composting), whereas anaerobic digestion for bioenergy generation is better suited to large-scale facilities due to the higher upfront costs, but both can be used at any scale. For instance, in response to a severe waste management crisis, Alappuzha Municipality, India, launched a project in 2014 to provide subsidized small-scale aerobic composting bins and biogas systems to households, promoting waste segregation and on-site processing (The Print, 2017). Although no employment impact analysis was conducted and the project likely did not have a huge impact in terms of job creation, it undoubtedly built skills and knowledge within the community on organic waste management. The project ran community engagement and awareness campaigns for about two years, fostering widespread adoption. Today, the initiative has expanded to 3,000 biogas plants and 2,800 compost bins, covering most homes, while 33 communal aerobic units serve those without individual bins.

An interesting approach for managing the organic fraction of MSWM comes from the United Nations Economic and Social Commission for Asia and the Pacific (ESCAP), which in 2009 launched a regional project to promote Integrated Resource Recovery Centres (IRRCs). IRRCs are decentralised, small-scale waste recovery facilities that receive segregated or non-segregated municipal waste and use low-cost processes to recover resources from the waste. An IRRC is designed based on local needs and capacities, considering the quantity and quality of local waste generation, waste management requirements, and available technical and financial resources. It can serve multiple purposes, including converting the organic fraction of waste into compost or biogas for electricity generation, co-composting faecal sludge while filtering wastewater to a quality suitable for groundwater recharge and recovering and sorting recyclable materials, among others.

Compared to large-scale urban waste management solutions that use expensive technologies such as waste incinerators, the technologies employed in an IRRC are simple to construct and operate locally, mostly non-mechanized, and durable, being modular, scalable, and replicable. From 2009 – 2018, ESCAP has implemented ten IRRCs in nine cities of Bangladesh, Cambodia, Indonesia, Pakistan, Sri Lanka, and Vietnam. The ESCAP approach ensures the participation of local and national governments, communities, non-government organizations, private enterprises, and other relevant local stakeholders through social dialogue to identify and discuss potential costs and benefits of IRRCs. This includes the Identification of the immediate beneficiaries from the IRRC and those that may be negatively impacted, as well as the impact on the employment of vulnerable groups such as informal waste workers.

► **Box 1. Tackling food loss: upstream organic waste management and valorisation**

Beside enhancing waste management and valorisation, food loss has to be reduced upstream. According to FAO, approximately 13 per cent of food produced globally is lost between harvest and retail, while an estimated 19 per cent is wasted across households, food services, and retail (United Nations, n.d.; FAO, n.d.; UNEP, 2025). In some cases, food is wasted because it does not meet the aesthetical standards required by markets. Much of this waste ends up in landfills, contributing to environmental and economic inefficiencies. While proper collection, disposal, and treatment are essential, authorities must prioritise food waste prevention and reduction strategies. Organizations are supporting these efforts by providing tools to measure and assess food waste,⁴ which serve as a foundation for designing targeted policies and sustainable solutions.

For instance, in La Garay, Argentina, it was estimated that local industries were generating approximately 100 tons of carrot daily—equivalent to the waste output of a town of 100,000 inhabitants—due to strict market standards on shape and size, leading to nearly 40 per cent of the carrot harvest being discarded (IDB, 2019). In 2013, the local private company Val Mar, a packaging firm, and the Asociación para el Desarrollo del Departamento Garay, partnered with CONICET to identify solutions to transform this waste into high-value products. As a result, since 2018, a plant has been operational processing two tons of carrots per day for the production of three key by-products: bioethanol, dietary fibers, and carotenoids. Bioethanol is used in the pharmaceutical, perfume, beverage, and biofuel industries, while carotenoids and dietary fibers serve as natural food colorants and nutritional supplements, both of which Argentina currently imports entirely.

Beyond tackling a growing national waste problem, Argentina's carrot waste initiative is creating a new industry in a previously underserved region, with the potential to scale up and generate more jobs. However, while adaptation strategies like waste valorization address market inefficiencies, stronger mitigation efforts—such as Carrefour's "Tous AntiGaspi" campaign⁵—are essential to challenging consumer biases and restrictive market standards that contribute to food loss. Prioritizing mitigation is key to ensure a systemic shift that reduces waste at its source while complementing adaptation strategies for a more sustainable agrifood system.

Conducting waste assessment and/or surveys⁶ to understand the type and characteristics of the waste and to identify city-wide trends is a crucial first step for any intervention (ESCAP, 2017). Assessments also help assess the willingness to adopt new waste management practices, track disposal methods, and identify key actors, such as waste pickers and industries contributing to waste generation and disposal. Cities can provide capacity-building to support informal workers in advocacy, negotiation, and self-organisation, e.g. creation of cooperatives. They can also assist in identifying key stakeholders with whom to negotiate and experts who can help them to co-design supportive policies, practices, and services. An example is the needs assessment reports carried out by C40 between 2021 and 2022 about informal waste pickers in Accra, Ghana, which represents an interesting participatory approach for the improvement of waste pickers' working conditions and waste systems (C40 Cities, 2022; C40 Cities & Accra Metropolitan Assembly, 2021).

Example: supporting migrant waste pickers' livelihoods in Accra, Ghana – C40

Accra, Ghana, a rapidly growing city of over 2 million inhabitants, generates approximately 2,200 tons of solid waste per day, a figure projected to double to over 4,400 by 2030 due to urban expansion and population growth (C40 Cities, 2023). Managing this increasing waste volume is a significant challenge, requiring a coordinated approach that integrates formal and informal waste management systems. The current solid waste management system is hybrid, with formal waste management companies providing structured waste collection, while informal workers playing a crucial role in waste sorting, treatment, and recycling. Recent studies show that the informal

⁴ The Food Loss and Waste Accounting and Reporting Standard, for instance, offers a structured framework to help cities collect and analyze data, guiding their waste minimization strategies (C40 Cities Climate Leadership Group, 2021)

⁵ More information available at <https://www.carrefour.fr/engagements/environnement/anti-gaspi> (French)

⁶ Tools such as *OrganEcs* has been developed to support cities at the planning stage, particularly to guide them at financial planning and technology selection based on cost estimation. Available at: <https://www.c40knowledgehub.org/s/article/OrganEcs-A-Cost-Estimating-Tool-for-Managing-Source-Separated-Organic-Waste>

sector collects approximately 40% of the waste in the Greater Accra Metropolitan Area (GAMA), particularly in areas where private companies do not operate (C40 Cities, 2023).

To improve waste management, AMA and private actors are investing in waste recovery infrastructure. A key example is the Accra Composting and Recycling Plant, a large-scale facility capable of processing 2,400 tonnes of municipal solid waste daily, producing 240 tonnes of compost (C40 Cities, 2023). This initiative contributes to reducing landfill dependency by converting organic waste into compost for agricultural use. Additionally, Accra has established transfer stations where waste is sorted before being sent to composting plants or aggregators for recycling.

The informal waste sector operates at all stages of the waste management value chain, from collection to treatment and recycling. Waste collection follows two primary pathways: formally collected waste is transported to composting and recycling plants, landfills, or transfer stations, where informal waste workers recover valuable recyclables. In contrast, waste collected by informal workers is sorted directly at the source, with high-value recyclables sold to aggregators who process them before resale to recycling industries.

Through a process of social dialogue, AMA has launched initiatives to integrate them into the formal economy (Mayors Migration Council, 2022; Sackey et al., 2024). The Creating Livelihood and Environmentalism in Accra Now (CLEAN) project, funded by the Global Cities Fund for Migrants and Refugees, has brought over 400 informal waste workers—many of whom are migrants—into the formal waste sector by enrolling them in cooperatives overseen by the city government. Participants have been registered into Ghana's national health insurance scheme, and skills training programs have resulted in a 15 per cent increase in job security among waste pickers. To further support these workers, a childcare centre was established in a key waste collection hub, providing a safe environment for children away from hazardous work sites. Moving forward, Accra aims to expand financial support for health services, cooperative registration, and childcare facilities while also establishing a Migrant Desk to facilitate access to social services (Mayors Migration Council, 2022).

Composting beyond environmental sustainability

Composting is a natural microbiological process in which organic materials decompose under controlled conditions, transforming waste into a stabilized organic amendment. While decomposition occurs naturally in ecosystems, composting as an organized practice has emerged as a response to the need for a structured and hygienic method for handling large amounts of organic waste (FAO, 2007). This bio-oxidation process, facilitated by a diverse population of microorganisms, produces compost—a stable organic material that enhances soil fertility and contributes to sustainable agricultural practices.

In many regions, particularly across Africa, soil fertility decline is a major challenge due to nutrient depletion caused by continuous cropping, leaching, and erosion (FAO, 2007). The annual losses of nitrogen, phosphorus, and potassium per hectare of arable land make nutrient replenishment essential for sustaining agricultural productivity. Composting offers a viable solution by recycling organic matter, returning vital nutrients to the soil, and improving soil structure and moisture retention while reducing reliance on chemical fertilisers, mitigating environmental risks associated with improper organic waste disposal, and enhancing food security through improved crop yields. At the urban level, the separate collection and treatment of organics is key because it avoids cross-contaminating recycling streams and avoids landfill methane generation (Ribeiro-Broomhead, J. et al., 2021).

Composting can range from small-scale backyard to industrial-scale waste systems to process the organic fraction of MSW. The advantage of on-farm composting lies in the availability of necessary resources—feedstock, water, space, and labour—without the need for significant external inputs and farmers benefit from composting in multiple ways. They can reduce input costs by substituting compost for commercial fertilisers and soil conditioners, and in some cases, high-quality compost can be marketed, generating additional income streams. On the other hand, large-scale composting operations at the private sector level, either individually or through farmer cooperatives, can capitalize on economies of scale, making compost sales a viable business model. Communal composting facilities also present an efficient means of managing waste and generating economic returns for communities. By pooling organic waste from multiple sources, communities can establish centralized

composting hubs, reducing individual investment burdens while ensuring a steady supply of compost for agricultural use or sale.

The feasibility of composting as a revenue-generating activity depends on the scale of production, the quality of the final product, and the existence of a market for compost-based soil amendments. Organic waste producers, such as farmers, abattoirs, and local markets, can benefit from the circular waste economy by charging tipping fees for organic waste collection. Also, municipalities financially benefit from the implementation of composting, which is a cost-effective waste management solution (Ribeiro-Broomhead, J. et al., 2021). The composting operation in La Pintana, Chile, for instance, which processes 20.5 per cent of the locally generated organic waste, requires only 2.4 per cent of the solid waste budget while generating the equivalent of 3-7 jobs/10,000 TPY (Ribeiro-Broomhead et al., 2021).

There is a lack of dedicated research to estimate the job creation potential of composting-related activities. Small-scale composting as an activity integrated in a wider on-farm cycle is not likely to create additional jobs apart from those already in-farm. However, large-scale composting, such as urban-scale composting management of organic waste, does. Available information mostly refers to direct work in producing compost at a facility, without considering recollection, transport, and distribution of the finalised compost, with an average of 6.6 jobs/10,000 TPY. Including jobs for waste collection, compost sales, and other products, in addition to standard compost processing, sums up to a higher job figure of 14 jobs/10,000 TPY, based on a case study in Bali, Indonesia. In the analysis, the authors also suggest that more mechanization leads to fewer jobs, based on the results from a case study analysis in Lahore, Pakistan, that utilises highly mechanized windrow composting to dispose of organic waste, which has a lower job figure compared to the other site analysed of 2.7 jobs/10,000 TPY.

► Box 2. Online training and resources on composting

There are several online training resources on composting which can equip farmers, entrepreneurs, and waste management practitioners with practical skills to transform organic waste into valuable agricultural inputs. Videos such as *How I make Vermicompost* provide hands-on guidance on setting up vermicomposting systems, making the process accessible to a wide audience.⁷ Platforms like *accessagriculture.org* offer practical demonstrations on constructing composting and vermicomposting beds using locally available materials, emphasising low-cost and scalable methods.⁸ The Organic Farm Knowledge platform further supports users with technical insights into composting processes, reinforcing sustainable agricultural practices.⁹

From backyard composting to urban integral solid waste management

Integrated solid waste management (ISWM) for zero waste is a comprehensive waste management approach that prioritises waste reduction and material recovery, including policy interventions to drive the redesign of products and delivery systems and increasing access to reuse, repair, recycling, and composting (2021). ISWM approaches to create more jobs than systems that primarily burn or bury waste and position sustainable waste management as an opportune social infrastructure in which investments can strengthen local and global economic resilience' (Ribeiro-Broomhead, J. et al., 2021). Furthermore, multiple studies of zero waste systems cite higher wages and better working conditions than in comparable fields, and opportunities to develop and use varied skills. Cities need to invest in training and employment opportunities that support workers to participate in sustainable waste management and a just energy transition. This could mean focusing, for example, on engaging informal workers in a transition to sustainable collection and treatment of organic and recyclable waste and on creating equitable and inclusive jobs in the renewable energy sector.

⁷ Available at: <https://www.youtube.com/watch?v=xfWjbeMMAZw>

⁸ Available at: <https://www.accessagriculture.org/making-vermicompost-bed>

⁹ Available at: <https://organic-farmknowledge.org/tool/43058>

As mentioned, composting can evolve into a revenue-generating activity when integrated into broader business models. This shift is particularly relevant in a just transition, where industries reliant on conventional inputs explore organic alternatives while fostering decent jobs. When structured as a waste-based and employment-focused model, these initiatives can provide livelihoods and resilience in agricultural supply chains. However, their success requires a coordinated effort among multiple stakeholders, including municipal authorities, private enterprises, waste workers, and local communities. Initiatives capable of promoting inclusivity are particularly relevant in contexts where waste-related activities, such as collection, sorting, and recycling, have historically been carried out by informal workers without social protection or stable incomes.

The following experiences exemplify how composting could be scaled up to become a stand-alone economic activity. The first example presents the foundation of a multi-stakeholder waste-valorisation project, highlighting the potential for job creation, formalization of labour, and economic integration within an ISWM urban framework. This example is extracted from a feasibility assessment carried out by ILO in 2024 on the establishment of an ecological village through integrated waste management in the intercommunal area of Sfax-Nord, Tunisia. As part of an FAO-supported project, the second example presents the experience of an established chemical fertilizer company that integrated organic alternatives into its operations, using vermicomposting technology to bridge economic and environmental objectives. It highlights the role of private sector partnerships in scaling organic waste processing, expanding market access, and positioning composting as a viable business model within the circular economy.

Example: integrated solid waste management in Tunis – ILO Tunisia¹⁰

The ILO-led waste valorisation project proposed in the intercommunal area of Sfax Nord aims to establish sustainable waste treatment and processing systems ensuring waste minimization and soil revitalization while prioritising employment creation, social inclusion, and skills development. The initiative focuses on valorising the organic fraction of municipal waste generated from households and businesses and seeks to reduce reliance on landfill disposal. It includes key components such as source-separated waste collection, mechanical sorting, reuse and transformation of recyclable materials, and compost production. The composting process is further supported by the reuse of treated wastewater from a local wastewater treatment plant. Green waste from public and private gardens, agricultural residues, and organic waste from households will be collected, shredded, and processed into compost at designated sites. The compost will be applied to identified depleted lands to reestablish soil health.

The project envisions the creation of an ‘Ecological Village’, integrating civil society organizations, municipal authorities, and local enterprises into the waste management system. Environmental associations will play a critical role in raising awareness and mobilizing residents to participate in waste sorting and source separation. The initiative also formalizes partnerships with municipalities and the private sector to streamline waste collection, provide necessary training, and establish incentives that reward households and businesses for participating in selective waste sorting.

The project is expected to create approximately 210 permanent jobs across various sectors and skills requirements, including waste collection and sorting, co-composting operations, green waste processing, and recyclable material transformation. Furthermore, it seeks to address informal waste collection and integrate existing waste pickers into a structured waste management system. It will ensure women’s participation, with an estimated 69 out of 210 jobs expected to be occupied by women, particularly in waste sorting and administrative roles. Workers involved in municipal waste collection, mechanical sorting, and composting will receive technical training in waste handling, machine operations, and quality control. Specialized training for composting technicians, agronomists, and laboratory staff will support the production of organic amendments, fostering sustainable agriculture in the region. Moreover, the project encourages entrepreneurship by facilitating the emergence of small enterprises engaged in recyclable waste transformation and compost sales.

¹⁰ Source: Key Informant Interviews

The project integrates multiple waste management facilities. It includes mechanical and manual sorting units with a capacity of 20 tons per hour, a secondary transformation centre for non-organic recyclables, and two co-composting units to be located across two state-owned agricultural sites with a combined production capacity of 70,600 tons of compost per year. The total estimated budget for the implementation of the Ecological Village Concept through Integrated Waste Management amounts to €20 million. This budget covers all phases of the project, including the establishment of an integrated waste management system, capacity-building, and technical assistance, with most of the funding (70 per cent) allocated to developing the waste management infrastructure.

Example: the private sector towards a Just Transition in Zimbabwe – FAO and Sable Green Trust¹¹

Between 2022 and 2024, in Zimbabwe, FAO collaborated with Sable Chemicals, one of the country's largest chemical fertilizer producers, to pilot a vermicomposting Public Employment Programme to provide alternative organic fertilisers while creating employment opportunities for rural youth. The pilot project, implemented in Kwekwe district under the Sable's Green Trust, has trained youth in vermicomposting—a process that uses earthworms to transform organic waste into nutrient-rich compost. This transition-oriented initiative has allowed Sable Chemicals to explore organic fertilizer production while supporting local youths with stable employment and knowledge-sharing opportunities.

Sable Chemicals has utilised biodegradable waste from local sources, establishing linkages with the local City Council, city markets, and the local abattoir to obtain organic matter. These inputs were processed into three key products: vermicompost as a basal fertilizer, earthworm poop tea for seed coating, and vermifoliar as a nitrogen-rich foliar spray.

The initiative has emphasised employment creation and skill development, with youth engaged in various production roles. Training under the FAO Green Jobs for Rural Youth Employment (GJ4RYE) program has enabled participants to acquire hands-on experience in composting, waste management, and organic farming.

Sable Chemicals is aiming at institutionalizing the initiative by building alliances with local partners and registering it as a stand-alone business. EFG is intended to scale up vermicompost production and distribution, gradually absorbing youth workers from the Wage Employment Program into more permanent roles. Expansion plans include securing additional biodegradable waste sources, mechanizing production to increase efficiency, and conducting large-scale demonstration trials with different farming groups.

¹¹ Source: Key Informant Interviews

► **Box 3. Waste of the bioeconomy in Argentina: valorising peanut shells**

Over the past decades, Argentina has developed a robust bioeconomy sector, characterised by strong institutional frameworks and active participation from both public and private stakeholders. As already shown in the example presented in Box 1, the country's experience demonstrates how multi-stakeholder collaboration—between private enterprises, local and national public institutions, and the academia—can identify bottlenecks and develop innovative solutions to transform agricultural waste into valuable resources to be re-introduced within the agrifood system. Another example of this is the peanut agro-industrial cluster, which integrates farmers, SMEs, and processing industries into an export-driven value chain, supporting approximately 12,000 direct and indirect jobs. However, the expansion of peanut production has resulted in significant waste, particularly from peanut shell residues. To address this challenge, waste valorisation strategies have been implemented, turning these by-products into useful inputs. Peanut shells are processed into biofertilisers, reducing dependence on synthetic alternatives, while thermal power stations convert them into electricity, circularly supplying energy to processing facilities, while ashes from bioenergy production are further repurposed into ecological bricks.¹² The cluster generates employment in various fields, including agrochemical production, farming, industrial equipment, quality control, transportation, and R&D. The demand for specialized skills in biotechnology, environmental management, and sustainable agriculture has also stimulated the education sector, fostering collaborations between universities, technical schools, and industry to enhance workforce capabilities. While replicating this model requires substantial financial and human capital, the core principle—enhancing multi-stakeholder engagement and cooperation to identify locally suitable solutions for reutilizing agricultural waste—is adaptable across different contexts, value chains, and regions.

Scaling biochar: a profitable agriwaste solution for rural jobs and the private sector

The use of charcoal to enhance soil fertility dates back thousands of years, but its large-scale adoption has gained momentum only recently. Recycling agricultural and organic residues for biochar production offers a cost-effective and locally viable approach with benefits for both climate mitigation and soil health. Biochar is the solid carbon-rich material that remains after biomass undergoes pyrolysis—a high-temperature, low-oxygen decomposition process. It is specifically produced for soil application to improve fertility and enhance carbon sequestration, making it a valuable tool for sustainable land management and climate resilience.

Biochar functions as a soil conditioner with the potential to enhance soil health by reducing nutrient loss, increasing nutrient bioavailability, and minimizing nutrient-leaching (Scholz et al., 2014). While its effectiveness may vary (FAO, 2023), its application can decrease dependence on chemical fertilisers, lowering both environmental impact and production costs. Additionally, biochar's high water-holding capacity improves the biophysical and chemical properties of drought-prone soils, making them more resilient to water stress (Obia et al., 2013). Beyond its agronomic benefits, biochar serves as an effective carbon sink, as its decomposition occurs at a significantly slower rate than that of raw biomass. While fresh biomass releases stored carbon back into the atmosphere within months to years, biochar stabilizes carbon for centuries or even millennia, making it a strong tool for long-term carbon sequestration and climate change mitigation.

Biochar can be produced from various types of biomasses, including agricultural residues, rice husks, and urban organic waste. However, different production conditions yield biochar with distinct properties, which interact differently depending on soil type. To maximize sustainability and minimize disruption to local carbon and nutrient cycles, biochar production should prioritise "true wastes"—materials that would otherwise be landfilled or burned, or invasive species, which offer no climate or soil benefits (Scholz et al., 2014). Using dedicated crops or deforesting land for biochar production would counteract its carbon sequestration potential. Instead, biochar

¹² Furthermore, peanut shells are also being used to produce activated carbon, reducing imports in food processing, pharmaceuticals, and water sanitation as well as to create absorbent blankets for oil spill clean-ups.

technology presents a viable solution for managing agricultural residues that exceed livestock fodder stem and for woody crop residues such as coconut shells, stalks of cassava, and cereal straw.

Biochar production systems vary in scale, ranging from small household cookstoves to large industrial pyrolysis plants. These systems are typically classified as gasifiers or pyrolyzers, depending on the technology applied. Smallholder farmers often adopt biochar-producing cookstoves, which not only enhance soil fertility and crop productivity but also provide an alternative to traditional biomass cooking fuels. By reducing reliance on firewood, these systems help alleviate deforestation while decreasing the time and labour required for fuel gathering—a responsibility that disproportionately falls on women. Reducing this burden also mitigates these women's risks of exposure to physical and sexual violence associated with firewood collection (FAO, n.d.).

Biochar systems can integrate bioenergy, soil enhancement, and economic benefits, making them valuable for small-scale agricultural economies. The choice of technology is closely linked to feedstock availability, as different organic residues perform optimally in specific production methods. However, many biochar technologies remain flexible enough to accommodate a variety of feedstocks. Research efforts are ongoing to develop affordable, farm-level kilns that enable smallholder farmers to produce biochar efficiently (Pasumarthi et al., 2024).

From a health and labour perspective, biochar-producing cookstoves significantly improve fuel efficiency, allowing for a wider range of feedstock inputs while reducing smoke emissions. This is particularly beneficial for women and children in rural communities, as it lowers indoor air pollution and associated respiratory illnesses. Additionally, by providing a sustainable alternative to wood fuel, biochar systems contribute to environmental conservation and reduce the time burden on women, allowing for greater engagement in economic and community activities.

Example: private sector engagement in biochar production in Namibia – Africa sun holdings¹³

Several civil society organizations, private sector actors, and international development agencies are promoting biochar for climate change mitigation, soil enhancement, and rural development.¹⁴ While biochar itself is a valuable agricultural input that improves soil fertility and can support productivity within an Integrated Farming System perspective, at small or medium scales, it can hardly constitute a standalone economic activity capable of sustaining full-time employment or generating significant income. For this reason, development projects are increasingly integrating biochar production with carbon markets through Carbon Removal Certificates (CRCs).¹⁵

These projects typically provide farmers with biochar production units adapted to local conditions, train them in their use, and facilitate carbon certification through accredited partners. Certified agents audit and verify the carbon sequestration achieved through biochar production, enabling farmers to generate tradable CRCs on carbon markets. The sale of these credits, rather than biochar itself, becomes the primary income stream for participating farmers while they continue to benefit from biochar's positive application. An example is the project being implemented in the Ovitoto Conservancy area, Namibia, by Africa Sun Holdings (ASH) International, a British-based company.

The project is a biomass-to-biochar initiative under a Public-Private Partnership model. ASH International is a company specialized in developing integrated biomass businesses across Africa, focusing on producing biochar for agriculture and soil rehabilitation. The project focuses on converting encroacher bush into biochar for agricultural applications and generating CRCs, which are sold on the carbon market—the company's primary revenue source.

¹³ Source: Key Informant Interviews

¹⁴ Multinational corporations are investing in biochar-related carbon markets. For instance, Google has partnered with Indian supplier Varaha to purchase carbon credits from an initiative that converts agricultural waste into biochar, sequestering carbon while enhancing soil productivity. Google plans to acquire 100,000 tons of carbon credits by 2030, supporting farmers in turning crop residues into biochar, which can also serve as an alternative to chemical fertilisers (Economic Times, 2024).

¹⁵ For instance: the [Business Partnership Platform](#) in Vietnam

In Namibia, ASH International has established a local enterprise, ASH Namibia (Pty) Ltd, which holds an 80 per cent stake in the project, while the Ovitoto Conservancy, a self-governing entity legally sized by the Ministry of Environment, Forestry and Tourism (MEFT) which oversees environmental conservation and the sustainable use of natural resources for economic benefit, retains a 20 per cent share.

The project integrates sustainable bush thinning and biomass utilization practices in compliance with Namibian environmental and labour regulations. Encroacher bush have aggressively spread across communal and conservancy lands and are recognised by the MEFT as a species requiring management. By transforming these bushes into biochar using pyrolysis kilns (Kon-Tiki kilns), the initiative pursues the restoration of degraded rangelands and conservation of biodiversity, the preservation of groundwater resources, the creation of a sustainable enterprise for rural communities, and the sequestration of atmospheric CO₂.

The initiative is creating jobs among local and low-skilled rural workers. It operates with 75 employees (a ratio of five workers per kiln), 30 of which are women, involved in biomass harvesting, transport, biochar production, packaging, administration, and additional biomass plantations. Employment contracts comply with national labour laws, guaranteeing formal wages, social security registration, maternity and sick leave, and contributions to Namibia's Workmen's Compensation Fund for workplace injury coverage while adhering to legal prohibitions against child and forced labour.

At the start of the project, a non-trading pilot phase was conducted over three months to evaluate the feasibility of large-scale biochar production, assess management structures, and establish operational protocols. The community-owned charcoal production permit was converted into a biochar production permit, giving green light to operations. ASH conducted training for selected workers: a two-week program focusing on health and safety, understanding biochar systems, and technical production processes, as well as on soft skills.

One of the key social impacts of the initiative is the provision of a stable income for rural workers, allowing them to plan their livelihoods with greater financial security, particularly in remote areas with limited employment opportunities. In addition to direct job creation, the project encourages local farmers to integrate biochar into their agricultural practices. When activated with manure, biochar has led to noticeable improvements in small-scale crop yields, supporting household-level food production. However, rather than pushing for large-scale agricultural expansion, the initiative focuses on strengthening subsistence farming and soil health. Beyond employment and soil restoration, ASH has incorporated a community development component into its business model. Through its education foundation, the company commits 10 per cent of all profits to local education initiatives, ensuring that economic benefits extend beyond the immediate workforce and supporting long-term community resilience.

► Box 4. Online training and resources on biochar production

Educational material on Biochar production is widely available online. Accessagriculture offers based on examples of Biochar in India.¹⁶ Ripple Africa, also offers a video on how to make Biochar in Africa from crop waste.¹⁷

Turning waste into income through the insect economy: black soldier flies

Increasing global demand for animal protein combined with an urgent need to advance towards global sustainability has spurred the development of insects as a protein source in animal and fish feed, which is projected 80 per cent increase in production by 2030 (Feed Mill of the Future, 2024). Edible insects are viable and sustainable protein sources for animal feed. Being simple to manage at a small production scale, insect agribusinesses can improve the livelihood and productivity of smallholder farmers at low cost.

¹⁶ Available at: <https://www.accessagriculture.org/biochar-improve-soil-health>

¹⁷ Available at: <https://www.youtube.com/watch?v=ljDeB3bzhgc>

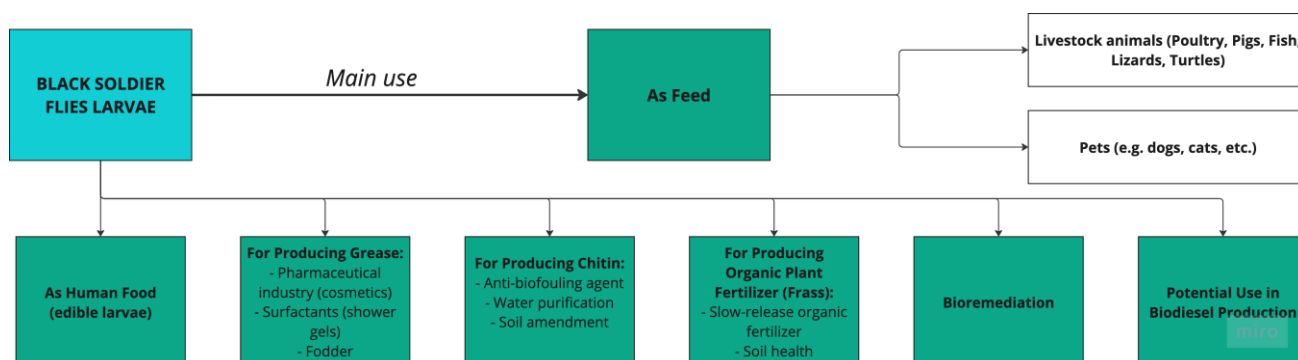
The Black Soldier Fly, also known as *Hermetia Illucens*, is a medium-sized fly characterised by its sleek black exterior and robust appearance. Unlike other fly species, BSFs are not considered a disease vector or pest, have the potential to deter known transmitters and has antimicrobial properties. BSFs thrive in environments with warm temperatures and moderate humidity and do not require standing water, which can attract mosquitoes. FAO estimates that replacing just 10 per cent of fishmeal in aquaculture with insect meal could save over 15 trillion litres of water annually – a significant benefit for water-scarce countries (FAO, 2013). BSF receive their required water intake through their diet and can consume a wide range of organic waste, including animal manure, municipal organic waste, food waste, crop straw, and empty fruit bunches (Kalova et al., 2013; Salomone et al., 2017; Manurung et al., 2016; Dickinson et al., 2019). BSFL converts waste into protein and fat-rich biomass and gains up to 5,000 times its body weight in a couple of weeks (Kotch, 2024), significantly reducing waste volume and diverting it from landfills and dumping sites, all while reducing water inputs to the food sector. Furthermore, BSF-fed livestock fed with BSF convert their feed more efficiently, research shows; research proved that BSF-fed poultry can achieve better feed conversion ratios, requiring less feed and consequently less water to produce the same amount of meat (Veldkamp et al., 2023). BSF farming embodies a circular economy, as the farm and household organic waste becomes the BSFL's food, turning the BSFL into a nutrient-rich source of protein for poultry, fish, and even pet food.

BSF solution is spreading very rapidly worldwide and in Africa, and farmers in East African countries are increasingly adopting BSF technologies. Based on a study conducted by Fair & Sustainable Consulting and led by FAO, in Kenya and Uganda, there are an estimated 1,200 and 500 BSF producers, respectively. The research shows that two main production systems are shaping the BSF value chain, the first being BSF production at household level, done by small-scale farmers who use a mixed farm with both crop production and animal rearing and aim to reduce feed and fertilizer costs, and the second being commercial producers target large-scale buyers, including feed millers; these production systems are fluid and producers moving from one to the other overtime (F&S, 2023). Despite its increasing relevance, the sector faces issues related to weak regulatory system, production consistency and volumes, limited drying and processing infrastructure, and lacks standardized pricing. In some cases, such as in Kenya, the sector operates in a legal grey area, with regulations split between institutions and policies focusing mainly on feed safety, without official guidelines for BSF production. Future interventions should focus on strengthening the regulatory systems, enhancing training programs and knowledge dissemination, improving public awareness, particularly targeting women and youth, and developing commercially attractive product-market strategies, among others (F&S, 2023).

In evaluating the feasibility of BSF projects, it is key to assess the social acceptance of insect rearing as well as the use of insects as animal feed. For instance, the International Centre of Insect Physiology and Ecology (ICIPE)¹⁸ conducted an assessment among Kenyan farmers on their readiness to use insect-based feed. The research indicated that about 90 per cent of farmers and 85 per cent of feed producers in Kenya were ready to apply this technology, with an expected demand for BSF more than 2000 times higher than current production capacity (Rockefeller Foundation, 2020). This represented a fertile soil for ICIPE in collaboration with the Rockefeller Foundation to support BSF-related initiatives around the country, including the training in how to raise and use BSF as feed supplements of thousands of farmers across Kenya. Furthermore, as a novel agricultural practice, BSF farming is subject to varying regulations and guidelines in different regions, which can create barriers to market entry and hinder industry growth. Feasibility assessment should consider the existing regulatory framework, and development agencies might be required to support enhancing regulatory frameworks to facilitate the development of a supportive environment.

Waste streams include fresh manure and food wastes of both animal and vegetable origin: organic waste, including animal manure, municipal organic waste, food waste, crop straw, and empty fruit bunches.

¹⁸ <http://www.icipe.org/>

► **Figure 22: BSF main applications**

Some key technologies and infrastructure components are needed to ensure efficient and sustainable farming practices, such as waste-processing equipment, to prepare the substrata that will feed the insects; controlled environment equipment, to maintain optimal environmental conditions for BSF to thrive; and post-processing equipment, like dryers, shredders or oilpressers, to prepare the insects for market. BSF farms usually present various infrastructural sections, each dedicated to a phase of the workflow and life cycle of the insect: breeding area, hatching area/nursery, waste processing areas, growing area, and post-processing area.

BSF's solution can be applied anywhere, particularly at smallholder farmer scale where it can be integrated with poultry or aquaculture production to strengthen self-sustainability and relieve farmers from dependency upon often expensive feed providers; or can be produced at a wider scale as a stand-alone product to supply aquaculture and livestock producers. In developing countries in Southern and Central Africa and Southeast Asia, where demand for edible insects exists and where it is relatively easy to bring insects to market, the process of insect gathering, rearing, and processing into street foods or for sale as chicken and fish feed is easily within reach of small-scale enterprises.

Although literature on the employment creation potential of BSF systems is scarce, based on existing literature, they have huge potential for job creation in Eastern African countries.¹⁹ Small-scale production sites with a production target of 1000 kg BSF per two-week cycles/ 2000 kg per month) requires approximately 2 workers in daily operations such as shredding, dewatering of substrates, loading and harvesting activities, and excluding temporary workers involved in the construction/ set-up of required infrastructure and in the transportation of larvae feed and final product (FAO, 2021). Based on KIIs, a medium-size plan requires about 5 people directly engaged with the operations, in addition to waste aggregators in case the waste is bought out-of-farm (2 to 3 people engaged in aggregation).

Whilst BSF farming is relatively easy to manage, it requires specialized expertise due to its multi-step process and potential biosecurity risks. Although according to KII, no advanced education is needed to operate a BSF plant, vocational training combining both theoretical knowledge—such as understanding BSF biology and biosecurity protocols—and practical experience in areas like breeding, rearing, and processing is essential to ensure efficient and safe operations. Effective biosecurity measures, including hygiene protocols and regular cleaning, are critical to prevent diseases and ensure colony health. Breeders must also address challenges like stable egg output and genetic diversity, incorporating periodic introductions of new strains to sustain colony productivity and robustness. The rearing and processing phase involves transforming the larvae into valuable products such as protein, fertilizer, and oil. Competencies here include managing the larvae's environment and nutrition to maximize growth and ensuring efficient harvesting and processing techniques to meet product standards. Finally, understanding the legislation governing BSF farming ensures compliance with safety, health, and environmental standards, which are vital for sustainable and lawful operations.

¹⁹ According to (Abro, Z. et al., 2022), the economic benefits of BSF could lift 4.53 million people above the poverty line and generate between 1,252 to 563,302 new jobs per annum.

According to KII, one of the main challenges faced by BSF businesses is the adaptation of this technology to diversified climates. BSFs thrive in warm climates, and they can also be produced in cold areas, however, greenhouses are required to guarantee a comfortable growing environment. Similarly, challenges are often faced in terms of waste aggregation and quality of waste provided, meaning that there is a need for training in adaptive methodologies tailored to the geography of the area in terms of waste and climate adaptiveness.

Example: black soldier fly-based feed for sustainable tilapia farming in Zimbabwe²⁰

Zimbabwe's aquaculture sector holds significant potential for growth; however, the industry has struggled to expand. High production costs—largely driven by expensive, imported feed—have hindered smallholder farmers from increasing their output. FISH4ACP, an initiative implemented by FAO and partners, aims to improve the sustainability and productivity of the Zimbabwean tilapia value chain. To address the cost barrier associated with feed, the project is promoting the production and use of Black Soldier Fly (BSF) larvae as an alternative feed ingredient for small-scale tilapia farmers.

In collaboration with the Chinhoyi University of Technology, FISH4ACP initiated BSF-based feed trials in Manicaland province to assess both technical feasibility and economic viability. The project established pilot sites, where extension officers, feed suppliers, and farmers were trained in BSF-based fish feed production. Furthermore, to evaluate the effectiveness of BSF as a sustainable feed ingredient, the project conducted a cost-benefit analysis, comparing different formulations of BSF-based feed with conventional fish feed. The findings from the cost-benefit analysis indicated that incorporating BSF larvae into fish feed can significantly reduce production costs. The trials confirm that BSF-based feed is a viable alternative for widespread use among smallholder tilapia farmers.

The project has invested in strengthening production capacity by establishing a breeding facility, housing 20 breeding cages, and machinery for feed making with a lifespan of about 8 years and will set-up another breeding facility. Together, the production sites will produce tons of dry BSF per month, valued USD500/ton with the site being managed by 5 youth, mostly women – therefore, 10 people are directly engaged in BSF production. These facilities are projected to increase fish production in Manicaland by 60 tons per month, contributing to an overall production of 1,800 tons annually. Youth involved are currently doing the aggregation of organic waste and the project is aiming to establish partnerships with institutions such as prisons and boarding schools that generate considerable amount of waste.

However, scaling up BSF-based feed production in Zimbabwe still faces challenges, starting from the lack of a regulatory system for the sector. Farmers require training on BSF rearing, feed formulation, and optimal fish feeding practices that are tailored to the local climatic conditions and waste availability. In colder areas, for example, BSF production may require greenhouses to maintain suitable breeding conditions. BSF rearing in Zimbabwe has gained traction in recent years, and there are few experts in the country to provide consistent training. Furthermore, now, no established supply chain exists for BSF larvae in Zimbabwe, requiring further investment in local production networks. However, with continued technical support and investment, BSF-based feed has the potential to transform the tilapia value chain, making aquaculture more profitable and accessible for smallholder farmers.

²⁰ Sources: a) Food and Agriculture Organization of the United Nations (FAO). (2024). *Boosting Tilapia Farming with Black Soldier Fly-Based Fish Feed: A Case Study from Zimbabwe*. FISH4ACP. Retrieved from <https://www.fao.org/in-action/fish-4-acp/where-we-work/africa/zimbabwe/en/>; b) Key Informant Interviews.

Oyster mushrooms for climate-resilient smallholder businesses

Mushrooms are edible fungi that have been consumed by generations of people. There are different types of mushrooms, one of which is the *Pleurotus Ostreatus*, commonly known as *oyster mushroom* for its resemblance to oysters' shells. In their natural habitat, oyster mushrooms feed on straw and wood and play a crucial role as organic matter decomposers (saprotrophic fungi). But instead of collecting them from the wild, they can be easily grown indoors at a low cost and in a relatively short time by using agricultural waste materials (FAO, 2017). Oyster mushrooms mature within 30 days and are rich in proteins, vitamins, fibre, and minerals and enrich people's diets when meat sources are limited. Oyster mushrooms are highly tolerant of variations in temperature, humidity, light conditions, and carbon dioxide levels. They can be produced easily by all classes of farmers, including young and old men and women, as they require little land, effort, and investment, as well as skills compared to the production of other varieties of crops and mushrooms. Furthermore, oyster mushrooms have a great potential to enhance the circularity of smallholder farms as besides growing upon agricultural by-products, they generate a virtually inexhaustible supply of a co-product called *spent mushroom substrate*, which the mushroom industry is exploring in terms of its potential for production of value-added products (Phan et al., 2012).

Oyster mushroom farming is a practice that can be adopted by small-scale farmers to diversify their income during the dry season, when lack of water may challenge the cultivation of other crops and reduce their vulnerability to adverse weather including floods and extreme droughts. Several case studies presenting different applications of oyster mushroom farming are available to consult online,²¹ including interesting in-city-based activities that are enhancing local circularities such as the Champignon de Bruxelles case²².

Labourwise, oyster mushroom production is a labour-intensive activity as many tasks—such as substrate preparation, bagging, inoculation, environmental monitoring, harvesting, and cleaning—require manual intervention, particularly at smallholder scales. Nevertheless, while oyster mushroom production is labour-intensive, it is not necessarily time-intensive throughout the entire production cycle. During the fructification period—when the mushrooms are growing—workers typically do not need to engage in constant activities. Instead, their role is focused on monitoring and maintaining the growing environment, such as controlling humidity, temperature, and ventilation. These tasks are less demanding and can often be performed intermittently. This means that during the fruiting phase, workers have the flexibility to dedicate time to other tasks or activities, whether within the mushroom operation (e.g., planning the next production cycle, cleaning equipment, or processing harvested mushrooms) or in other areas. A rural family can easily manage a small-scale oyster mushroom business while carrying on additional income-generating activities. In a cost-benefit analysis conducted by FAO in Uganda in 2017, mushroom cultivation was compared to the opportunity cost of labour in farms affected by a dry spell between 2016–2026, and it was observed that the net benefit of mushroom growing over 11 years is more than seven times higher than the opportunity cost of labour (FAO, 2017). At the same time, in non-hazard conditions, the net benefits from mushroom growing were more than nine times higher than the opportunity cost of labour, bringing USD 5.3 per one US dollar invested. The main capital investment included a growing room and a solar dryer to commercialize dried mushrooms.

Establishing and managing an oyster mushroom business does not require advanced training. In a benefit/cost analysis conducted on general mushroom production in developing countries for income diversification, Celik and Peker identified that managers who were graduates of elementary and high schools (30.8 per cent elementary school, 30.8 per cent high schools) formed the majority (61.6 per cent) of the businesses (Celik et al., 2009). Mushroom production can be managed by people with lower-level education in rural areas although vocational training opportunities shall be provided in order to develop strengthened human resources.

²¹ Such as [Practical Actions](#) or (Phan et al., 2012).

²² Available at: <https://www.visit.brussels/en/visitors/venue-details/Le-Champignon-de-Bruxelles.269708>

► **Box 5. Online training and resources on oyster mushrooms**

Several platforms offer effective step-by-step training courses and materials which are freely accessible online. *Accessagriculture.org* offers an effective 12-minutes video on oyster mushroom cultivation, showcasing its potential to improve livelihoods, particularly for women and small-scale farmers.²³ The video explains the benefits of mushrooms as a nutritious, protein-rich food and a source of income, requiring minimal land, effort, and cost. It provides step-by-step instructions on preparing the substrate, planting mushroom seed, maintaining proper hygiene, and harvesting. Additionally, it highlights innovative practices like substrate sterilization, effective pest control, and recycling used substrate as compost. Other platforms offer step-by-step written guides for oyster mushroom farming, such as *MushroomClasses.com*.²⁴

Example: young mushroom agripreneurs under grant-based schemes – FAO²⁵

Green Quality Produce was established by Charles Muswati and other three recent agricultural college graduates, as a response to the limited employment opportunities in Marondera District, Zimbabwe. Supported by a grant from the GJ4RYE project, the team created a sustainable oyster mushroom production business that leverages agricultural waste as a core input. The initiative utilises affordable and readily available agricultural residues, such as cotton hulls, wheat straws, maize husks, dried banana leaves, and sawdust from surrounding agricultural activities, as substrates to produce fresh and dried oyster mushrooms. The team buys organic agricultural waste from nearby farms and cotton processing industries at \$30/ton.

The GJ4RYE project provided grant opportunities to rural youth to launch or expand their agro-businesses. Youth beneficiaries received soft skills and advanced business management training to enhance their business capacities, and no specific oyster mushroom training was provided. However, being agricultural college graduates, Charles and his peers had practical knowledge of some lab techniques, including inoculation, agar preparation, sterilization, and incubation, which are necessary. The GJ4RYE provided USD2500 per individual part of each group over 2 years to establish the business. Furthermore, the project provided technical agriculture and business mentorship to support youth in establishing their businesses.

Green Quality Produce has established itself as a leader in sustainable agribusiness in the Marondera region. Since its inception in 2023, the company has achieved significant growth, expanding production capacity by three times and increasing its workforce from 4 to 8 full-time employees and producing about 2000-3000 kits per month, which translates into 4000 to 6000 kgs of mushroom per month. Beyond its business operations, Green Quality Produce has become a valuable training resource for agricultural students, recent graduates, and local farmers. The team regularly hosts visits to their facility, providing practical training on organic production techniques and sustainable business practices, fostering entrepreneurship among young agricultural professionals.

Among the challenges the business is facing is the alternative use of organic waste for purposes other than mushroom production. According to Charles, many local farmers and households have traditionally composted organic waste and used natural materials like straw, wood chips, and leaves for animal bedding and mulch. Since similar materials are used as substrates for oyster mushroom production, Green Quality Produce had to establish market linkages to ensure a sustained source of substrate.

The success of Green Quality Produce has garnered attention beyond its region, with Charles being invited to share the business model and best practices in neighbouring countries such as Zambia and Namibia. The business has also provided its team with valuable skills in financial planning, market analysis, and supply chain management, enabling them to effectively navigate the challenges of running a growing enterprise. These lessons have been instrumental in their ability to scale operations and establish a reputation for innovation and sustainability. Looking ahead, Green Quality Produce aims to further diversify its product range by introducing

²³ Retrieved from <https://www.accessagriculture.org/growing-oyster-mushrooms>

²⁴ Retrieved from <https://mushroomclasses.com/grow-oyster-mushrooms-on-straw/>

²⁵ Sources: Key Informant Interviews.

button mushrooms alongside oyster mushrooms. The team is exploring opportunities to enter the export market and plans to establish a training centre to equip local farmers with skills in sustainable agribusiness.

Discussion: dichotomy and continuum between organic waste management technologies

As presented, organic waste, either from agricultural or urban waste sources, can be repurposed through various technologies that provide different benefits depending on their scale, market conditions, and policy incentives. While some technologies can be ‘appropriate’ in a sense to allow farmers and cities to manage and valorise organic waste into profitable economic activities, others might serve as enhancements to existing farming systems, improving productivity and supporting skills development without necessarily becoming a profitable business on their own. However, rather than a strict division between these two roles, these technologies exist along a continuum, where their function can shift between farm-enhancing and income-generating depending on contextual factors.

Farm-enhancing and profit-generating technologies

Farm-enhancing technologies are primarily used to improve sustainability, productivity, and resilience on farms without necessarily creating a standalone business opportunity. They allow farmers and households to reduce input costs, improve soil fertility, enhance nutrient cycling, and mitigate environmental degradation. These technologies generally require low capital investment and provide direct benefits to farm operations. Practices such as composting and biochar production have been adopted for centuries and form part of sustainable farming and can now help reduce reliance on synthetic fertilisers and improve soil health. Many of these techniques require minimal external inputs and are easily integrated into diversified farming systems, making them accessible even for smallholder farmers with limited resources.

Nevertheless, this same organic waste can be turned into a marketable product such as mushrooms, insect protein, biogas, and organic fertilisers or used to provide services such as waste processing and bioenergy production. Businesses can apply waste processing technologies to develop income-generating activities, whereas cities and communities can take advantage of these technologies to alleviate pressure on the environment, avoiding or drastically reducing landfilling and incineration while creating green job opportunities, integrating marginalized communities, and potentially selling processed products. These solutions require larger investments and logistics, as well as access to markets, buyers, and distribution channels. For example, as presented in the Kenya and Uganda report conducted by Fair & Sustainable Consulting (2023), BSF rearing at a small scale can be used to replace costly poultry feed, reducing farm expenses, but when scaled up, it can meet external demand and become a viable business.

These two sets of technologies could be thought of as existing along a continuum. The placement of a given intervention along this continuum is influenced by scale, market dynamics, policy incentives, capacities of the workforce and the level of investment required. Farmers, for instance, may use organic waste to produce compost for personal use, positioning their activity on the farm-enhancing side of the spectrum. However, if organized in cooperatives or supported by enabling policies, the same practice can shift towards income generation, creating employment and commercial opportunities. Biogas digesters used for household cooking and irrigation pumps remain farm-enhancing, but when surplus gas is produced and sold to neighbouring households, they move toward income generation. Similarly, biochar is largely a farm input when used directly in fields, but if linked to carbon credit markets, it can generate revenue, turning it into a business opportunity. Recognising this continuum helps ensure that waste-to-resource innovations remain contextually relevant, economically viable, and aligned with sustainability goals. It also allows for more dynamic planning in development programs, ensuring that appropriate technologies are not only technically suitable but also have the potential to contribute to livelihoods, employment, income and economic resilience.

Market conditions play a crucial role in determining whether a technology remains a farm-enhancing practice or shifts toward income generation. Some technologies only become profitable when demand for their outputs exists beyond the farm. For instance, biochar production is not an independent business model unless there is an established system for trading carbon credits, as seen in projects linking biochar to carbon removal markets.

Value addition is key to transforming farm-enhancing technologies into income-generating businesses. Composting remains a farm-level activity unless efforts are made to package and brand the compost for markets. Biochar, when processed into fortified soil amendments or pelletized for easy distribution, can attract buyers beyond the farm. Many smallholder farmers may begin by using these technologies for personal benefit, but with the right conditions, they can transition into full scale entrepreneurs providing inputs to local markets.

Farm-enhancing and income-generating technologies also have different labour impacts. For instance, small-scale composting requires minimal labour and infrastructure, making it a practical addition to farm systems without significantly increasing workloads. However, at commercial scales, it becomes labour-intensive, and requires technology-related specialized knowledge, competencies in logistics and marketing, as well as capital investment. Black soldier fly farming, while initially manageable at the farm level, becomes a job-creating activity when scaled up and requires trained workers to manually and constantly manage insect colonies, control environmental conditions, and process larvae for feed, contributing to employment opportunities.

Policy supports and incentives can also shift technologies along the continuum. If a government subsidizes biochar production for its carbon sequestration benefits, what was once a practice focused solely on soil fertility improvement becomes an economic opportunity. Anaerobic digestion can transition to commercial ventures if policy frameworks promote its broad use. Without such incentives, many of these technologies remain farm-enhancing, as the cost of producing and marketing their outputs may not justify the effort required for scaling up.

Conclusions

The selected examples highlight how waste-to-agrifood systems technologies mostly in Africa operate along a continuum, from farm-enhancing solutions that improve soil health and sustainability to income-generating activities that have higher jobs and economic outcomes. The extent to which a technology shifts from one function to another depends on market conditions, policy incentives, financial investment, and the scale of operation. Composting, biochar production, and black soldier fly farming exemplify how organic waste can be repurposed into valuable inputs for food production, whether as fertilisers, animal feed, or bioenergy.

Recent discussions in development economics have dedicated increasing attention to the qualitative dimensions of growth, emphasizing technological change and the development of skills as fundamental drivers of productivity, income generation, job creation, the transition to formality, and poverty reduction. In this context, an appropriate technologies approach, that is, identifying technologies that are adapted to local resources availability, are simple to construct and operate and contributes to capability development of its workforce, is crucial in making these solutions accessible and adaptable to local contexts, ensuring that also smallholder farmers and decentralised communities can benefit. When implemented at the farm-enhancing scale, many of these technologies require minimal external inputs, making them viable for resource-constrained environments while offering scale potential. Employment impacts are equally significant: at the farm level, waste valorisation reduces costs and reliance on external inputs and improves productivity while enhancing skills, while at commercial scales, it generates diverse jobs upstream and downstream waste management activities.

In Africa, where youth unemployment and informal labour remain major challenges, these waste-based innovations provide appropriate examples for job creation, particularly in rural and peri-urban areas. However, their scalability depends on enabling policy frameworks, financial access, and multi-stakeholder collaboration between governments, private sector actors, and research institutions. Cases like the Ghana or Argentina, exemplify how strengthening these linkages can support communities in identifying locally tailored technologies for waste-to-agrifood processing. Similarly, examples such as the biochar production in Namibia, show the role that the private sector can play in developing appropriate technologies to local challenges linked to biowaste, also applying modern solutions such as the access to carbon market trading.

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► Transforming lives in rural Ethiopia

Maximizing social impact through trail bridge construction

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Acknowledgement

The data collection of the study was funded by Helvetas Ethiopia under the Transformative Rural Access for Improved Livelihoods (TRAIL) project, which is implemented in collaboration with the Ethiopian government.

Abstract

Over the past three years (2022 - 2024), the regional road bureaus, in collaboration with Helvetas Swiss Intercooperation, has invested half a billion birr in the construction of trail bridges across Ethiopia. During this time, more than 75 trail bridges have been built and are now operational, bringing the total number of trail bridges in the country to over 180. The construction of trail bridges has significantly transformed the lives of rural communities. These bridges connect isolated communities to essential services such as healthcare, education, and markets, thereby enhancing overall accessibility in a sustainable manner, improving agricultural productivity as well as saving life. Trail bridges have comparatively low-cost advantage, and they are environmentally friendly with less disruptions during construction. This paper assesses the impact of trail bridge construction in Ethiopia from the users' perspective, utilizing a combination of survey methods and site visits to gather data. Additionally, a review of various articles was conducted to understand the broader impact worldwide. The findings reveal that trail bridge construction has positively impacted the lives of people in Ethiopia. Notably, rural transportation costs to nearby markets have decreased, and travel times have shortened. The construction projects have also provided employment opportunities, creating an estimated 1480 permanent and temporary jobs for residents near the bridge sites over the course of its construction period which equals to 240,000-person day, though most of the permanent jobs are predominantly held by men. Some completed bridges have become market attractions, stimulating the development of bridge-side businesses and enabling communities to sell small products nearby. The planning process for these bridges is participatory, encouraging inclusive planning from the initial demand request. To ensure the sustainability of the bridges, most sites have established bridge management committees that include both men and women, promoting gender balance. Despite the benefits & positive impact, there remains a significant gap between the demand for and the number of bridges constructed. This highlights the ongoing need for further investment in trail bridge construction to meet the demands of rural communities. Moreover, the findings indicate that in older bridges, the bridge management committees are no longer active, this could negatively impact long-term routine & preventive maintenance which signals area to reinforce.

Keywords: Rural connectivity; Social impact; Sustainability; Trail Bridge; Travel time

Introduction

In rural Ethiopia, residents often travel long hours, traversing challenging terrain filled with valleys and gorges, compromising safety to reach all-weather roads and services such as school, health and marketplaces [[1], [2], [3]. This lack of access and significant travel time has led to productivity loss and is strongly linked to poverty [4]. Lack of safe access is also associated with higher under-five mortality rates and lower GDP per capita, as noted in sustainable mobility studies [5]. According to the 2020 Ethiopia Poverty Assessment by the World Bank, 57% of the poor live more than three kilometers from an all-weather road in Ethiopia [3].

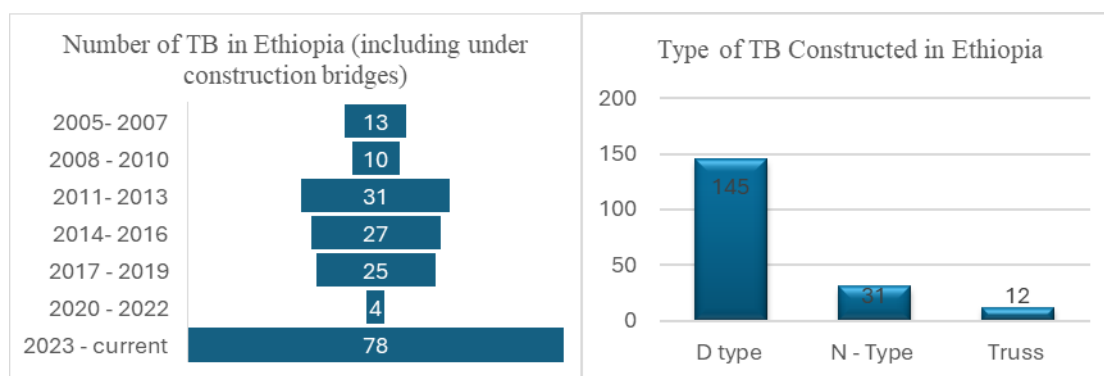
Recognizing the impact of improved rural access on socioeconomic livelihoods, Helvetas Ethiopia, a Swiss-based international NGO, in collaboration with the Ethiopian Road Administration (ERA), began piloting trail bridges in 2003 [6]. Trail bridges (TB), also known as pedestrian or footbridges, are simple, low-cost structures providing year-round safe and reliable river & gorge crossings for pedestrians, motorbikes, and non-motorized transport in rural and remote areas [7] [8]. The collaboration between Helvetas & ERA has enhanced "first mile" connectivity in many rural areas lacking access through trail bridge construction. The "First Mile" refers to the initial transport segment connecting settlements or farms to the nearest produce collection point, local market, or all-season access road. Lessons from the pilot program led to the establishment of a nationwide trail bridge program in Ethiopia starting in May 2008 [6]. To date, more than 180 trail bridges have been constructed across Ethiopia. Post-2020, the NGO initiated systemic changes to advocate for more trail bridges to create an enabling environment for first mile connectivity. The systemic change focuses on enabling regional road bureaus to independently plan, design, prepare bid documents, and administer contracts for trail bridge construction. A cost-sharing mechanism between the NGO and the government has been devised, with 20% of the construction cost contributed by Helvetas Ethiopia and 80% by the government after modifying the previous 60:40 cost sharing arrangement. The initiative aims to address rural access challenges and emphasizes government leadership in infrastructure provision across rural districts. The government has now taken the lead, planning to construct over 370 trail bridges through the Rural Connectivity and Access for Food Security Program funded by the World Bank over the next five years [9].

One of Ethiopia's primary tactics for fostering economic growth is investing in large-scale infrastructure projects such as road construction [10]. However, in the past, it seems that small scale infrastructures vital to rural connectivity overlooked. This paper tries to shade light on the importance of this low cost but impactful rural transport infrastructure. It also aims to evaluate the impact of trail bridges on transforming rural community life in Ethiopia. Given their low-cost structure, trail bridges are believed to offer a high return on investment and maximize value for money. The objective of this paper is to link the impact of trail bridge construction through various indicators, time saved to get basic services, value for money, and benefits to the rural community from the users' perspective.

Trail bridge in Ethiopia

In Ethiopia currently three type of trail bridges are being built. These are Suspended (D type), Suspension (N type) and Truss types. Suspended and suspension trail bridge types are built with 1.06m width and span ranging from above 32 m up to 120m [11]. Figure 1 below shows the number of bridges constructed across years and the type of bridges distribution. About 180 trail bridges are constructed in various parts of Ethiopia and additional eight are under construction, including 17% suspension (N- type), 77% suspended (D-type) and 6% of Truss type bridges.

► **Figure 23. Number and type of Trail Bridge built from 2005 - 2024 in Ethiopia**



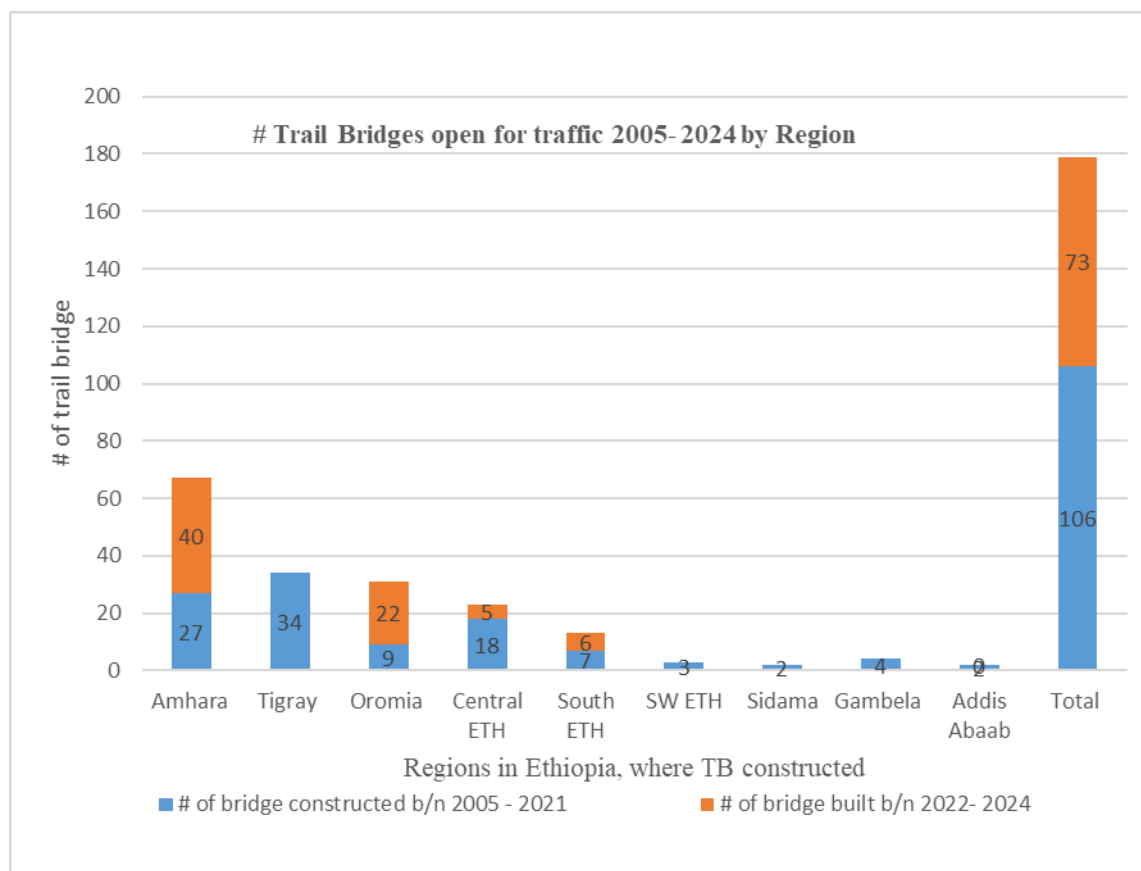
The bridge below in figure 2 (right) is suspension type foot bridge under construction over Akaki river. This type of bridge is conventionally termed as 'N-type' by taking the last letter from the word 'suspension.' The N - type bridge is favourable in an area with flat to medium rolling terrain where there is no adequate free board to construct Suspended (D- type) bridge. Suspension trail bridge is a cable bridge which utilizes load bearing cables above the deck that are strung across high towers with an arching walkway. This design is most suitable for use in flat river terrain or in flood plains where achieving freeboard could be difficult.

► **Figure 24. Suspended Bridge over Tekeze river (left) & Suspension bridge over Akaki river (right)**

The bridge in figure 2 (left) is suspended type trail bridge constructed over Tekeze river. It is conventionally terms as “D – type” after the last letter in the word ‘Suspended.’ As compared to the N -type, the D type is simple to construct, less costly and favourable in mountainous & gorge areas where there is no free board problem. Likewise, Suspended trail bridge is a cable supporting the walkway surface hang from masonry abutments on each bank of the river. This type of bridge is suitable for short to mid spans in gentle sloping valleys and short to long spans in gorges.

Countries like Nepal in Asia and Rwanda in Africa, with experience in constructing footbridges for rural communities, have achieved better Rural Access Index (RAI) scores. Rwanda’s RAI is 55.3 (World Bank, 2019) and Nepal’s RAI is 55.2 (World Bank, 2016) as compared to Ethiopia’s RAI 22. Recently, Ethiopia launched the Rural Connectivity and Access Program (RCAP) to intensify efforts to increase rural access, with significant emphasis on trail bridges. Trail bridges have gained recognition as sustainable rural access structures by various intergovernmental organizations. The Asian Development Bank (ADB) recently included trail bridges in its Green Roads Toolkits [12].

One measure to improve rural access could be through trail bridge construction as indicated in the above cases. Construction of TB not only improve access but also ensures equity challenge where it is not possible to build big bridges and roads, because such a cost-effective bridge somehow solves the issues of equity. The principle of ‘equitable access for all’ is a cornerstone of most transportation policies, including Ethiopia’s [3], [13]. From data, see the below chart, showing TB distribution across regions in Ethiopia.

► **Figure 25. Trail bridge open to traffic, constructed from 2005 - 2024 by region in Ethiopia**

Even though such bridge could be a tool to ensure equity and solve rural access problem, the proportion across regions significantly differ and the data signals additional works need to be done to solve the equity issue across region so that no one is left behind.

Trail bridge has a comparative advantage over a conventional bridge for disconnected rural area. It costs a lot of money to build medium - and large-sized bridges out of concrete or steel. Trail bridges present a cost-effective alternative to the more expensive medium and large-sized concrete or steel bridges, offering a viable solution for regions with limited infrastructure funding. The challenging topography and absence of narrow riverbanks often make the construction of conventional bridges impractical. Moreover, for the purposes of pedestrians, cyclists, motorbikes and carts, heavy-duty materials such as big concrete mass are not necessary. Hunde et al (2024) have analysed and compared the construction cost of trail bridge in Ethiopia and Rwanda. Accordingly, they found that suspended D type trail bridge costs from \$500 – 850 per meter, whereas Suspension N type bridge costs in the range of \$900 – 1500 per meters. The field observation and studies of the BOQ and contract document of Trail bridge construction in Ethiopia have reassured this fact. However, constructing concrete or steel bridges of comparable size would incur significantly higher costs and pose considerable challenges in environments with difficult terrain and scarce narrow riverbanks. Therefore, in terms of impact and cost-effectiveness, trail bridges offer excellent value for money. Constructing trail bridges over gorges and rivers where movement is difficult has proven to be an easy and cost-effective solution [14]. Trail bridges stand out as the optimal solution for rural connectivity, being not only affordable and lightweight but also environmentally friendly and climate resilient with a minimal carbon footprint [15].

Materials and methods

A structured survey was developed to gather both qualitative and quantitative data. The questionnaires were developed using Kobo collect and designed to capture insights into specific areas of interest, such as service delivery and travel time, which shows the impact and transformation in the community. The survey used a combination of closed-ended and open-ended questions.

The survey used sample size of 1200 trail bridge users (respondents) from four regions namely Amhara (385), Oromia (389), Central (151) and South Ethiopia regions (275). The survey technique used a random sampling, which means that every community member within the selected woredas had an equal chance of being chosen to participate in the survey. This method helps reduce bias and ensures that the findings are representative of the broader community.

The research team has also undertaken field observations of trail bridge sites across various regions of Ethiopia in different time from 2022 - 2024, capturing a variety of informative photographs, observing the impact of the trail bridge, and conducting different formal and informal interviews, and focus group discussions. These methods helped to discern different new developments changes after the trail bridge construction. In addition, trail bridge construction demands have been collected through telephone and ground truthing conducted in selected woredas to identify the reality of the bridge demand in ground which helped to predict and project the bridge needs in the country.

Secondary data such as contract document and bill of quantities are used. Literature searches were performed using Mendeley and Google Scholar to identify credible and relevant literature related to rural access and trail bridges. Moreover, different reports prepared by Helvetas & other organizations regarding trail bridge project implementation in Ethiopia have been used.

Results & discussion

This section presents the findings from site observations, desk study and survey results. The results and discussions are organized into subsections, each addressing specific topics on bridge demand, time saving, and job opportunity created due to the trail bridge construction in rural parts of Ethiopia.

Trail bridge demand in Ethiopia

As part of the Transformative Rural Access for Improved Livelihoods Ethiopia (TRAIL Ethiopia) project, Bridges to Prosperity (B2P) in collaboration with Helvetas, regional government, and other partners conducted a comprehensive needs assessment for trail bridges. The assessment aimed to estimate the overall requirement for trail bridges across the nation, evaluate the potential impact of constructing these bridges, and identify specific site needs in various regions.

The demand for trail bridges in Ethiopia is substantial. In Oromia, a pilot trail bridge demand assessment was conducted in 12 Wereda of Jimma, Buno Bedale, West Hararge, Arsi, and Guji zones. For instance, in the Jima zone, specifically in Sigimo and Limmu Seka Weredas alone, more than thirty-five trail bridge sites were identified. Similarly, in other woreda where pilot ground-truthing was conducted within the zones, on an average of 10 - 13 trail bridge sites were identified in each woreda. With more than 305 woreda in Oromia, a simple extrapolation estimates the trail bridge demand to be between 3,500 and 5,000. Additionally, an assessment coordinated by Bridges to Prosperity (B2P) identified 1,235 potential trail bridge sites in the Amhara, Oromia, Central, Sidama, South, and Southwest regions, after conducting a comprehensive assessment in few woreda across these regions. This underscored the need for thousands more bridges, leading B2P to estimate a national requirement of 18,000 to 23,000 bridges based on the density of identified sites per square kilometres. Communication with woreda-level governments through zonal structures indicated limited awareness of trail bridges, security concerns, and gaps in coverage across all areas. In the identified sites, the community reported losses of cattle and deaths of individuals attempting unsafe river crossings. This demand highlights the crucial role of rural infrastructure in alleviating isolation and poverty, particularly in areas inaccessible to heavy vehicles. The lack of safe crossings severely restricts access to essential services such as healthcare, education, and markets, adversely affecting economic activities and mobility.

Addressing this urgent need for trail bridges requires robust funding opportunities. Projects like TRAIL Ethiopia exemplify the collaborative efforts necessary for effective implementation, involving local governments, NGOs, and communities to ensure that financial resources are allocated to the most underserved regions. Moreover, innovative technologies and data-driven approaches, such as the Fika Map [16] offer potential for optimizing planning and resource allocation. By integrating local knowledge with advanced analytics, stakeholders can prioritize bridge sites that will have the greatest positive impact on community connectivity and livelihoods. While challenges such as security and logistical constraints persist, a sustained commitment and collaborative approach can help realize the vision of safe and accessible transport for all rural Ethiopians.

Social impact of trail bridge in Ethiopia

The impact of the trail bridge construction on improving access to essential services in the community has been positive. Prior to the bridge's construction, accessing services such as healthcare and education was reported to be very difficult by 96% of participants, and after the construction of trail bridge, the overwhelming majority 93% of respondents believe that access to services has greatly improved. Though a small number of respondents 3% saying there was no change or a slight improvement while 4% felt it was somewhat improved. Moreover, prior to the bridge, more than half of the respondents (64%) said their community was frequently cut off from the nearest service centres due to flooding in the rainy sessions, while a smaller group (23%) experienced occasional disconnects.

Transportation options have also become more accessible. Prior to the bridge, transportation was either unavailable or difficult to access for many in the community. Since its completion, however, transportation options have significantly improved, with increased availability and frequency. To this end, 90% find transportation to be easily accessible. This shift indicates a significant improvement in the mobility of community members, which is likely to enhance economic growth and enhance livelihoods by providing better access to markets and economic activities.

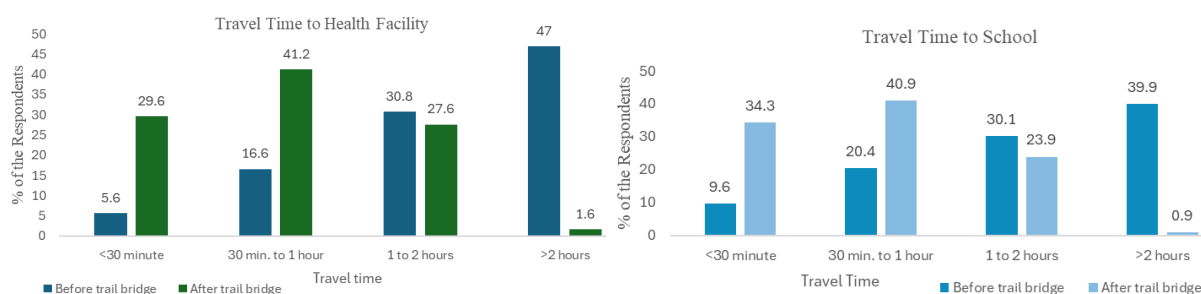
The focus group discussions and field observation have also confirmed the above fact. For example, the visit and focus group discussion conducted at the newly constructed Wabe Trail bridge in Edo kebele, Dodola Wereda in West Arsi zone of Oromia region, shows that before the bridge was built, traveling to the adjacent kebele of Wakachela in Gedeb Hasasa Wereda required an 80 km round trip. After the construction of the Wabe Trail Bridge, the journey now takes only 20 minutes on foot. The construction of trail bridges has had a tremendous impact on agriculture as well. Farmers who previously had to take long and treacherous routes to reach their fields on the other side of the river can now cross safely and efficiently. This has not only saved them time and effort but has also increased their productivity and access to their land. Trail bridges have played a crucial role in improving the livelihoods of these farming communities by facilitating easier and quicker access to their agricultural lands. From a cost perspective, the community has transitioned from spending money on motor bike & car transportation to using walking & horseback for travel purposes. In general, where trail bridges are constructed travel times are reduced, and transportation costs are lowered. This makes market trips more efficient and less burdening. A similar study in Rwanda yielded comparable findings [17].

Travel time to services

The construction of the trail bridge has significantly reduced the overall time it takes to access essential services, with most respondents experiencing much quicker access. To this end, Before the bridge built, staggering 46.8% indicated it took more than 2 hours to reach essential services while 30% said it took between 1 to 2 hours to reach services, leaving only 21% and 2% who could access services in between one hours and 30 minutes, respectively. After the construction, the situation improves drastically. The percentage of respondents traveling less than 30 minutes to access services increased to 31% compared to just 2% before. Additionally, 44% of respondents now travel 30 minutes to 1 hour to reach services, which is a significant reduction from the previous situation. Only 8% of respondents reported it still taking 1 to 2 hours, a sharp decline from 30% before construction. According to the Oromia 10-year Road & Logistics Bureau Plan, it currently takes about 2.33 hours to reach an all-season road in rural Oromia. The plan aims to reduce this travel time to 1.89 hours by 2029 [18], which was planned without considering trail bridge construction. In this study, in areas where trail bridges are constructed, it is possible to cut walking time by 55 minutes on average, from 107 minutes to 59 minutes, to reach any service in rural areas.

As the figure 4 below(left) shows the time travel to Health facilities, before the trail bridge, accessing healthcare was difficult for many, with 47% of respondents traveling more than 2 hours to the nearest health facility. After the trail bridge was constructed, travel times were significantly reduced. Only 2% of people now travel more than 2 hours, while the majority (71% combined) travel 1 hour or less. This suggests that the trail bridge improved access to health services, making healthcare more reachable for most of the population.

► **Figure 4. Travel time to health(left) & school (right) before and after Trail bridge construction**



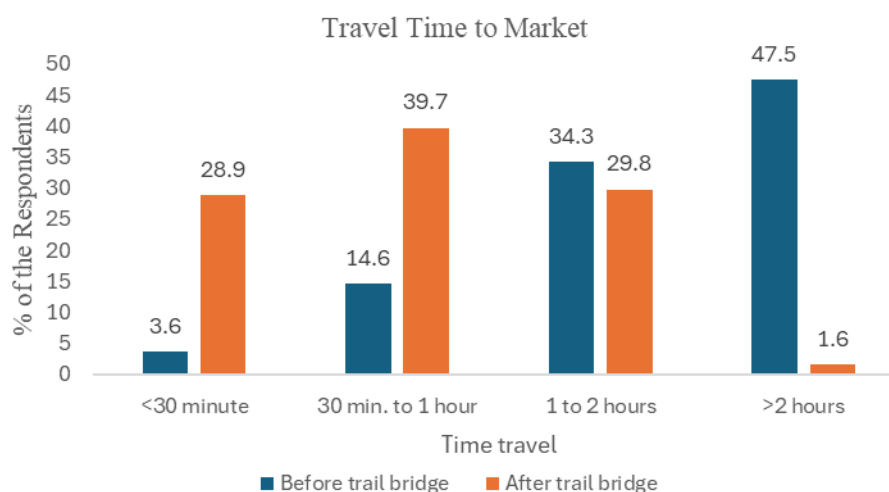
Similarly, the figure 4 above (right) indicates before the construction of trail bridge a substantial number of people 40% had to travel more than 2 hours to reach the nearest school, which suggests difficult access to education for these individuals. The second largest group 27% still travelled between 1 to 2 hours. The construction of the trail bridge brought a huge improvement in access to educational facilities. The percentage of people who travel more than 2 hours dropped dramatically to only 0.9%. Now, many people 41% can get to school in 30 minutes to 1 hour, and a large group 34% can make the trip in less than 30 minutes, highlighting much easier access to education after the bridge.

Moreover, due to the better access situation and ease of travel after the construction of trail bridges, the frequency with which community members visit healthcare facilities have also improved. A large majority 92% now visit healthcare services more often, suggesting that the bridge has made it much easier for people to access healthcare. Very few people visit healthcare less often, and only a small portion 8% visits with the same frequency as before, further reinforcing the bridge's positive effect on healthcare access.

About 88% of respondents reported that school attendance has improved significantly after the trail bridge construction. This indicates that the improved accessibility, due to the construction of the trail bridge, has had a major positive impact on school attendance. This is a strong signal that easier access to schools has removed barriers to regular attendance, ensuring more students can consistently attend school.

Similarly, figure 5 below shows that travel times were long, with half 47% of people spending over 2 hours to get to the market. While the construction of the trail bridge significantly improved travel efficiency. Only 2% of respondents still take more than 2 hours, and the majority (40% + 29%) now take less than 1 hour.

► **Figure 5. Travel time to market center before and after Trail bridge construction**



The survey indicates that the trail bridge has resulted in substantial time savings. As 41% of respondents reported saving 30 minutes to 1 hour after the construction of the trail bridge, while 21% saved 1 to 2 hours and a smaller portion 28% saved less than 30 minutes, and 8% saved more than 2 hours. Furthermore, the construction of Trail bridge helped farmers to sell their produce more easily, and traders can bring essential goods to remote communities. For example, in Omonada Wereda of Jimma zone, farmers reported that they are forced to sell their agricultural products at low prices due to the Gibe River blockading access, because of this they preferred to sell locally at reduced prices to avoid the high transportation costs associated with traveling long alternative distances to the market. However, with the recent construction of the trail bridge, they can now deliver their agricultural produce to the market within minutes. This has improved their ability to sell at better prices and reduced the transportation costs they previously faced.

Job creation & economic benefits

Trail bridge construction in the year 2022 – 2024 have generated an employment opportunity of 240,000 measured in person days (for about 1480 people for six months approximately). It has created permanent jobs for thirty-seven local consulting firms, forty-six contractors, nine metal work fabricators and twenty-three small-scale construction enterprises, during the 2022 – 2024 construction period. The site observation also revealed that in the around the newly open trail bridges, few side business emerged and the existing improved. Different studies support this fact. For instance, Trail bridge construction have improved the number of women with access to labor markets by 59%. Improved connectivity boosts local economies. Farmers can transport their goods to the market more efficiently, leading to increased income. In some communities, labor market income has increased by 30%, and farm-related profits have risen by 75% [19] With better access to markets and jobs, more women can participate in the labor market. In rural Nicaragua, the number of women with access to labor markets has increased by 60% [20].

Ownership & sustainability

Trail bridges have a significant social and economic impact on rural communities. However, to maintain its sustainable impact, it is essential for users to take ownership and responsibility for their regular maintenance. The data analysis from user questionnaires highlights some key challenges and opportunities for improving the ownership and maintenance of trail bridges in rural communities.

In Ethiopia, in bridges sites constructed before 2020, around 98% confirmed the absence of a maintenance committee. A considerable number of respondents (99%) presented the lack of access to maintenance tools and equipment like spanners, harnesses, etc. Additionally, for the bridges constructed before 2020, there is confusion regarding ownership, 49% believe the ownership belongs to the government or NGO (Helvetas) and around 33% responded that the government institutions are the primary responsible for trail bridge regular inspection. This lack of organization and resources poses a significant challenge to the sustainability of trail bridges in the region. However, this has improved for recently built bridges. However, there is potential for improvement, as a significant percentage of respondents (around 66%) believe that someone from the community can be trained to perform routine maintenance on the bridge. In addition, a considerable number of respondents (55%) believe that the primary responsible for trail bridge regular inspection is the trail bridge users. Furthermore, around 49 % of the respondents believe that the trail bridge belongs to both the local community and maintenance committee.

After the systemic change introduction in 2021 and after, i.e., trail bridge building with a cost sharing modality between government (80%) and NGO (Helvetas 20%), the bridge has not only improved physical connectivity but also raised a sense of community involvement and ownership. There is a powerful sense of ownership and commitment to the maintenance and long-term care of the bridge, with the community showing a positive outlook on its future sustainability. The results suggest that the project has been successfully integrated into the community, fostering a collective sense of responsibility and pride. Community engagement during the planning stages was significantly high, with 43% of participants feeling highly involved and 64.5% contributing to many suggestions for the design or location of the bridge. This level of involvement has enhanced the community's connection to the project, as reflected in the data showing that 76% of respondents now feel a sense of complete ownership over the bridge. Additionally, 91% expressed feeling proud of the newly constructed bridge, indicating a strong emotional investment in its success.

Communication regarding the bridge's progress was also effective, with 49% of respondents feeling well informed. Participation in community meetings related to the bridge was high, with 66% attending frequently. This ongoing dialogue has contributed to a collective responsibility for the bridge's success, as 64% of participants felt highly responsible for its outcomes. Additionally, the community's commitment to the bridge's maintenance is evident, with 79% stating they feel highly committed to its upkeep. A significant majority, 64%, actively encourage others to respect and care for the bridge. Respondents also indicated strong personal connections to the bridge, with 62% reporting a strong connection and 64% willing to help with maintenance or repairs if needed. The likelihood of advocating for the bridge's preservation is high, with 94% indicating they are likely to do so in the future.

Conclusion

The need for trail bridges in Ethiopia is immense. Despite the community's high demand, the yearly construction output is inadequate to meet the needs. From the preliminary study, Ethiopia requires more than 18,000 trail bridges to ensure safe access to rural communities. However, a comprehensive trail bridge needs assessment supported by digital technology is required and essential to determine the specific bridge demand across the country and the necessary funding.

Trail bridges positively impact rural lives by creating access to essential services, reducing travel time, and saving costs. In rural Ethiopia, constructing trail bridges reduced travel time by more than half (on average from 104 minutes to 49 minutes) to reach service provision points such as health centers, markets, and other essential services. Trail bridges can also help address gender problems in rural areas, providing comfort for women, the elderly, and children when crossing gorges and rivers. They can improve student enrolment and increase health visits.

Therefore, it is imperative for the government, donors, and partners to invest more in rural access. Financial constraints, exacerbated by a heavy reliance on domestic revenues, pose significant challenges to infrastructure development. Engaging the private sector emerges as a promising strategy to address these budgetary limitations enhances overall efficiency in infrastructure projects. Although few NGOs currently focus on transport infrastructure, there is considerable potential for partnerships in areas like institutional strengthening and joint funding proposals. Strategic engagement with key stakeholders, including government ministries, donors, NGOs, and academic institutions will be vital for enhancing rural access through trail bridge initiatives. Enhanced access could be a vital tool in managing rural infrastructures sustainably as a whole.

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► Infrastructure, growth and poverty reduction in Ethiopia

A dynamic CGE analysis
a zero draft report

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Introduction

How much a country should invest in its physical infrastructure is a crucial question being asked by policy makers from developing countries where financial resources for economic development are limited. Empirical studies suggest that infrastructure investment has significantly contributed to Ethiopia's GDP growth and sectoral productivity. For example, a panel study from Sub-Saharan Africa found that infrastructure development in Ethiopia contributed to higher total factor productivity (TFP) and economic expansion (1). In the same manner, (2) used time-series data to estimate the impact of infrastructure investment on Ethiopia's GDP. Their findings indicate that a 1% increase in infrastructure investment leads to a 0.5% increase in GDP. A recent report shows that Ethiopia's economic growth (averaging 8–10% per year from 2000–2019) was partly driven by massive public infrastructure spending, particularly in transport and energy (3). However the pro-poorness of the public investment on infrastructure has not been well documented. In this regard, this research aims to examine the impact of public investment on infrastructure; on economic growth and poverty reduction in Ethiopia using various data sources and methods. It aims to answer two important questions (1) Is public investment on infrastructure pro-poor in Ethiopia? And 2) What is the impact of infrastructure on growth, and 3) what is the impact of infrastructure on welfare?

Materials and methods

Micro analysis of impact of public investment on infrastructure and poverty

For the micro level analysis of income, consumption expenditure, and Multidimensional Poverty Index (MPI) is used as measures of poverty indicators. This helped to compare the consistency of the results across different indicators. The measure of income (the sum of all incomes from all sources in a specified period time) and consumption expenditure (the sum of food and non-food expenditure) is straight forward; however, construction of the MPI from the LSMS-ISA data required bringing a wide variety of welfare indicators together (4). The deprivation score (MPI), which reflects household's joint deprivation is used to compute the multidimensional deprivation score of households and this score was classified into two groups to determine the multidimensionally poor and non-poor household. All households assigned a deprivation score in all selected multidimensional poverty indicators. A deprivation status score of 1 is assigned if the household is deprived in any indicator, and a status score of 0 is given otherwise. The weighted deprivation score (C_i) for each household calculated following this simplified equation,

(1) $C_i = W_1I_1 + W_2I_2 + W_3I_3 + \dots + W_nI_n$; Where W_i is the weight attached to each indicator, I_i is the score for each indicator of all dimensions.

In addition to the decomposition of change in poverty as due to economic growth and redistribution, we also looked at the drivers of household consumption among consumption quintiles. Quantile regression has the possibility of generating different responses in the dependent variable (total expenditure per adult equivalent) at different quantiles. In this respect, to estimate the pro-pooriness of growth one can assume conditional quantile of a random variable Y (Logarithm of total expenditure per adult equivalent) to be linear in the regressor X ; where Y is the sum of food and non-food expenditure within a year, and it takes the natural logarithm of total expenditure per adult equivalent. Following (5), the quantile regression model for panel data has the following form;

(2) $L(y_{it}) = \beta X_{it} + \varepsilon_{it}$

Where, $L(y_{it})$ is the natural logarithm of the total expenditure per adult equivalent of household i in period t ; X_{it} is a vector of the individual characteristics of the i th household in period t ; β is a vector of unknown parameters to be estimated and ε_{it} is the random disturbance term which is assumed to satisfy the usual properties of zero mean and constant variance.

The micro-level variables used come from the Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA). The LSMS-ISA has panel data for three waves between 2011/12 and 2018/19 that follows the same households. It is a sub-sample of the bigger Annual Agricultural Household Sample Survey (AAGSS) and contains information at the field level, plot level, household level, and community level. list of the variables, their operational definition, and measurements is given in Table .

► **Table 1: Definition and measurement of variables from the LSMS-ISA dataset**

Variable name	Definition	Measurement ¹
Consumption	Total annual household consumption expenditure	Real Birr amount spent per annum in AEU's
Income	Total income generated from farm and non-farm sources per annum	Real Birr amount generated per annum in AEU's
Age	Age of head	Age in completed years
	Square of age of head	Age in completed years
AEU's	Household members counted in Adult Equivalent Units	Household member count calculated as per Storck et al., (1991)
Dependency ratio	Alternative to dependency ratio=dependents/Household size	Share of dependents in household
Schooling	Total years of schooling by male household members	Number of school years completed for male members added up for the household
TLUs	Total Livestock Units	Livestock count calculated as per Storck et al., (1991)
Nearest health post	distance to the nearest health post	Measured in kms
Education expenditure	Annual expenditure on education (including assistance)	Real Birr amount spent on education of household members per annum in AEU's
Nearest primary school	distance to the nearest primary school in kms	Measured in kms
Nearest asphalt road	Distance to the nearest asphalt road in kms	Measured in kms
MPI	Multidimensional Poverty Index	Measured as a score between 0 and 1 where lower values mean lower multidimensional deprivation and higher values mean more multidimensional deprivation. See Alkire and Foster (2011)

Modeling infrastructure investment in CGE and the closures rule

We introduce shock to investment to infrastructure investment, such as an increase in government spending on infrastructure projects (20 percent increase in our case). On the other hand, investment on infrastructure has productivity effects, which would require modeling the productivity-enhancing effects of infrastructure, such as reduced transportation costs or improved energy efficiency. The other is the financing mechanisms of infrastructure investment (here indirect taxes and reallocation of government spending) used. Moreover, concerning time horizon, while the short-term (demand-side effects) and long-term (supply-side effects) impacts of infrastructure investment.

Infrastructure investment typically involves allocating resources to improve transportation, utilities, energy, communications, and other public goods. In CGE models, infrastructure investment can affect the economy in several ways. These can be classified as direct effect and indirect effects. The direct impact on sectors (infrastructure development can directly boost the productivity of industries reliant on transportation, energy, or communication (e.g., manufacturing, agriculture, services). For example, improved roads reduce transportation costs for goods, leading to lower prices and higher demand) 2) sectoral Linkages (Infrastructure investment creates positive externalities by improving the productivity of other sectors, such as increasing the efficiency of the labor force, facilitating trade, and lowering production costs), 3) Factor Mobility and Productivity (by improving

¹ For the real birr amounts the 2011/12 CPI was used as the base.

infrastructure, CGE models may show that capital and labor become more mobile and efficient, meaning resources can be allocated more efficiently across sectors, boosting overall productivity), 4) government Investment (In a CGE model, infrastructure investment is typically modeled as a government expenditure that increases capital stock in the economy). The government may finance infrastructure development through taxes or borrowing, affecting the broader economic equilibrium. The CGE models consist of a system of equations representing economic relationships. For example the production equations relevant to infrastructure investment is given in the following equations:

$$(3) \quad Y = A \cdot F(K, L, IF)$$

$$Y = AK^\alpha L^\beta IF^\gamma$$

Where :

Y =Output

A =TFP

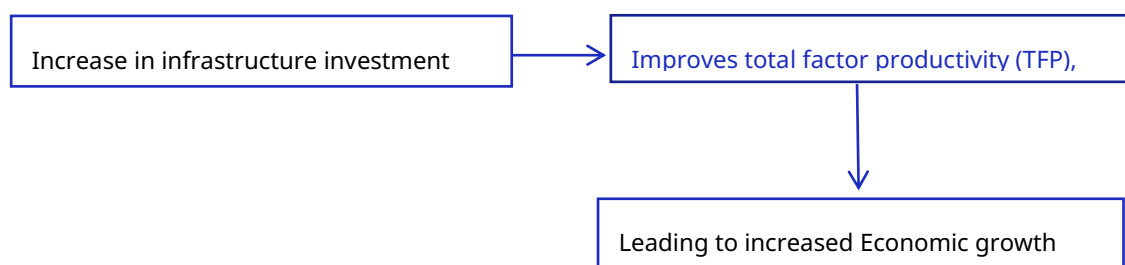
K =capital

L =labour

IF =Infrastructure stock (Road density, telecommunication) and a higher IF due to infrastructure investment increases output.

α , β , and γ = Elasticities of capital, labor, and public capital

► **Figure 1: Link between increasing investment and economic growth**



The increase in public investment is expected to enhance economic growth (Y). In our model public investment is expected to be financed by increase indirect tax, foreign aid and government borrowing. A CGE simulation can assessed different scenarios of infrastructure investment. In the baseline Scenario there is no additional infrastructure investment (maintained the status quo). In the intervention scenario an investment shock scenario in infrastructure investment is introduced (20%).

To this end, a savings-driven closure, where total investment expenditure is equal to the sum of agents'savings, is adopted. Thus investment is endogenous and depends on available savings. The exogenous variables are the nominal exchange rate, which is used as the numeraire, the current account, current government expenditure, capital supply, labour supply, the world price level and inventories. Capital is assumed to be sector-specific, since this is a static model depicting the short run, thus it cannot move across sectors. World prices of imports and exports are assumed to be exogenous because Ethiopia is a small economy with no influence on global prices and thus takes world prices as given.

Poverty analysis –microsimulation

We applied the micro simulation (MS) approach in which the household agents in the CGE model correspond to the observed individual households in a survey. In this study, we linked the CGE model with MS model to distribute the economy-wide results of CGE model to assess the poverty effect (change in consumption). The high growth scenario and other policy reforms introduced in the CGE model bring about economy-wide changes in the consumer price index and consumption expenditures of households once we run the CGE model. Then, these simulation results for the before and after shock period are fed into the MS model using distributional analysis software (DAD) that yields the FGT poverty indices. Thus, for the CGE analysis, we used the FGT indicators of absolute poverty index and the Gini index for inequality. The measurements used for poverty are presented in Table 2.

► **Table 2: Inequality measures**

Poverty measures	Inequality measures
P0 - head count	Square coefficient of variations
P1 - poverty gap	Variance of log of income
P2 - Squared poverty gap	Gini coefficient

Data

In this study, we used the upgraded 2018 SAM prepared by IFPRI for Ethiopia that captures resource flows associated with economic transactions taking place in the economy, showing the interlinkages and relationships between all economic sector and agents (activities, households, firms, government, and the rest of the world). The SAM 2018 includes 79 production sectors and 80 commodity types. The production sectors employ eight types of labor classified by residence (rural or urban) and skill levels and combines them with a single land and three capital factor types. Factor incomes are distributed to 10 representative household types classified by residence and income quintiles. Moreover, the 2018 SAM Factors are disaggregated into labor, agricultural land, and capital. Labor is further disaggregated across three education categories. The Nexus SAM defines household groups, namely rural and urban households disaggregated by per capita expenditure quintiles. The remaining accounts include enterprises, government, taxes, savings-and-investment, and the rest of the world. The 2018 SAM for Ethiopia also includes at least 10 household groups comprising households residing in rural and urban areas. Urban households are either poor or non-poor; rural households are classified as farming and non-farming households, with each group divided to poor and non-poor.

Result

Is public investment pro poor – a quantile regression analysis

We employed a quantile regression of household consumption on different categories of indicators. We compared the quantile regression coefficients against their OLS counterparts to see if there is a difference among explanatory variables across household consumption expenditure quintiles. The results are reported in Table 3. The results show that all covariates except access indicators, and education expenditure had coefficients that were statistically significant across all five consumption quintiles. Moreover, these coefficients had generally an increasing pattern as one climbs up the consumption quintiles indicating that the effect of these variables increases as a household's consumption increases. There were a few exceptions to this, though.

Sex of head, age of head, share of dependents, total male schooling years in the household, had increasing coefficients, in absolute terms, implying that these variables are more important in the higher quintiles of the consumption distribution than in the lower quintiles. For example, household with female heads had higher consumption than households with male head and this increased as one climbed the consumption quintiles. On the contrary, as the age of a household head increased, the household's consumption declined, and the magnitude of this relationship increased as one climbed up the consumption quintiles. Residing in small towns has the highest positive effect on the household's consumption expenditure.

The coefficients on other covariates had consumption quintile specific nuances. Access to health services (as proxied by distance to the nearest health post) was important for households in the lowest quintile. Access to primary school education, that is to acquiring basic literacy and numeracy skills, was important to the forth quintile. In terms of being in different regions of the country, we find that being SNNP seems to affect consumption negatively while for the "other" category of regions, a negative effect is observed for the lowest quintile and a positive one for the highest quintile relative to Tigray, our reference category.

From a micro perspective, these results show that indeed change in household consumption is nuanced across consumption quintiles. The results also show that change in consumption, for most parts, is not favoring the poorest households in terms of consumption poverty.

► **Table 3: Quantile regressions of annual household consumption**

		Pooled OLS	0.2 quantile	0.4 quantile	0.6 quantile	0.8 quantile
Sex of head (F=1)		0.143**	0.106**	0.137**	0.142**	0.179**
		(0.021)	(0.030)	(0.022)	(0.025)	(0.026)
Age of head (in yrs.)		-0.029**	-0.020**	-0.030**	-0.028**	-0.035**
		(0.004)	(0.004)	(0.004)	(0.003)	(0.004)
Square of age of head		0.000**	0.000**	0.000**	0.000**	0.000**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Head can read and write (Yes=1)		0.176**	0.177**	0.178**	0.159**	0.167**
		(0.019)	(0.024)	(0.023)	(0.021)	(0.025)
Share of dependents		-0.004**	-0.004**	-0.004**	-0.004**	-0.005**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Total male schooling (in yrs.)		-0.005**	-0.004*	-0.005**	-0.004**	-0.006**
		(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Total Livestock Units		0.016**	0.018**	0.018**	0.014**	0.008**
		(0.002)	(0.004)	(0.002)	(0.002)	(0.003)

Small town dweller		0.235**	0.153**	0.261**	0.273**	0.299**
(Yes=1)		(0.028)	(0.031)	(0.032)	(0.034)	(0.031)
Regions	Amhara	-0.253**	-0.248**	-0.259**	-0.274**	-0.267**
(Reference category = Tigray)		(0.025)	(0.031)	(0.024)	(0.027)	(0.030)
	Oromia	-0.028	-0.036	-0.010	0.008	-0.020
		(0.025)	(0.033)	(0.026)	(0.027)	(0.027)
	SNNP	-0.250**	-0.404**	-0.230**	-0.189**	-0.134**
		(0.029)	(0.046)	(0.030)	(0.029)	(0.030)
	Other	-0.002	-0.094*	0.008	0.068	0.089*
		(0.031)	(0.037)	(0.036)	(0.036)	(0.037)
Nearest distance to ...	Health post	0.002	0.004*	0.001	0.000	0.002
(in Km)		(0.002)	(0.002)	(0.002)	(0.001)	(0.003)
	Primary school	0.001	0.002	0.000	0.001**	0.000
		(0.001)	(0.002)	(0.000)	(0.000)	(0.000)
	Market	0.001	0.002	0.000	0.000	0.000
		(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
	MFI	0.000	-0.000**	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Water service connection length (in m)		0.000**	0.000**	0.000**	0.000**	0.000**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Education expenditure		-0.001	-0.001	-0.001*	-0.001	-0.001
(Including assistance)		(0.000)	(0.001)	(0.001)	(0.000)	(0.001)
LSMS survey round	2013/14	-0.153**	-0.080**	-0.111**	-0.139**	-0.156**
(Reference category		(0.021)	(0.026)	(0.022)	(0.023)	(0.026)
= 2011/12)	2015/16	-0.160**	-0.117**	-0.111**	-0.118**	-0.129**
		(0.022)	(0.027)	(0.023)	(0.023)	(0.028)
Constant		8.972**	8.272**	8.806**	9.037**	9.537**
		(0.092)	(0.103)	(0.102)	(0.094)	(0.114)
R-squared		0.138				
F-stat		53.21**				
Observations		9,310	9,310	9,310	9,310	9,310
Robust standard errors in parentheses		** p<0.01, * p<0.05				

Simulation results for public investment on infrastructure simulation of growth

Table reports the simulation results of selected macro indicators. The first scenario is an increase in government indirect tax by 30 percent increase. In recent years, domestic sources registered an average annual growth rate of 30 percent. Thus, the assumption about government indirect tax to finance the increase in TPF in the priority sectors seems to be realistic. During 2021/22 while public spending had increased by 31 percent, domestic revenue grew by 20 percent and tax revenue grew by 21 percent in 2021/22 compared to 16.1 percent in 2020/21 (6). In this regard, the government policies of Ethiopia placed high importance on domestic resource mobilization. The highest average growth rate recorded for manufacturing (9.5%) followed service (6.9%) industry (6.83%) and agriculture (5.51%).

► **Table 2: Simulated sectoral growth under BAU**

Sectors	Average	2025	2026	2027	2028	2029	2030	2031	2032	2032	2033
Agriculture	5.21	6.09	4.99	3.88	5.78	5.68	5.56	5.43	4.29	6.23	6.29
Non-agriculture	6.18	6.42	6.40	6.36	6.29	6.20	6.08	5.94	5.77	6.44	7.77
Agroprocessing	5.22	6.63	6.35	6.04	5.70	5.35	5.00	4.68	4.39	5.58	5.39
Industry	6.43	6.61	6.58	6.52	6.41	6.25	6.06	5.82	5.57	5.22	5.57
Manufacturing	9.50	9.49	9.49	9.46	9.43	9.43	9.47	9.55	9.65	9.15	10.65
Other industry	4.99	5.67	5.60	5.49	5.31	5.05	4.71	4.27	3.79	5.17	7.79
Services	6.65	6.29	6.26	6.24	7.21	6.16	6.11	6.02	5.91	6.12	6.91
Other services	5.33	5.48	5.30	5.32	5.33	5.33	5.33	5.31	5.27	6.31	7.27

The first simulation result is presented in Table 5. This increase in government indirect tax revenue brought strong increases in investment (8.43%) that can offset the negative changes in private consumption by 3.75 percent. This decrease in private consumption could also be affirmed by the decreases in consumption expenditure of households. Due to the increase in taxes, government income has increased by 20.03 percent. On the other hand, simulation 2 presented the effect of growth through increased government expenditure. In the Ethiopian SAM, government consumption spending is reported for public administration, education, and health. When we look at the current experience of the government expenditure policies, data shows that final government consumption expenditure has increased by close to 20 percent. Thus, in line with this, we used 30 percent value to introduce the shock. Government consumption expenditure is explicitly accounted for in the DCGE model and thus we investigate the impacts of a 30 percent increase in government consumption.

A 30% increase in government indirect tax revenue brought about a 2.5 percent decrease in real GDP at factor cost. The same table shows that absorption has shown a 5.85 percent increase as investment increased by (8.4 %) that offsets the negative changes in private consumption by 4.75 percent. This decrease in private consumption was revealed also by the decreases in consumption expenditure of households. Also, government regular expenditure has increased by 15.7 percent contributing to increases in absorption. However, due to the increase in taxes, government income has increased by 20.30 percent. This explains the increase in investment (8.4 %), this is evident as government plays a significant role in investment in the country through its development corporations and mega projects. The CPI has risen by 7.67 percent indicating the increases in prices when government imposes taxes on consumers.

► **Table 5: Summary of results of macroeconomic effects of simulations (% changes)**

Macro-economic effects	BAU Average growth	30 % increase in government indirect tax	20 % increase in infrastructure investment
Investment	12	8.41	-1.5
GDP	8	13	2.50
Government income	15	20.30	-8.75
Absorption	4.7	5.85	2.1
Government expenditure	20	15.70	-20
Consumption expenditure	4.2	-3.75	4
CPI (% change)	30	7.67	-6.3

Note: The annual growth rates for the period 2023-2030 (%).

On the other hand, in simulation 2 (increasing government expenditure by 20 percent), while real GDP has shown a 2.5 percent growth at factor cost, absorption has increased by 2.1 percent, in the simulation, the causes are 20 percent increase in government recurrent expenditure and 4 percent increase in private consumption that offset the 1.5 percent decline in investment. The reason behind the increase in private consumption expenditure

is the decline in CPI (6 percent). Moreover, the major reason for the decrease in investment is the decline in government income by -8.75 percent.

Public investment and scenario impact

For reporting purposes, we classified activities into five; agriculture, industry, trade, service, and manufacturing and agroprocessing (agriculture and non-agriculture). Table 6 presents the simulation results based on the mean growths of the stated economic activities. The result shows sectoral growth of output compared to the baseline. In simulation 1, sectoral output has shown negative growth both in the agricultural and non-agricultural sectors. Domestic output in the agricultural sector has declined by 1.5% whereas non-agricultural output declined by 0.7%. The main reason for these changes is the price related effects when indirect taxes are imposed (factor returns have decreased in all cases and that the output purchasing power of consumers decreases as the CPI increases). A peculiar change we can appreciate in non-agriculture is the 2.4% output increase in construction services which could be associated with the increases in fixed investment as a result of the increase in government income. On the other hand, in simulation 2, sectoral output has increased by 2.5 percent and 2.9 percent for agriculture and non-agricultural selectors respectively. When government consumption for goods and services increases, it could bring in producers who want to gain profits from the increase in exogenous government demand for goods and services. The relatively large change in level of output in non-agriculture emanated from the large increase in construction services of 5.4 percent.

► **Table 6: Effects of simulations on sectoral output (% changes)**

Sectors	BAU	Increase government indirect tax by 30% (Simulation 1)	Investment in infrastructure (Simulation 2)
Agriculture	6	-1.5	2.5
Industry	11	-1.3	2.15
Service	8	-1.4	1.34
Manufacturing	5	-1.4	1.35
Agroprocessing	6	-1.2	1.34
Construction	4.5	2.4	5.4
Trade	2	2.1	1.23
Nonagricultural	7.5	-0.7	2.9

The impact of public investment on income change

It can be argued that the main consequence of increase in infrastructure investment is the increase in factor production prices due to the increase in demand for factor of productions. That is in our case increased government expenditure can act as a demand stimulus in the economy thus it increases the overall demand in the economy, which can lead to increased production, employment, and income generation. In this regard, an increase in infrastructure investment increases return to factors of production resulted in increases in income of both poor and non-poor households but with different levels of effect (see Table 7). Implying infrastructure investment growth has a differentiated impact on income level between the poor and non-poor households. Thus, given the fact that infrastructure investment has positive effect on income does not necessarily mean all the poor benefit proportionally. Thus, all the poor might not equally be benefiting from the high growth divided. Accordingly, the simulation result shows that while the growth rate in income for the first and second quantiles found to have an income growth rate effect of 0.9 and 1.25 percent respectively, the income growth for highest income group found to be 2.2 percent. One of the major consequences of investment on infrastructure is the increase in factor prices. Given that factor prices are the main driving forces behind household income, our simulation shows that there is an increase in income in all household incomes.

► **Table 7: Effects of high growth scenario on income change (%)**

	Baseline	Increase in public investment on infrastructure (% change)
All households	2.45	2.4
Poor	1.2	1.42
Nonpoor	2.1	2.3
Quintile 1	1.28	0.9
Quintile 2	2.32	1.25
Quintile 3	2.13	1.5
Quintile 4	2.83	1.8
Quintile 5	2.34	2.2

However, when we look at the simulation result by location, the increase in income of urban households is more than that of income of rural households. This is possibly due to inelastic demand for agricultural goods in the long run (the productivity gains in agriculture tend to reduce the demand for labor in agricultural sectors). On the other hand, the incomes of non-poor households increased by 2.1 and 2.3 percent in rural and urban areas in respective order. The result in the same table also shows that incomes of the poor increase by 0.8 and 2.3 percent respectively in rural and urban areas.

► **Table 8: Income change effects of public investment on infrastructure**

Category	Base	% Change
Rural poor	2.42	0.82
Rural non-poor	2.75	2.12
Urban poor	2.5	2.33
Urban non-poor	2.12	2.32

Welfare impact of public investment

Given the fact that the major transmission channel through which increase in infrastructure investment increase TPF is by increasing indirect tax and then increasing government expenditure on infrastructure, there is a need to examine how such shocks impact the poverty conditions of households. In this regard, government expenditure is assumed to be an important public policy tool. However, since resources are limited and thus have opportunity costs, specifying national priorities is clearly critical. Thus, we opted to see the effect of increase in indirect domestic tax and government expenditure on infrastructure on welfare. In this regard, one of the important welfare indicators is the equivalent variation (EV). Since policy shocks are usually followed by major price adjustments, the EV measures the level of income that the consumer needs to (presumably) pay before the shock to leave him as well off at the equivalent level of utility loss after the price increase.²

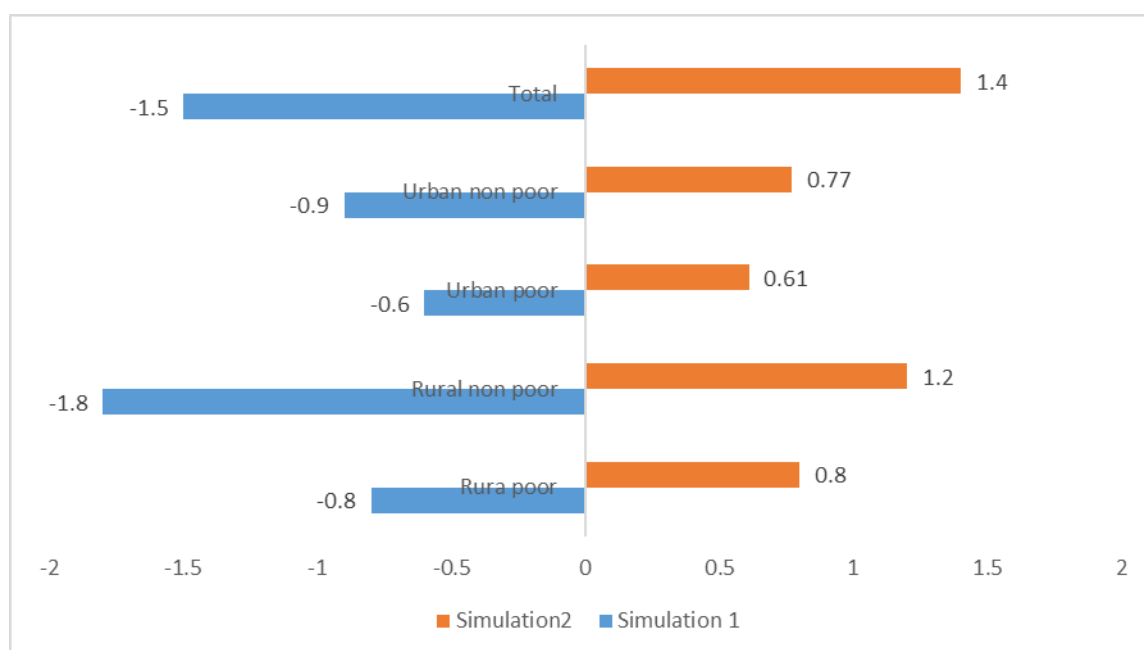
In the first simulation, the increases in domestic indirect tax collected by government have negatively affected both the urban and rural households. The EVs have declined by 0.8 1.8, 0.6 and 0.9 percent for rural-poor, rural-non-poor, urban-poor and urban-non-poor, respectively. Comparatively, the EVs indicate that the non-poor receive much of the welfare pressure in both rural and urban areas. This is due to the price increasing effect of taxes which is mainly evident in urban areas in relation to tax such as VAT imposition (mostly observed in urban

² Since the consumer is affected prior to the policy change by paying the price equivalent in income, negative EV changes represent welfare loss because of the policy shock.

areas because of the low penetration in rural areas where significant proportion of the population lives). In the same way, compared to urban households, rural households still face larger welfare losses.

In the second simulation, we see positive EVs for the increases in government expenditure indicating welfare improvements (see Figure 2). The EVs showed increases for all household groups by 1.4, 0.8% (rural-poor), 1.2% (rural non-poor), 0.6% (urban-poor) and 0.87% (urban-non-poor). Similar results were also observed for other studies (Wang et al., 2010). The welfare of rural households improved more than that of the urban counterparts with non-poor households benefiting the most. One of the main reasons could be the structure of the Ethiopian SAM.

► **Figure 2. Effects of simulations on welfare (EV) of household groups (% changes)**



Poverty impact of public investment on infrastructure

The poverty severity index is a tool (index) that describes expenditure distribution among poor and given that the SAM (CGE) model has only two poor categories (rural poor and urban poor each with singleton within distribution). Moreover, the poverty categorization in the SAM is a relative poverty (i.e., the poor are defined as those with bottom 20% expenditure and are different from the standard poverty line) which makes mapping the changes in poverty from the SAM (or business-as-usual simulation scenario in CGE) to the different poverty/welfare indicators at population level. Thus, we found it important to link individual household level consumption information (for example, from HICES data 2016) to the household groups in the SAM/CGE to be able to map the changes from CGE simulation to the wider/larger individual households (or vice-versa). This way, it might be possible to understand the changes in poverty (with a given poverty measurement) including poverty intensity. In this regard, for example, there was an attempt by IFPRI back in 2012/13 to undertake a mapping between the about 15 household groups in SAM/CGE to about 30,000 households in HICES data and backwards.

Thus, to analyze poverty, we used the percentage changes in consumption expenditure of household groups that are taken from the CGE model. It is these economy-wide changes in consumption that we used as the source of link with the MS model in conducting the poverty analysis using the three poverty indicators. To examine the change in FGT poverty estimates for households at national, rural and urban level is used. The distribution of households at various locations (rural and urban) with share is presented in

Table 9. The results show that while 85.7 percent of the sample Households are from rural the remaining are from urban area.

► **Table 9: Representative households in the SAM**

Representative Household Populations	Number (1000s of people)	Share
All households	109,224	100
Quintile 1	21,857	20
Quintile 2	21,854	20
Quintile 3	21,824	20
Quintile 4	21,849	20
Quintile 5	21,840	20
Rural households	93,640	85.7
Rural quintile 1	21,242	19.4
Rural quintile 2	20,835	19.1
Rural quintile 3	20,244	18.5
Rural quintile 4	18,608	17
Rural quintile 5	12,711	11.6
Urban households	15,584	14.3
Urban quintile 1	615	0.6
Urban quintile 2	1,019	0.9
Urban quintile 3	1,581	1.4
Urban quintile 4	3,241	3
Urban quintile 5	9,129	8.4

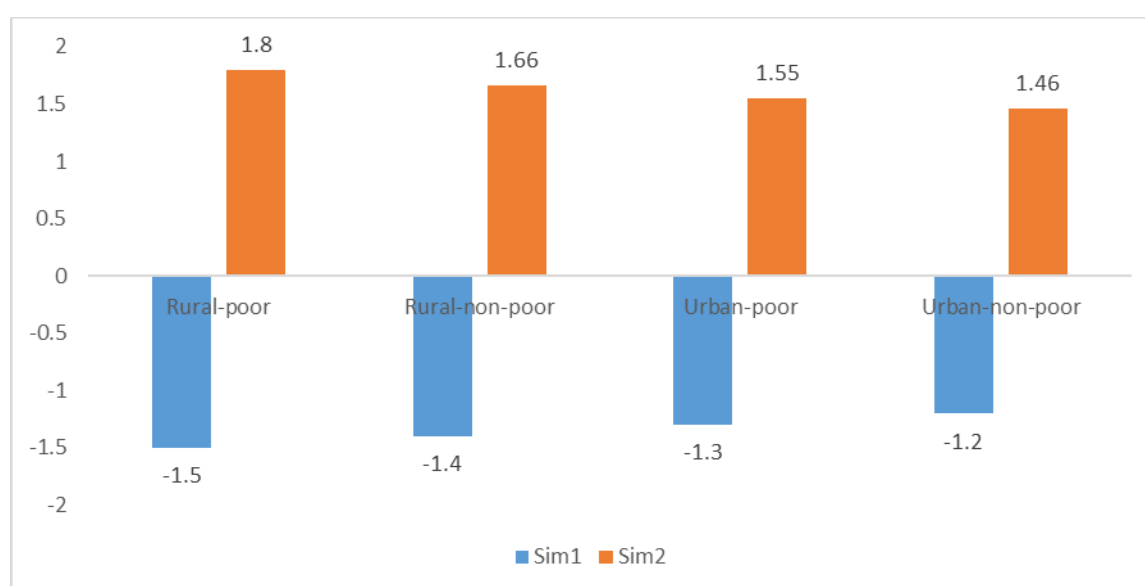
The HICES for 2016 indicates that, at national level we have 30,229 households of which 10,368 were rural and 19,861 were urban. The households were divided into poor and non-poor rural and urban households based on the bottom 40 percent were considered as poor and top 60% as non-poor (Based on SAM classification). Based on this classification we got 4147 as poor and 6220 as non-poor among the rural households whereas among urban households, we found 7944 as poor and 11917 as non-poor (Figure 3). After this, we changed the household consumption expenditures in the HICES survey to household expenditure per adult equivalent based on adult equivalent household size for the HICES 2016 survey. This adjustment has been made on household's consumption expenditure in the 2016 HICES survey using the consumption expenditure results in the CGE model under high growth policy scenarios.

► **Figure 3. Adjustment on household's consumption expenditure HICES 2016**

Figure 4 presents the CGE results for changes in consumption. In the first simulation, consumption shrank for all the household groups by 1.5, 1.4, 1.2, 1.3 and 1.2 percent for rural poor, rural non poor, urban poor and urban non poor respectively. The decline in consumption is due to the increases in price of consumption commodities that might force households to adjust their use of income. For example, the increase in indirect tax (such as tax imposed on commodities) directly affect the consumption of goods by households (as it is imposed on the price paid by the consumer which increases the price of consumable goods by households while still income is fixed).

In the second simulation, consumption has increased by 1.8, 1.66, 1.55 and 1.46 percent for rural poor, rural non poor, urban poor, and urban non poor households. The reason could be the increase in government expenditure increase TPF increases and hence leads to increase in production the increase in production increase demand for factors of production (depending on the relative price of factors of production) which again increases wage and that give households more income which increased consumption expenditure.

► **Figure 4. Effects of simulations on consumption expenditure growth of household groups**



On the hand, using adult equivalent household size for the 2016 HICES from CSA, we changed the consumption expenditures in the survey to consumption expenditure per adult equivalent. After this, we took approximate levels of consumption expenditure at the demarcation of the bottom 40% (two quintiles) to represent cut points for national, rural, and urban-poor and non-poor households. So, among rural households, we got 3,861 as poor and 5,632 as non-poor whereas among urban households, we got 4,751 as poor and 7,350 as non-poor. We presented the consumption changes on the base values of the four households (rural poor, rural non poor, urban poor and urban non poor) after simulations from the CGE model (8).

The model is first used to examine the impact of Ethiopia's current growth path on poverty. This business-as-usual or baseline scenario draws on recent and observed production trends for the various subsectors in the model to construct a growth trajectory for 2023–2030.

Table shows the results for the poverty head count index. At the base run, the proportion of the poor from total population is 19 percent at the national level. But at rural and urban levels, the index becomes 23 and 14 percent, respectively. In the first simulation, we see that poverty incidence has increased by 1.2, 1.1 and 0.9 percent at national, rural, and urban levels implying worsening of the poverty situation at least in the short-run (the tax effect has a short-run negative impact on the welfare households). The same table shows that for the high growth simulation, poverty headcount has declined by 2.1, 2.2 and 1.8 percent for national, rural, and urban households, respectively.

► **Table 10: P0 (Head count index)**

	Base	Simulation 1	Public investment on infrastructure (Simulation 2)
National	19	1.2	-2.1
Rural	23	1.1	-2.2
Urban	14	0.9	-1.8

Table 11 presents the results for the poverty gap index. The results show that the poverty gap index increases in the first simulation for all the three categories from the base. Poverty depth has increased by around 2.1, 1.6 and 1.2 percent at national, rural, and urban levels, respectively. Rural poverty gap has increased by a relatively larger margin compared to urban poverty gap. The implication is that when the increases in domestic indirect taxes decrease the consumption power of households, the mean level of consumable goods that the households need to get out of poverty increases worsening their poverty conditions. Other studies have also shown that poverty gap index increases in the short run (7).

The same table shows that the poverty gap has declined by relatively higher percentages than the effect of the first simulation. In the second simulation, the poverty gap has declined by 1.2, 0.2 and 0.4 percent for national, rural, and urban households, respectively. The indication is that increase in government expenditure or high economic growth scenario can slightly reduce the income shortfall of poor households from the poverty line. However, from the result, high economic growth is not strong at rural and urban levels compared to the effect on headcount. The implication here that in addition to public investment, there is a need to work on pro-poor policies and social programs that directly target the poor through investment on health, education, and nutrition (who are not participating in an economic activity that are targeted by the public investment or government expenditure). In this regard, experience from other countries shows that those who have invested in these sectors have achieved better results in terms of reducing the poverty gap.

► **Table 11: P1(Poverty gap index % change)**

	Base	Indirect tax and borrowing	Investment on infrastructure (Simulation 2)
National	3.6	2.1	-1.2
Rural	3.3	1.5	-0.2
Urban	3.5	1.2	-0.4

Table 12 presents the results for the poverty severity (squared poverty gap) index. In the first simulation, we see a 2.2, 2.1 and 2.3 percent increase in poverty severity at national, rural, and urban levels, respectively. The implication of this is that the inequality among the poor has risen due to the imposition of domestic indirect taxes. Poverty severity has increased by higher margins for urban households compared to rural households. In the second simulation, poverty severity has been reduced by 0.6, 0.2 and 0.3 percent at national, rural, and urban levels, respectively. This shows that increases in government expenditure slightly reduces inequality among the poor. This is more pronounced for urban households compared to rural households. This shows, government investment on infrastructure needs to be tilted towards pro-poor sectors (such as education and health) and other productive economic sub sectors.

► **Table 12: P2 (Severity of poverty, % change)**

	Base	Simulation 1	Public investment (Simulation 2)
National	1.69	2.2	-0.6
Rural	2.16	2.1	-0.2
Urban	2.23	2.3	-0.3

Conclusions and recommendation

Event though, public investment on infrastructure can improve growth and lowers income inequality it is still depends on the size of public investment, type of investment made and sector prioritization/ the choice of targets by the government. Thus, making public investment work for the poor requires identifying the right mix, choice and type of of public investment and an approach beyond the same size fits all . This suggests that infrastructure development should top policy priority in the poverty and inequality reduction agenda in Ethiopia. Moreover, planning and prioritization of public investment by type would bring the highest befit in terms of poverty reduction and growth.

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► Building resilient communities

Maximizing social impact through sustainable infrastructure development

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Abstract

In an era marked by increasing environmental challenges and socio-economic disparities, the development of resilient communities through sustainable infrastructure has never been more critical. This paper examines the multifaceted approach of the Support to Rural Entrepreneurship, Investment and Trade (STREIT) Project in Papua New Guinea. It focusses on how the International Labor Organization's application of Employment Intensive Investment Approaches in infrastructure development contributed to building resilient communities and maximizing social impacts by integration of sustainable practices within the project lifecycle. It highlights the significance of utilizing appropriate technologies in building climate-resilient infrastructures that meet the needs of vulnerable populations and ensure long-term viability. Central to this discussion is the role of stakeholder engagement, which ensures that the voices of local communities are heard and prioritized in the planning and implementation phases. This participatory approach fosters a sense of ownership among community members and enhances the relevance and effectiveness of the proposed infrastructure solutions. The paper underscores the importance of selecting infrastructure initiatives that facilitate economic growth while providing substantial social benefits, particularly in sectors such as agriculture and fisheries where local producers are directly impacted. Through effective communication and knowledge sharing, the project fosters a collaborative environment that empowers communities and enhances their capacity to adapt to changing circumstances. Furthermore, the findings reveal that by striking a balance between labor utilization, appropriate technologies and sustainability principles in infrastructure development, it is possible to create decent jobs that contribute to both economic stability and social well-being. This paper advocates for a paradigm shift in infrastructure development, urging policymakers and practitioners to recognize the potential of these investments as catalysts for transformative change. The insights gained could serve as a blueprint for maximizing the social impact of infrastructure development, paving the way for healthier environments and resilient infrastructures that benefit society. Ultimately, this paper calls for a holistic approach to infrastructure investment, one that aligns economic objectives with social and environmental goals, thereby fostering a more inclusive and sustainable future for communities facing uncertainties in a rapidly changing world. Prioritizing resilience and sustainability ensure that infrastructure developments meet the immediate needs while laying the groundwork for thriving communities in the decades to come.

Keywords: Resilient Communities, Sustainable Infrastructure, Social Impact, Climate-Proofing, Stakeholder Engagement, Decent Jobs, Community Needs, Economic Opportunities, Fragile Environments, Transport Infrastructure Development, Local Producers, Knowledge Sharing, Project Design, Environmental Sustainability.

Introduction

The global context of infrastructure development is undergoing a significant transformation, driven by the urgent need to address the challenges of climate change, and socio-economic inequality. Infrastructure projects, particularly in developing regions, have the potential to serve as catalysts for social and economic empowerment. In Papua New Guinea (PNG), enormously unique development challenges such as geographical remoteness, limited infrastructure, and vulnerability to natural disasters abound, hence the significance of integrating sustainable practices in infrastructure development for building resilient communities cannot be underscored.

The STREIT Project in PNG is funded by the European Union under the 11th European Development Fund (2014 - 2020), and is being implemented as a United Nations Joint Program under the leadership of the Food and Agriculture Organization, partnering with the International Labor Organization, International Telecommunication Union, United Nations Capital Development Fund, and United Nations Development Program and in close collaboration with the Government and local partners with an emphasis on local agripreneurs.



Its overall objective is “to increase sustainable and inclusive economic development of rural areas” by investing in improvements in three value chains: cocoa, vanilla and fisheries (aquaculture, riverine and in shore/reef) through a combination of two integrated outcomes:

Increasing economic returns and opportunities from the cocoa, vanilla and fisheries value chains through **outputs** such as increased volume, value and improved quality of value chain products, more value addition and an increased number of people and enterprises engaging in and benefiting from improved value chain development.

Strengthening and improving the efficiency of value chain enablers including the business environment and supporting

sustainable, climate resilient transport and energy infrastructure development.

The International Labor Organization focused its work on delivering Outcome 2, to improve access to communities and markets, particularly those linked to the value chains development of the project, by rehabilitating and maintaining rural transport infrastructure (roads, airstrips, wharves/jetties and waterways) in a sustainable and impactful manner.

These were executed by applying technologies that (to the extends possible), relied on the use of local resources (materials, entrepreneurs, communities, etc.); mainstreaming gender, social and environmental issues, involving disadvantaged groups (women and youth) and strengthening capacity of local institutions mandated to develop, improve and maintain rural transport infrastructures.

By applying local resource-based approaches in the infrastructure works, the ILO increased:

- participation of local community in planning and implementation of works, hence ensuring ownership and sustainability
- participation of local entrepreneurs in the construction industry, thus developing local construction capacity
- household income through jobs created by use of employment-intensive work methods

The International Labor Organization’s mandate “to promote decent work and social justice for all” were reinforced by this inclusive approach that considered the context and needs of the local communities in project area.

This paper explores the recent initiatives in rural transport infrastructure within PNG that aim to enhance local resilience while promoting social equity. By focusing on sustainable infrastructure development, the paper discusses how strategic investments can lead to substantial social impacts, particularly in fragile environments prone to climate change.

Infrastructure development and employment paradox

The correlation between infrastructure development and employment generation is rather paradoxical. The normal expectation is that infrastructure projects create jobs and stimulate economic growth, but the reality is more complex. Often, there is unequitable distribution of the benefits of infrastructure investments, and marginalized communities may not experience the intended economic uplift.



The Country's economy is characterized by a dual structure that consists of a small formal sector dominated by resource extraction (e.g., mining and liquefied natural gas) and a large informal sector that employs approximately 80 - 85% of the population in subsistence agriculture and small-scale economic activities. Infrastructure construction projects are viewed as ways to economic development, yet they often rely on heavy machinery and imported expertise, limiting local employment opportunities. While infrastructure investment is intended to boost employment, the jobs created are often temporary, skill-specific, or inaccessible to most of the rural and informal workforce, thus failing to address widespread poverty or unemployment.

Employment-intensive investment (EII) approaches aim to shift this dynamic by prioritizing use of labor-based methods (local labor and resources) over capital-intensive techniques. The use of community workers to build and maintain rural roads, airstrips and waterways rather than relying on mechanized methods to create jobs. However, implementation of these approaches have been laden with significant challenges due to PNG's unique socioeconomic, geographic, and institutional context.

Geographical and logistical barriers

The topography comprises a rugged terrain with mountainous highlands, swampy marshlands, dense rainforests, and scattered islands, making infrastructure development challenging. Most locations are remote and /or isolated and only accessible on foot, by small dinghies or small aircraft, thus complicating the transport of materials and workers. The significant need for manual labor and coordination becomes a logistical challenge. Furthermore, maintaining a consistent workforce in remote locations with dispersed communities lacking basic transport links stretched project timelines and increased costs, therefore undermining the cost value of labor-based approaches.

Limited skills and capacity

Majority of the workforce lacked formal training or technical skills to implement not only conventional mechanized but also labor-intensive infrastructure projects. Whereas EII approaches the leverages of unskilled labor, certain tasks such as ensuring structural integrity of roads or bridges) require basic competencies that were not available in rural areas. Moreover, the rapid growth in the working-age population coupled with a low level of educational attainment as well as poor access to quality education and vocational training further exacerbates the problem. This limitation in skills further constrained the ability to employ local workers effectively and necessitated external contractors or imported labor (from other villages), hence contradicting the EII ethos.

Institutional / governance issues

Inadequate institutional capacity and governance have posed significant hurdles. The Works and Technical Services Divisions/Units that provide infrastructure services at the Provincial and District Authorities often struggle with planning, coordination, and oversight of infrastructure projects, leading to poor project execution. Furthermore, political leaders engage in both macro-level policy formulation as well as micro-level prioritization of projects to be executed. Technocrats are disempowered in making independent professional/evidence-based

decisions in favor of political expediency. The lack of strong /independent local institutions to manage and sustain labor-intensive infrastructure investments implies that maintenance works crucial for long-term employment may falter after rehabilitation / reconstruction.

Economic constraints / funding models

Compared to capital-intensive methods, employment-intensive approaches usually need higher upfront labor costs, and governments or donors that prefer quick, visible results may be discouraged. PNG's infrastructure funding is majorly from foreign investment and/or development partners who may favor rapid, large-scale projects over slower, labor-focused ones. The Medium-Term Development Plan IV (2023 - 2027) targets construction of 25,000 km new roads to the existing National Road infrastructure but the focus on economic growth through connectivity often overshadows employment goals. Balancing cost-efficiency with job creation remains a persistent challenge.

Socio-economic and cultural issues

The Country's large informal economy is a double-edged sword - providing resilience yet complicating EII implementation. Many rural folks are deeply attached to their subsistence livelihoods and don't rate wage labor as a viable or desirable alternative, especially for short-term employment. Cultural norms, such as sharing monthly income with one's clansmen disincentivize some people from working on EIIPs. Communal landownership and disputes over land use for EII implementation also cause delays. Moreover, the deep sense of mistrust and lack of dialogue between authorities and informal sector participants meant that some local needs and capacities were overlooked.

Environmental and sustainability issues

Some infrastructure projects conflicted with PNG's environmental goals - with a likelihood to escalate environmental degradation and loss of biodiversity because the roads were being used to transport logs by licensed logging companies. Moreover, while labor-based methods may reduce machinery use, scaling them up to meet ambitious targets (e.g., adding 25,000 km to the National road network by 2027) risks exacerbating deforestation and land degradation, unless carefully managed. The friction between development and sustainability adds complexity to EII adoption.

Maximizing social impact

Maximizing the social impact of infrastructure development requires a comprehensive understanding of community needs and aspirations as well as aligning the projects to broaden goals of sustainable and inclusive economic development. Contextualizing the social and cultural norms, the deliberate actions following key principles and outcomes taken to significantly impact society included:

- The transport infrastructure projects were strategically identified to address the community needs where poor infrastructure (impassable roads, limited river transport, isolated/remote villages) historically hindered access to markets, social services (education, health, etc.). Through rehabilitation and improvement of roads, airstrips and waterways, the project improved critical bottlenecks that affected remote populations inclusive of smallholder farmers who rely on cocoa, vanilla and fisheries value chains. For example, all road rehabilitation projects reduced the last mile accessibility for beneficiaries (on dirt roads) to a radius of 2 km from the rehabilitated road. The selection thus prioritized areas with high potential for improving livelihoods and reducing isolation.
- Mainstreaming social and environmental inclusion in the program framework, with particular emphasis on women, youth and other vulnerable group. For example, there was a notable focus on gender equity where women made 52% of the workers engaged on community-based labor-intensive works. With the projected 390,000 decent workdays envisaged to be generated by the project end date and its attendant economic benefits, trickle-down benefits include community empowerment to maintain and sustain their infrastructures, hence a sense of ownership and long-term social resilience.
- Collaborative and participatory project identification, with stakeholders such as partner UN Agencies, Government Authorities, and beneficiary communities. These multi-stakeholder engagements enabled alignment of interventions to national development priorities (MTDP III and IV) while at the same time addressing community specific needs.

Building resilient communities and implementation modalities

Building resilient communities through infrastructure development requires a holistic approach that entails:

- Employment-Intensive and Local Resources-Based Approaches

By adopting intensive labor methods that emphasize the use of local human resources and materials, sizeable number of community members engaged directly and indirectly in the works. Prioritization of local participation over mechanized processes in the routine maintenance of transport infrastructures ensured job creation and retention of economic benefits in the community. For example, 207 km of road have been rehabilitated by local entrepreneurs/contractors applying a labor-equipment mix, 312 km of roads have been routinely maintained by community-based road maintenance groups, 5 airstrips have been rehabilitated Rural Airstrips Authority engaging Ward Level community groups and 215 km of waterways under maintenance by Ward Level community groups – with overall support by ILO's EIIP Specialists

These modalities provided income to the communities, reduced economic vulnerabilities and reinforced community resilience, enabling them to meet education, health and livelihood needs in the community.

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- Capacity Building

Capacity building of counterpart officers from Government MDAs, Provincial Administrations and Contractor's Staffs were executed by the ILO in partnership with international, national and local academic and vocational institutions (Indian Association of Highway Engineers, International Labor Organizations' International Training Centre in Turin, Papua New Guinea University of Technology and Yawasoro Technical and Vocational Education Training Center). This buttressed acceptance, ownership and sustainability of the infrastructure development works. In addition, intentional targeting, selection and training of vulnerable populations including women, youth, single mothers and widows and their eventual employment on the infrastructure projects fostered community resilience. More than 1,200 stakeholders have been trained in various aspects of road rehabilitation using EI Approaches, equipping the stakeholders with necessary skills for infrastructure maintenance.

- Climate Resilient Infrastructure Design

Climate-proof designs ensured all weather access and sustained functionality of the transport infrastructures were adopted. Some examples included embankment construction in marshy/low lying spots to elevate the roadways, Construction of mass concrete abutment slab bridges, construction of vented drifts/fords, construction of reinforced concrete box culverts, construction of rigid pavements/ plum concrete road surfaces, benching on steep slopes, etc. ensured accessibility of the roads in spite frequent natural hazards, including flooding, landslides, etc.

- Community Ownership and Participation

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Construction of Climate-resilient designs are hampered by inadequate infrastructure financing, as well as the skills gap. This is further exacerbated by the country's rugged terrain that increases the locations requiring climate proof infrastructure. Nonetheless, the ILO's approach demonstrates a balanced model of development that prioritizes both resilience and equity.

Lessons learnt and implementation challenges

While significant strides have been made in executing the rural transport infrastructure component of the STREIT Program in PNG, valuable lessons have been learned along the way. These lessons underscore the intricacies of undertaking infrastructure projects in challenging environments and offer insights for future endeavors:



- Feasibility studies and planning

As posited by (Alamgir et al, 2019), the need for comprehensive assessments of proposed transport infrastructure projects in PNG's challenging landscape cannot be underscored. This facilitates proper scoping and costing of the works, long-term maintenance planning for PNG's rugged terrains with high rainfalls and aids to foreshadow potential challenges and project viability.

- Environmental safeguards

Due to the Country's rich biodiversity, undertaking thorough environmental impacts assessments coupled with the environmental management plans help to mitigate adverse impacts before, during and after infrastructure development. In projects where the potential risks outweighed the potential benefits, inclusive stakeholder consultations were effectuated to address the concerns before commencement.

- Community participation and ownership

Active involvement of local communities is paramount throughout project life cycles. In addition, due to diverse interests of individuals in the communities, the importance of proper documentation and record keeping of resolutions agreed with the communities during the consultative processes cannot be overemphasized. For example, at one project location, a community at the front end welcomed and accepted the project to proceed while the community at the back end, who had tensions with their front-end neighbors preferred the access in its poor state. Later, when the project had been executed and commissioning had been completed, the back-end community backtracked and requested for improvement of the road access.

- Capacity building

Local capacity building is indispensable for long term sustainability of infrastructure projects. Apart from counterpart officers from government, contractors and local communities lacked pathways for retention and/or long-term employment of trained staff. Moreover, there is stiff competition between multinational and national companies engaged in the construction and extractive industries for the few skilled staffs, leading to a high staff attrition rate from the construction companies as well as UN Agencies.

- Geographical and logistical challenges

The Country's remote location and challenging terrain present significant logistical hurdles for infrastructure projects. Construction materials take a long time to be shipped from China to the country and eventually project locations. The rugged terrain presented numerous challenges such as landslips causing road blockages. Occasional diversion of river courses from the known routes have occurred after heavy downpour. Also, complete wash outs / destruction of drainage structures due to rocks carried by turbulent stream water flow down steep gradients. All these jeopardize executed projects.

Besides, fuel shortage was a frequent occurrence countrywide - caused by monopoly of the fuel supply market. This was made worse by the Bank of Papua New Guinea imposing restrictions on use of foreign exchange, that hindered importation of fuel by the national fuel supply company.

- Multistakeholder coordination

Effective implementation requires strong coordination among various actors, including government agencies, local communities, implementing partners, and funding organizations. Stakeholder collaboration (National and Provincial Governments, District Administrations, Lower-Level Governments, etc.) ensures clear communication and well-defined roles for seamless project implementation. Furthermore, coordination ensures development budgets are not duplicated for the same infrastructure development.

- Insecurity

The spontaneous outbreak of community violence caused suspension of transport infrastructure maintenance and rehabilitation works at many locations, in particular Angoram and Wosera Gawi Districts were most frequent. This caused time overruns on many projects.

Recommendations, conclusion and lessons learnt

Recommendations:

To enhance sustainable infrastructure development that fosters resilient communities and maximizes social impact, the following are required:

i. Local Capacity Building

Comprehensive training programs for local engineers, contractors and communities should be further prioritized and developed to ensure technical skills are embedded in the local workforce for long term maintenance, and further amplifying social impact through employment and skills development.

ii. Planning Frameworks

Adaptive planning that accounts for local constraints such as funding, logistics, environmental conditions, etc. should be prioritized. Phased, achievable targets enhance project credibility and ensure resource optimization.

iii. Climate Resilient Design

Given the Country's vulnerability to climate and natural disasters, infrastructure projects must incorporate climate proofing measures such as elevated roads or flood resistant materials into their designs from the onset.

iv. Community Engagement and Ownership

Future initiatives should formalize participatory mechanisms such as community lead infrastructure maintenance committees to foster ownership and ensure that infrastructures meet local needs.

v. Digital tools

Rural Transport Information Management Systems, Provincial Transport Master Plan, Construction Site Monitoring, etc. must be used to improve planning and oversight. Expanding the use of digital platforms for real-time monitoring, data collection, and stakeholder communication can enhance accountability and efficiency, particularly in remote rural settings.

vi. Financial management

Managing a large development budget requires robust financial oversight to prevent inefficiencies or mismanagement. Implementing transparent procurement and expenditure tracking systems can build trust among stakeholders and ensure funds directly benefit communities.

vii. Multisectoral Partnerships

The collaboration between FAO, ILO, ITU, UNCDF, and UNDP exemplifies the power of multi-agency coordination. Future projects should replicate this model, integrating expertise from agriculture, infrastructure, and digital sectors to create holistic solutions that address interconnected rural challenges.

Conclusion:

The STREIT Program in Papua New Guinea offers a compelling case study of how sustainable infrastructure development can serve as a catalyst for building resilient communities and maximizing social impact in rural settings. Under the rural transport infrastructure component, the program has improved market access, reduced travel costs, and empowered over thousands of households' dependent on cocoa, vanilla, and fisheries value chains. However, its journey has not been without challenges, including unmet targets, capacity gaps, and the ever-present threat of climate vulnerability.

The Lessons Learnt

Commencing with the necessity of local capacity building and climate-resilient design to the innovative use of digital tools like RuTIMS - provide a roadmap for future initiatives aiming to balance economic development with social and environmental sustainability. These insights underscore that resilience is not merely a technical attribute of infrastructure but a dynamic outcome of community empowerment, adaptive governance, and strategic planning.

As global attention increasingly turns to sustainable development in vulnerable regions, the experience in PNG highlights the transformative potential of integrating infrastructure with social objectives. By adopting the recommendations outlined, i.e. strengthening local skills, embracing technology, and fostering community ownership, policymakers and practitioners can amplify the impact of such projects, ensuring that infrastructure not only connects places but also uplifts lives. Ultimately, the program exemplifies how targeted investments in rural infrastructure can lay the foundation for inclusive, resilient communities capable of thriving amid the complexities of the 21st century.

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► Maximiser l'impact social des infrastructures

Le capital social, pilier d'une gouvernance écosystémique d'infrastructure durable et résiliente

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Résumé

Dans un contexte marqué par des défis environnementaux, économiques et sociaux croissants, les infrastructures sont un levier essentiel du développement durable et inclusif. Leur impact ne se limite plus aux externalités économiques et sociales classiques, mais intègre la création d'un capital social au sein d'un écosystème dynamique et résilient. Cette approche systémique mobilise l'ensemble des parties prenantes tout au long du cycle de vie du projet, garantissant une meilleure gouvernance, une redistribution équitable des bénéfices et une acceptabilité sociale renforcée.

Les avancées technologiques et les nouveaux modèles économiques, notamment les partenariats public-privé (PPP), permettent de repenser les infrastructures à Haute Intensité de Main-d'Œuvre (HIMO) comme des plateformes interactives favorisant l'innovation et l'inclusion. En intégrant une gouvernance écosystémique, le capital social se développe et maximise la valeur créée en matière d'investissement, d'emplois, de transferts de compétences et de renforcement des communautés locales de manière durable.

Cet article explore l'intérêt de la gouvernance écosystémique appliquée aux infrastructures et son impact sur l'emploi et le capital social. En enrichissant l'Évaluation d'Impact sur l'Emploi (EIE) par la dimension du capital social, une étude de cas sur un projet d'autoroute démontre la pertinence et les bénéfices concrets de cette approche innovante.

Introduction

L'augmentation des investissements en infrastructures dans les pays en développement est souvent présentée comme un moteur de croissance économique et de transformation structurelle (World Bank, 2020). Toutefois, l'optimisation de leur impact social reste un défi majeur, non pas en raison d'une négligence de la dimension sociale, mais en raison de multiples contraintes, telles que la difficulté d'évaluation précise des retombées et l'intégration efficace des bénéficiaires dans le processus décisionnel (Rodrik, 2014).

Plutôt que de se limiter à un simple assemblage d'actifs physiques, une infrastructure doit être envisagée comme un écosystème complexe et évolutif, où les interactions entre parties prenantes déterminent sa résilience, son efficacité et sa soutenabilité à long terme (Ostrom, 1990).

L'approche Haute Intensité de Main-d'Œuvre (HIMO) a démontré son efficacité pour maximiser les bénéfices socio-économiques des projets d'infrastructure, notamment en matière d'emploi et d'inclusion. Néanmoins, son impact pourrait être encore amplifié si elle s'inscrivait dans une vision systémique, intégrant pleinement la notion de capital social de l'écosystème. Cette approche favoriserait une meilleure acceptabilité sociale, une gouvernance plus inclusive et une redistribution plus équitable des bénéfices (Putnam, 2000).

De plus, l'impact social des infrastructures ne se limite plus à la réduction des externalités négatives, mais s'étend désormais à la création et à la consolidation d'un capital social. Celui-ci repose sur une mobilisation coordonnée des concepteurs, régulateurs, financeurs, constructeurs, usagers et bénéficiaires, aussi bien directs qu'indirects (World Economic Forum, 2021).

L'essor des innovations technologiques permet aujourd'hui d'appréhender les infrastructures sous un prisme écosystémique et intelligent, intégrant une dimension territoriale et trans-sectorielle. Cette mutation des modèles économiques repose sur une synergie entre technologies émergentes et partenariats public-privé (PPP) pour maximiser la création et la capture de valeur (UNEP, 2022). Une telle dynamique encourage également l'émergence de nouvelles compétences et de collaborations renforcées entre autorités publiques et acteurs économiques, depuis la phase de conception jusqu'à la mise en service.

Cet article vise à approfondir les principes de la gouvernance écosystémique des infrastructures et à démontrer comment une Évaluation d'Impact sur l'Emploi (EIE) enrichie par l'analyse du capital social pourrait maximiser les bénéfices sociaux des infrastructures tout au long de leur cycle de vie (ILO, 2019).

La vision écosystémique d'une infrastructure

Définition et principes

Une infrastructure ne peut plus être perçue comme un simple assemblage d'actifs physiques. Elle doit être envisagée comme un écosystème vivant et interactif, où les relations entre les acteurs économiques, sociaux et environnementaux déterminent son efficacité, sa résilience et sa soutenabilité (Meadows, 2020).

Cette approche repose sur quatre piliers essentiels :

Interconnexion des acteurs et des flux : Gouvernements, entreprises, institutions financières et communautés locales interagissent continuellement, générant des dynamiques économiques et sociales évolutives (Porter, 2021).

Multidimensionnalité : Une infrastructure impacte non seulement l'économie locale, mais aussi les dimensions sociale et environnementale, influençant ainsi la cohésion territoriale et les conditions de vie des populations (World Bank, 2022).

Temporalité et cycle de vie : Chaque phase du projet – planification, construction, exploitation et réhabilitation – façonne les relations entre les parties prenantes et conditionne son impact à long terme (Folke et al., 2021).

Résilience et adaptabilité : Une gouvernance flexible permet de s'adapter aux évolutions technologiques, économiques et climatiques, garantissant ainsi la pérennité des infrastructures (Ostrom, 2020).

Gouvernance écosystémique des infrastructures et modèle économique

L'évolution des infrastructures vers un modèle écosystémique impose une réflexion approfondie sur leur gouvernance et leur modèle économique. Dans un contexte où les financements publics sont limités et où la rentabilité financière ne doit pas primer sur les bénéfices sociaux, la gouvernance doit être repensée pour inclure une logique de création de valeur élargie (World Economic Forum, 2023).

Le modèle économique de l'infrastructure-écosystème repose sur des principes d'intégration territoriale, de mutualisation des ressources et de valorisation des externalités positives. Cela signifie que l'infrastructure doit non seulement répondre à un besoin fonctionnel, mais aussi générer des opportunités économiques, sociales et environnementales pour l'ensemble de ses parties prenantes (UNEP, 2023).

Cette approche implique :

- Une gouvernance multi-niveaux, où autorités locales, nationales et acteurs privés collaborent de manière agile pour aligner les infrastructures avec les stratégies de développement durable (OECD, 2022).
- Des modèles financiers hybrides, combinant financement public, investissements privés et mécanismes de valorisation des externalités positives, comme les crédits carbone ou les fonds d'impact social (World Bank, 2023).
- Un cadre réglementaire souple, qui s'adapte aux innovations technologiques et aux nouvelles formes de partenariat public-privé (UN-Habitat, 2021).

En intégrant ces dimensions, la gouvernance écosystémique permet de maximiser les effets multiplicateurs d'une infrastructure sur son environnement économique et social. C'est précisément dans ce contexte que la notion de capital social prend toute son importance.

Le capital social des infrastructures

Le capital social est le socle qui garantit la cohésion et la résilience des écosystèmes d'infrastructure. Il repose sur trois composantes fondamentales (Putnam, 2019) :

- Capital relationnel : Il s'agit des interactions entre les parties prenantes, favorisant la coopération et la coordination des efforts. Une infrastructure bien intégrée socialement génère un réseau d'acteurs engagés et actifs, renforçant son acceptabilité et sa pérennité.
- Capital normatif : Il englobe la confiance, les règles de gouvernance et les mécanismes institutionnels qui structurent les interactions entre acteurs. Un cadre de gouvernance clair et inclusif permet de stabiliser les engagements et d'assurer une répartition équitable des bénéfices.
- Capital cognitif : Il repose sur le partage des connaissances, l'apprentissage collectif et l'innovation sociale. En encourageant l'échange d'expériences et l'adoption de solutions innovantes, le capital cognitif améliore la capacité d'adaptation des infrastructures face aux évolutions socio-économiques.

L'intégration du capital social dans la gestion des infrastructures permet de transformer ces dernières en leviers de transformation territoriale, où les infrastructures ne sont plus des éléments statiques, mais des vecteurs de changement socio-économique. Ce capital social renforce la gouvernance participative et l'ancrage territorial des projets, assurant ainsi leur durabilité et leur impact à long terme (World Bank, 2022).

Ainsi, en repensant la gouvernance et le modèle économique des infrastructures sous un prisme écosystémique, il devient possible de maximiser leur contribution au développement social, économique et environnemental. L'infrastructure ne se limite plus à sa fonction initiale, mais devient un acteur clé du développement territorial et de la résilience communautaire.

Expansion de l'évaluation d'impact sur l'emploi (EIE) avec la dimension du capital social

Méthodes classiques d'évaluation de l'impact sur l'emploi

L'Évaluation d'Impact sur l'Emploi (EIE) repose sur plusieurs méthodologies éprouvées permettant de quantifier et d'analyser les effets directs, indirects et induits des projets d'infrastructure. Ces méthodologies incluent :

- **Analyse Input-Output (IOA)** : mesure les effets directs et indirects des investissements en infrastructures en modélisant les interdépendances sectorielles (*Miller & Blair, 2021*).
- **Matrices de Comptabilité Sociale (SAM)** : évaluation macroéconomique permettant de mesurer les impacts redistributifs des infrastructures sur les revenus des ménages et les flux financiers entre secteurs (*Pyatt & Round, 2020*).
- **Modèles d'Équilibre Général (GEM)** : simulations multi-secteurs prenant en compte les ajustements structurels de l'économie en réponse aux investissements en infrastructures (*Dixon et al., 2022*).
- **Méthodes expérimentales et quasi-expérimentales** : identification des impacts sur les bénéficiaires à l'aide de techniques économétriques avancées comme les différences-en-différences et les expériences randomisées (*Angrist & Pischke, 2019*).

Cependant, ces méthodes, bien qu'efficaces pour mesurer l'impact économique et l'emploi généré, ne prennent que partiellement en compte la dimension sociale des infrastructures et leur contribution à la création d'un capital social durable.

Intégration du capital social dans l'évaluation

L'extension de l'EIE au capital social permet d'analyser non seulement les effets quantitatifs sur l'emploi, mais aussi les dynamiques collaboratives et l'impact des infrastructures sur la cohésion sociale et l'autonomisation des communautés. Cette approche inclut :

- **Cartographie des parties prenantes et intensité des interactions** : identification des acteurs impliqués et évaluation du degré de coopération, de confiance et de gouvernance participative dans le projet (*World Economic Forum, 2022*).
- **Effets de spillover et développement de l'offre locale** : mesure des externalités positives du projet sur les chaînes de valeur locales, les opportunités entrepreneuriales et l'émergence de nouveaux modèles économiques territoriaux (*OECD, 2023*).
- **Capacité d'auto-organisation des communautés autour du projet** : évaluation de la manière dont les infrastructures renforcent les dynamiques locales, encouragent la gouvernance inclusive et facilitent la montée en compétence des populations bénéficiaires (*UN-Habitat, 2023*).
- **Indicateurs de résilience sociale et institutionnelle** : mise en place de métriques pour suivre l'évolution des réseaux de solidarité, la durabilité des partenariats public-privé et la capacité des acteurs locaux à pérenniser les acquis du projet (*ILO, 2023*).

Un des aspects essentiels du **capital social** est qu'il peut **croître avec le temps**, à mesure que les interactions et la confiance entre les parties prenantes se renforcent. Ce phénomène contribue à l'émergence d'une **valeur intangible** des infrastructures, comprenant :

- **Le capital de connaissances**, enrichi par les retours d'expérience et l'apprentissage collectif.
- **Les réseaux de coopération**, qui facilitent l'innovation et la mutualisation des ressources.
- **Le renforcement des communautés**, permettant une meilleure inclusion et une gestion partagée des infrastructures (*Putnam, 2020*).

Méthodologie de mesure du capital social

Afin d'évaluer le capital social, il est pertinent de cartographier les contributions initiales et les financements obtenus, qui forment la base du capital investi et de la prise de risque. Cette analyse peut inclure :

- **Valorisation du capital initial** : recensement des contributions financières et non financières des différents acteurs (investisseurs, États, partenaires locaux, etc.).
- **Apports en nature** : inclusion des ressources disponibles sur site, telles que les terrains mis à disposition, les matériaux naturels et les infrastructures existantes, qui participent à la construction du projet.
- **Goodwill des communautés** : mesure de l'engagement et de l'acceptabilité sociale du projet par les populations locales, évaluée via des enquêtes, des focus groups et des indicateurs de participation citoyenne.
- **Dynamique d'évolution** : suivi de l'évolution du capital social à travers le temps, grâce à des indicateurs de gouvernance, de collaboration et d'intégration des parties prenantes.

En intégrant ces dimensions, l'Évaluation d'Impact sur l'Emploi enrichie par l'analyse du capital social permet une meilleure compréhension des effets structurels des infrastructures sur le développement territorial et humain. Cette approche favorise une prise de décision plus éclairée et contribue à aligner les investissements en infrastructures avec les objectifs de durabilité et d'inclusion sociale.

Étude de cas : Projet d'autoroute de 100 km

Présentation du projet

Le projet concerne la construction d'une autoroute de 100 km reliant deux villes majeures, intégrant des stations-service, aires de repos et péages. L'évaluation des impacts sociaux et économiques est structurée en trois phases:

- **Pré-développement** : Études et planification, impliquant la mobilisation de 50 emplois qualifiés. Budget estimé : **3 millions USD**.
- **Construction** : Utilisation de l'approche HIMO, générant un impact direct sur l'emploi avec 1 000 emplois créés. Budget estimé : **150 millions USD** (incluant travaux, équipements et gestion de projet).
- **Exploitation et maintenance** : Création de 200 opportunités d'emploi à long terme pour assurer la gestion et la durabilité de l'infrastructure. Coût annuel de maintenance estimé : **5 millions USD**.

Application de l'évaluation EIE augmentée par le capital social

L'approche écosystémique permet d'optimiser le projet à travers plusieurs dimensions :

A) Valorisation du capital initial et cartographie des financements

Financement public de l'axe principal : 120 millions USD provenant d'un mix de financement public, de prêts multilatéraux (Banque Mondiale, BAD) et de subventions internationales.

Apports en nature : Valorisation des terrains mis à disposition par les collectivités locales, évalués à 20 millions USD.

Goodwill des communautés locales : Appui institutionnel et adhésion des populations évalués via des sondages de perception et des indicateurs d'acceptabilité sociale.

B) Impact sur l'emploi et le capital humain

Formation et montée en compétence : 500 travailleurs locaux formés à des métiers du BTP, coût estimé : 2 millions USD.

Création d'emplois indirects : Environ 3 000 emplois supplémentaires générés par les sous-traitants et fournisseurs locaux.

C) Effets multiplicateurs sur l'économie locale

Investissements complémentaires : Prévus de 50 millions USD en infrastructures connexes (hôtels, stations-service, centres logistiques) via PPP et concessions.

Développement des chaînes de valeur locales : 60 % des matériaux de construction et services sous-traités à des entreprises nationales.

Accélération de la croissance régionale : Augmentation de 15 % du volume commercial entre les deux villes après la mise en service.

D) Renforcement du capital social et gouvernance inclusive

Mise en place d'un comité multipartite impliquant État, collectivités locales et secteur privé pour assurer la durabilité sociale du projet.

Suivi des dynamiques collaboratives à travers des indicateurs de coopération entre les parties prenantes (fréquence des réunions, taux d'exécution des recommandations).

Effets sociaux positifs : Réduction de 20 % du temps de trajet, augmentation de 30 % de l'accessibilité aux services de santé et d'éducation dans les zones traversées.

E) Modèle économique du projet et structuration des financements

Financement public pour l'axe principal (route, ponts, tunnels) : 120 millions USD de financement public et multilatéral.

Modèles de concession et PPP pour les infrastructures complémentaires : Stations-service, aires de repos, infrastructures énergétiques et centres logistiques financés via PPP ou concessions, représentant un investissement de 50 millions USD.

Valorisation des externalités économiques : Mise en place de péages (prévision de 10 000 véhicules/jour) générant 15 millions USD/an en revenus.

Participation du secteur privé : Incitations fiscales et facilitation de l'accès au financement pour encourager les investissements locaux.

Avantage d'une approche HIMO combinée au capital social

► Table 1: Comparaison HIMO classique et HIMO augmentée appliquée à l'Autoroute de 100 km

Critères	Approche HIMO classique	Approche HIMO augmentée (ÉIE + Capital Social)
Investissement total	150 millions USD	170 millions USD (avec valorisation des apports en nature et goodwill)
Emplois directs créés	1 000	1 500 (y compris les emplois dans la gestion et les services)
Emplois indirects créés	2 000	3 500 (y compris les chaînes de valeur locales)
Impact économique régional	Faible	Augmentation de 15 % du volume commercial
Durabilité financière	Dépendant des financements publics	Revenus générés via péages et PPP (15 millions USD/an)
Capital social	Non intégré	Gouvernance participative, formation des communautés
Effets sur les communautés	Limité aux infrastructures	Inclusion sociale, accessibilité aux services, renforcement des capacités locales

En appliquant cette méthode d'évaluation **EIE augmentée** (cf. Table 1) le projet d'autoroute ne se limite plus à une infrastructure de transport, mais devient un levier de **développement territorial, social et économique**. L'optimisation du **capital social** renforce la durabilité de l'investissement et garantit un impact positif à long terme pour les communautés bénéficiaires.

Conclusion

L'adoption d'une gouvernance écosystémique de l'infrastructure à Haute Intensité de Main d'Oeuvre favorise le développement d'un capital social et constitue une évolution majeure permettant d'optimiser le développement territorial et de maximiser l'impact social des projets. En intégrant une **Évaluation d'Impact sur l'Emploi (EIE) augmentée**, les décideurs disposent d'un cadre analytique plus complet pour mesurer non seulement les bénéfices économiques immédiats mais aussi les dynamiques sociales et territoriales générées par les infrastructures.

L'adoption d'un **modèle économique hybride**, combinant financement public et investissements privés via des **PPP et concessions**, permet de garantir la soutenabilité des infrastructures à long terme tout en maximisant les retombées pour les communautés locales. De plus, l'ajout de mécanismes de gouvernance participative et de formation des travailleurs assure une meilleure inclusion des populations et favorise la montée en compétence des acteurs locaux.

Ainsi, en repensant la manière dont les infrastructures sont conçues, financées et gérées, il est possible de transformer ces projets en véritables **moteurs d'innovation sociale et de résilience territoriale**. Plutôt que d'être de simples actifs physiques, les infrastructures deviennent des **catalyseurs de développement**, générant des effets multiplicateurs durables sur l'économie locale et les conditions de vie des populations.

L'approche **HIMO combinée au capital social**, dans le cadre d'une gouvernance écosystémique et à une structuration financière optimisée, ouvre donc la voie à une nouvelle génération de projets d'infrastructures, capables de concilier efficacité économique, inclusion sociale et durabilité environnementale.

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► Employment intensive investment programmes for advancing decent work in the care economy in Africa

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Abstract

The care economy encompasses paid and unpaid care work, both direct and indirect, delivered through public and private sectors, in the community and households. It includes the individuals who provide and receive care, as well as the employers and institutions that offer care services.

Global care needs continue to rise, and care work, both paid and unpaid, faces significant decent work deficits. Public employment initiatives can address the care crisis by promoting investments, creating jobs, and supporting equitable and sustainable development. Employment-Intensive Investment Programmes (EIIPs) are uniquely positioned to play a transformative role in the care economy as part of integrated and coherent care policies and systems for decent work and gender equality called for by the 2024 ILO Resolution concerning decent work and the care economy. These programmes contribute to decent work in the care economy through key mechanisms, including:

- **Providing care policies and measures for EIIP workers with family responsibilities:** Develop policies and measures within EIIPs to support workers with care responsibilities. These measures could include job protected maternity and paternity protection and family leave, flexible work arrangements, access to on-site childcare, breastfeeding breaks and facilities. Such measures improve job and income opportunities, retention, productivity, and work-life balance.
- **Expanding EIIP investments to care infrastructure:** Allocate public investments to essential care facilities, including childcare and disability support centres, recreational areas, and community care hubs. This approach will create new employment opportunities in the care sector while relieving the unpaid care responsibilities, primarily shouldered by women.
- **Integrate care as a sector of work in EIIPs:** Where there is a need and it is technically feasible, include care sectors within EIIPs. This offers a way of creating formal, skilled, decent jobs in the care economy and can promote fair wages, safe working conditions, and secure jobs in care professions.

By ensuring that the care needs of workers in EIIPs are addressed, building care-related infrastructure, and integrating care as a sector of work in EIIPs, these programmes can help to recognize, reduce and redistribute the unpaid care work often largely shouldered by women. They can also create decent work in the care economy by rewarding and representing care workers and fostering inclusive growth. Moreover, when these initiatives are well designed, they can help to contribute to disaster resilience, peace-responsiveness and environmental sustainability.

Key words: employment-intensive investment, care economy, care policies, gender equality

Introduction

As global care needs continue to grow, there is an opportunity to improve both paid and unpaid care work by addressing decent work deficits faced by the care workforce and fostering more equitable and supportive conditions for workers with care responsibilities, while ensuring access to care for all. Public employment initiatives should, therefore, address the care crisis by promoting investments and job creation in the care economy as well as supporting equitable and sustainable development. Employment-Intensive Investment Programmes (EIIPs) which focus on poverty reduction, local economic and social development and job creation, are well positioned to play a transformative role in the care economy as part of integrated and coherent care policies and systems for decent work and gender equality called for by the ILO Resolution concerning decent work and the care economy (1).

► Box 1. The ILO Employment-Intensive Investment Programme (EIIP)

The ILO Employment-Intensive Investment Programme (EIIP) supports ILO Member States in the design, formulation, implementation and evaluation of policies and programmes aiming to address unemployment and underemployment through public investment, typically in infrastructure development. Its field programmes rely on employment-intensive and local resource-based approaches to the production of public assets in a range of areas such as road construction and maintenance, building construction and rehabilitation, irrigation infrastructure development, re-forestation and soil conservation. In its work, the ILO EIIP applies a gender-responsive approach, striving to achieve equitable outcomes for women and men through measures that promote women's participation and empowerment in and through its programmes. Examples of measures introduced by ILO EIIPs in different regions include targets for recruitment of women, pay equity policies, mechanisms to provide protection from violence and harassment as well as support measures for workers with care responsibilities.

Source: ILO EIIP Programme

By addressing the care needs of workers in EIIPs – through implementing measures such as care leave, including maternity and paternity leave – while also developing care-related infrastructure and integrating care sectors into EIIPs, these programmes can help to recognize, reduce and redistribute the unpaid care work that disproportionately falls on women. They can also create decent work in the care economy by channelling investments in care sectors and fostering inclusive growth. For businesses, such investments contribute to a more productive and engaged workforce by reducing absenteeism, improving retention rates and enhancing overall employee well-being. Additionally, care-responsive EIIPs can stimulate local economies by creating new jobs and expanding markets for care-related goods and services.

This paper explains the ILO's understanding of the care economy, highlights the importance of investing in it, and outlines practical ways in which EIIPs can contribute to advancing decent work in the care economy. While the paper primarily highlights ILO EIIPs as examples, given that it is a long-standing programme with a wealth of experience, it is hoped that the insights provided will also help inform EIIP-type initiatives managed by national actors (e.g. public works programmes) or by other partners.¹

¹ In this paper, unless a specific reference is made to "ILO", the use of "EIIPs" covers employment-intensive investment programmes implemented by ILO or other actors.

What is the care economy and why invest in it?

Transformative change in the world of work, driven by technological innovations, demographic shifts and environmental and climate change, affect the demand for, supply of, and access to care (box 2) (1). Care systems continue to depend heavily on unpaid care work—primarily carried out by women—as well as on paid care work, where workers often endure poor working conditions and lack voice and representation.

In 2015, 2.1 billion people around the world were in need of care, of which 1.9 billion were children under 15 years and 0.2 billion were older persons. By 2030, this number is expected to rise to 2.3 billion, with an additional 100 million children aged 6-14 years and 100 million older persons needing care (2). Despite this growing demand, investments in the care economy remain inadequate, leading to significant gaps in accessibility, affordability, quality, and availability of care services (3-4).

Unpaid care work meets the vast majority of global care needs, and the majority of unpaid carers are women (2, 5). The ILO estimates that, in 2023, 748 million people were outside of the labour force due to care responsibilities - 708 million of them women and 40 million men (5). Care responsibilities remain the main barrier preventing women from participating in the labour force, with the share of women outside the labour force due to care responsibilities being 45 percent globally (6). This substantial undertaking by unpaid carers often compensates for a lack of public expenditure on care services and infrastructure (2, 6).

The paid care sectors, including the education, health and social sectors, are often characterised by decent work deficits such as low pay, long hours and occupational risks, including violence and harassment (5). While the care workforce is highly heterogeneous - with workers who differ markedly in education levels, skills, and remuneration - over 70 per cent of this global workforce is comprised of women, with even higher rates of feminization at lower income levels (1, 5, 7). The World Health Organization projects a shortfall of 18 million health workers by 2030, mostly in low- and lower-middle-income countries (8). Consequently, unpaid carers and care workers have to fill these gaps, often choosing between decent employment opportunities and providing care for those who depend on them.

Furthermore, crises, including conflict and disasters, exacerbate gender-related inequalities in the world of work, with women and girls often suffering the most (9). During crises, women often experience a significantly increased workload as they take on additional care responsibilities due to lost family income, reduced access to social services, increased care needs, and damage to homes, workplaces, and community infrastructure (9).

► **Box 2. Defining the care economy**

As established by the ILO Resolution concerning decent work and the care economy (1), the care economy comprises care work, including both paid and unpaid, as well as direct and indirect care, provided through the public and private sectors, including Micro, Small and Medium Enterprises (MSMEs), non-profit organizations, social and solidarity economy (SSE) entities, such as cooperatives, and households. It includes the individuals who provide and receive care, as well as the employers and institutions that offer care services.

Care work consists of activities and relationships that sustain quality of life, nurture human capabilities, foster agency, autonomy, and dignity, and develop the opportunities and resilience of both caregivers and care recipients. It addresses the diverse needs of individuals across different life stages, meeting physical, psychological, cognitive, mental health and developmental needs for care and support of people including children, adolescents, youth, adults, older persons, persons with disabilities and all caregivers.

Direct care work involves personal care activities requiring relational contact, while indirect care work includes activities that promote well-being without direct personal interaction, such as cleaning and cooking.

Paid care work comprises diverse occupations and sectors. The care economy, spanning between formality and informality, includes, but is not limited to, the activities of workers in education, early childhood care and education, the health and social sectors, domestic workers and individuals who perform unpaid care work. Unpaid care work, often provided by the family and social networks of care recipients, is of great value for care recipients, care providers and society. This unpaid care, which should be more equally shared between men and women, complements and supplements but cannot replace paid care work.

The care economy also includes policies, regulatory frameworks, services, infrastructure, institutions, financing mechanisms, and social norms that influence and govern the provision and receipt of care and support throughout the life course.

Source: (1)

In this landscape, and given the centrality of care for human, social, economic and environmental well-being, and sustainable development, the call to invest in care has become a key priority in global development policy frameworks and agendas (1). In June 2024, the International Labour Conference adopted the Resolution concerning decent work and the care economy, affirming that the State holds primary responsibility for providing, funding and regulating care, as well as ensuring high standards of quality, safety and health for both care workers and recipients (1). This responsibility includes allocating the necessary resources, while adopting and maintaining robust policy and regulatory frameworks, which should contribute to a rights-based approach to care and be grounded in international labour standards and social dialogue. These investments in comprehensive care policy packages, aligned with the ILO 5R Framework for Decent Care Work (recognition, reduction and redistribution of unpaid care and reward and representation of care workers), would benefit the labour market, individuals, families and society (1).

Investing in integrated and coherent care policy packages has strong employment-generation potential. According to data from the ILO Care Policy Investment Simulator, by 2030, investments in childcare-related leave (maternity, paternity and parental leave), breastfeeding breaks, early childhood care and education and long-term care services in 14 economies in Africa² could create nearly 41 million jobs, with an additional 7.5 million by 2035, totalling close to 48.5 million jobs. The job creation potential by 2035 includes around 23.5 million jobs in childcare, around 14.1 million jobs in long-term care and around 10.8 million indirect jobs in non-care sectors that supply the care sector. Of the possible total net employment creation in 2035, 75 per cent is expected to go to women and 82 per cent is expected to be formal employment³. By 2035, employment rates would increase by 7.4 percentage points in Africa (3).

² Countries with available data: Côte d'Ivoire, Egypt, Ethiopia, Ghana, Kenya, Morocco, Mozambique, Nigeria, Rwanda, Senegal, Tunisia, United Republic of Tanzania, Uganda and South Africa.

³ The regional employment estimates are weighted by the corresponding baseline employed population aged 15 years old and above in 2019.

Data from the ILO Simulator estimates that every dollar invested in closing the childcare policy gap⁴ in these 14 economies could result in an average increase of US\$2.01 in regional GDP by 2035⁵. Furthermore, such investments could increase women's employment rate from a regional average of 43.1 per cent in 2019 to 54.2 per cent in 2035 and increase the maternal employment rate (mothers ages 25-54 with children aged 0-14 years old) from 61.6 per cent to 65.2 per cent. At the same time, it could reduce the average gender gap in monthly earnings from 26.0 per cent in 2019 to 5.6 per cent in 2035 in Africa⁶.

Investing in the care economy has many more dividends. It creates decent jobs while contributing to individuals' good health, well-being and capabilities, particularly for the most vulnerable (1, 10). For unpaid carers, such investments facilitate labour force participation and access to income. Given that women disproportionately shoulder unpaid care work, these investments also promote gender equality and women's empowerment (11). For businesses, care-responsive policies support enterprises, foster productivity, reduce absenteeism and promote better business performance (12). Overall, a robust care economy is critical for building resilience to crises, achieving gender equality, addressing inequalities, and promoting economic and social development (1).

4 The childcare policy gap refers to the period between the end of statutory childcare-related leave and the starting age for free, universal early childhood care and education or primary education. In Africa, the childcare policy gap is almost 6 years, driven by very short leave durations and nearly non-existent early childhood care and education entitlements (13).

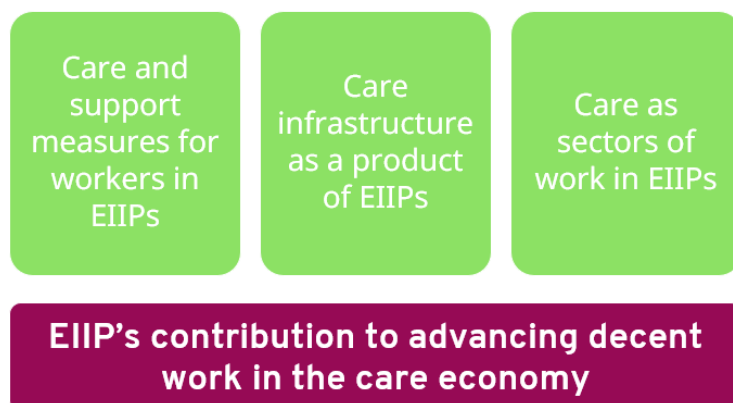
5 The regional return on investment estimate is weighted by the corresponding projected GDP in US\$ by 2035.

6 The regional employment estimates are weighted by the corresponding baseline employed population aged 15 years old and above in 2019.

How can EIIPs contribute?

In relation to care, EIIPs provide an opportunity for furthering decent work in the care economy by supporting EIIP workers with care responsibilities (section 1); supporting infrastructure development for the care economy (section 2); and integrating care as a sector of work in EIIPs (section 3).

► **Figure 1. The three dimensions of EIIP's contribution to advancing decent work in care economy**



Supporting EIIP workers with care responsibilities

One of the biggest challenges limiting women's participation in EIIPs is the disproportionate share of care responsibilities that they shoulder.

It is therefore essential that all EIIP initiatives, regardless of whether they are related to construction, green works or social services provision (such as care services), put in place strategies and practices related to care-responsive workplaces. These may include, for instance⁷:

- care-related paid leave policies (such as maternity, paternity or parental leave or emergency leave); this includes offering paid paternity leave and promoting more involvement of men in care responsibilities;
- labour protection policies when taking care-related leave or as a result of discrimination based on having family responsibilities (such as protection from dismissal during pregnancy and care-related leave, burden of proof lying on the employer to prove that a dismissal is not related to family responsibilities, prohibition of pregnancy tests in employment);
- occupational safety and health (OSH) for pregnant and nursing women, preventing and addressing workplace risks and ensuring they are not obliged to perform work which could be prejudicial to the health of mother or the child;
- provision of breastfeeding facilities and breaks;
- paid time-off available to both parents for prenatal and postnatal health care visits;
- provision of worksite childcare services;
- flexible hours and part-time work options enabling workers to combine family responsibilities with EIIPs work;
- awareness-raising and other mechanisms to prevent and address discrimination, violence and harassment against women, including pregnant women and workers with care responsibilities; and

⁷ See also ILO Maternity Protection Convention, 2000 (No. 183) and its accompanying Recommendation, 2000 (No. 191).

- allocating adequate resources and dedicated budgets for these measures is crucial to ensure the effective implementation of these initiatives.

Such provisions have been introduced in a number of employment intensive initiatives worldwide. Examples from Africa include national flagship public works programmes in Ethiopia (the Productive Safety Net Programme, PSNP) and South Africa (Expanded Public Works Programme). The PSNP has introduced flexibility in terms of working times so that women workers can better balance their paid work with unpaid care responsibilities as well as the provision of community crèches to enable women with small children to be able to work (14). The EPWP introduced a code of good conduct, including fair working conditions, OSH, and facilitation of women's participation that is incorporated in all projects; this included, for instance, provisions on protecting the health of pregnant and breastfeeding women.

While these programmes have played an important role in introducing such measures, their experiences have also highlighted some challenges in this regard. For instance, in Ethiopia, the slow progress in establishing childcare facilities was partly attributed to inadequate attention to addressing the underlying reasons for weak demand for such services by programme participants, who had concerns about their children being cared for by people unknown to them as well as about the possible spread of disease if large numbers of children are being cared for together (14).

► **Box 3. Supporting workers with family responsibilities under the ILO EIIP component of the “Productive Social Safety Net” (PSSN) programme in Tanzania**

In Tanzania, the “Productive Social Safety Net” (PSSN) programme, implemented by the Tanzania Social Action Fund (TASAF), was established in 2013 to contribute to the reduction of extreme poverty in Tanzania. It comprises a public works component technically supported by the ILO which has implemented sub-projects in the areas of watershed management, forestry, soil conservation, land use management, and environmental management. In order to address the needs of workers with family responsibilities, the public works component adopted measures such as providing work accommodations and reassigning pregnant and breastfeeding women to safer jobs. Additionally, in some localities, a system was introduced whereby older women were hired to take care of the children of younger women who participated in the public works programme.

Source: (15, 16)

It should be noted that most programmes have focused on facilitating the combination of unpaid care work with paid work for women. While this is essential for enabling women to benefit from these paid work opportunities, consideration should also be given to measures that can facilitate transformative change including a reduction in the unpaid care responsibilities of women and a fairer distribution of such work between women and men, as well as between families and the State. For instance, simply offering flexible hours to women workers does not reduce their share of unpaid care work, and can even reinforce traditional roles, while offering care leave also to men working in such programmes can help to transform roles and the division of care work.

Infrastructure development for the care economy

Supporting development of infrastructure that reduces unpaid care work

Improved infrastructure can help reduce unpaid care work by making essential tasks like water or firewood collection and childcare more manageable through new facilities and improved mobility. For instance, investments in safe roads and transport reduce travel time to school, healthcare services, and markets, thereby easing unpaid care as well as preventing violence and harassment when commuting to and from work.

Research confirms the direct link between physical infrastructure and the reduction of unpaid care work. While such figures are not available from Africa, studies from Asia on the impact of roads have found significant links: in one case in Sri Lanka, improved roads have meant that bicycles can be used to help transport water, bringing other family members, including men, to help in the task; similarly, in Lao People's Democratic Republic, a new

road led to a reduction in the time spent by women on housework, thereby increasing their opportunity to participate more in the labour market (17).

► **Box 4. Tanzania: Factoring in unpaid care work under the ILO EIIP component of the “Productive Social Safety Net” (PSSN) programme**

The “Productive Social Safety Net” (PSSN) programme implemented by the Tanzania Social Action Fund (TASAF) comprises a public works component technically supported by the ILO which has implemented sub-projects in the areas of watershed management, forestry, soil conservation, land use management, and environmental management (see box 3).

The programme ensures women are engaged in the planning of public works and that priority is given to works which reduce women’s regular work burden. As a result, the selection of sub-projects has included projects to ease their routine water fetching tasks, among others.

Source: (15, 16)

Gender-responsive investment in infrastructure is thus key to make the reduction of unpaid care work – one of the 5 “Rs” of the ILO framework – a reality, especially when it is a drudgery. Therefore, EIIPs involved in infrastructure development should assess the potential impact of planned infrastructures on unpaid care work and factor these impacts into decision-making on infrastructure projects.

Supporting development of care infrastructure

Investing in care-related infrastructure, such as childcare centres, recreational areas, long-term care facilities, and communal care centres, is essential for meeting care needs and fostering inclusive growth. Infrastructure planning processes that support local, inclusive planning and involve women and local communities in decision-making helps to put care infrastructure on the agenda, and improves their quality and accessibility, as well as their employment impacts. By prioritizing care infrastructure alongside traditional projects such as roads, public investment can drive more equitable labour force participation, support resilient communities, provide more health-promoting spaces for care recipients, and enhance social and economic outcomes (box 5).

► **Box 5. Care infrastructure constructed in Sudan under the ILO PROSPECTS Programme**

In consultation with UNHCR and under the PROSPECTS programme, the ILO rehabilitated existing structures and constructed additional new facilities at health centres in both East Darfur and West Kordofan States, Sudan. This initiative, undertaken in response to COVID-19, aimed to improve access to health services by the refugees and host communities.

The construction was undertaken by local contractors selected and trained by the ILO in the EIIP approach. Decent jobs and income, and skills development opportunities, were created to the refugees and host communities during the construction. The two projects created 60 job opportunities and 500 workdays for skilled and semi-skilled workers from refugees and host communities.

All the works were completed, and facilities handed over to the beneficiaries and local administration who assumed the operation and maintenance of these facilities.

Source: ILO PROSPECTS Sudan Project Team

EIIPs involved in infrastructure development should, therefore, consult local communities on the needs for and engage in care infrastructure development.

Care as a sector of work in EIIPs

EIIPs have typically focused on infrastructure, and other activities, including care, have not been a sector of work. However, as EIIPs are increasingly focusing on addressing local needs and becoming more gender-responsive, care has emerged as a potential sector. There are some promising examples of national public employment programmes that have included care as a sector of work.

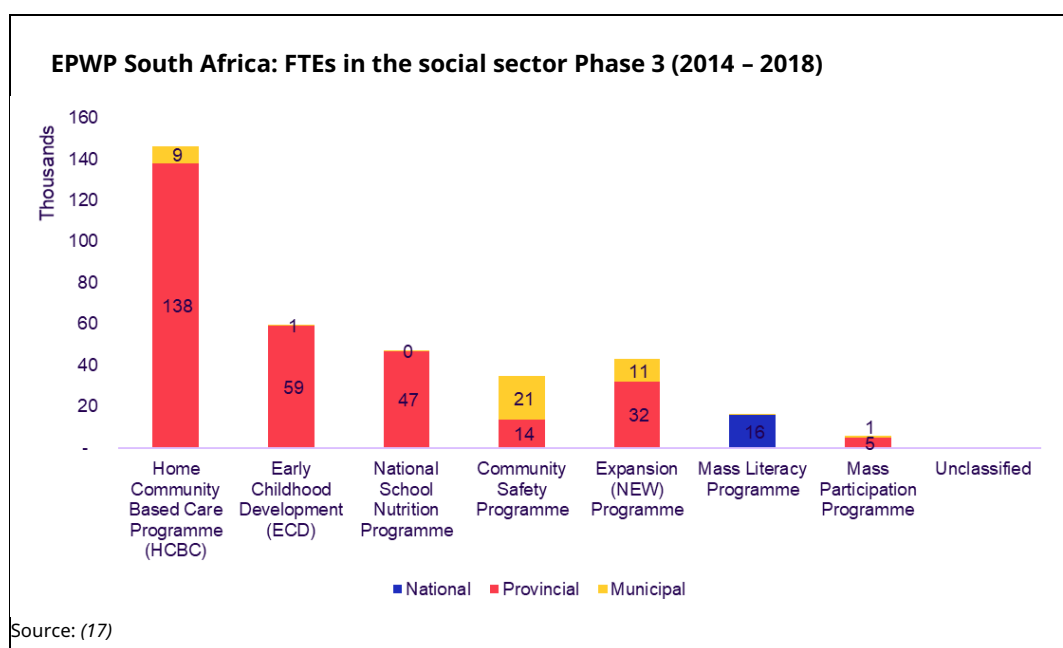
These programmes have the potential to recognize the value of care and remunerate previously unpaid or informal care work. At the same time, these experiences have shown that the design and implementation of such Public Employment Programmes (PEPs) needs careful attention to ensure decent work for PEP care workers and positive labour market outcomes for unpaid carers.

Examples of care-focused PEPs from Africa include:

South Africa (18): In the context of its Expanded Public Works Programme (EPWP), South Africa has had a pioneering role in introducing new approaches to PEPs, looking beyond traditional public works models to generate social value and extend social services to communities. Care-related programmes were first introduced in 2003, and the number of programmes included under the Social Sector has grown since. The Home Community-Based Care (HCBC), the Early Childhood Development (ECD), the National School Nutrition Programme (NSNP) and the Community Works Programme (CWP) are the most prominent care-related PEPs in the EPWP in terms of employment creation. These three programmes generated 254,000 full-time equivalent jobs (FTEs) in the third phase of the EPWP, representing 72% of the total FTEs in the Social Sector.

Rwanda (19,20): The expanded Public Works (ePW) programme in Rwanda, a key part of the Vision 2050 Umurenge Programme (VUP) initiative, aims to provide flexible, part-time work opportunities for moderately labour-constrained households, especially those with care responsibilities. Initially centred on road maintenance, ePW introduced a new Home-Based Early Childhood Development (HBECD) component in 2018-19 to address specific community needs. In this new model, ePW beneficiaries are employed as care workers for children aged 3-5 from low-income families within their community, enabling parents to engage in paid work. Local households select a home to host the ECD facility, with requirements for basic amenities like a clean area, toilets, and space for meal preparation. The programme provides selected homes with essential refurbishment, equipment, and supplies to meet these standards. The programme's results in 2022-2023 included over 36,000 care workers employed (approximately 25,000 women and 11,000 men). The initiative includes a strong training and supervision component to ensure quality care.

► **Figure 2. Employment results of the EPWP in the social sector**



The ILO has carried out studies on the experiences of countries having integrated care as a sector in their PEPs, notably Argentina⁸ and South Africa. These studies reveal that the programmes (18, 21):

- created a new baseline for wages and working conditions for participants who had previously worked as volunteers in the sector;
- expanded the pool of skilled workers in the areas of work by providing accredited training and upskilling existing practitioners;
- faced challenges with compliance to international labour standards - Examples include irregular hours, inadequate wages, a lack of access to social protection and a lack of exit paths from the temporary PEP;
- demonstrated that PEPs can play a role in establishing minimum standards to support progressive shifts toward decent work; and
- highlighted that PEPs alone cannot fulfil the needs of the care economy and must align with broader plans for developing the care sector.

Given these promising experiences, EIIPs should consider and promote the inclusion of care as a sector of work in the programmes. This should be done while acknowledging the challenges, ensuring decent working conditions, and establishing plans and measures for sustainable progress beyond the programme - whether in the public service or through private and community sector. In such initiatives, it is important that the job opportunities provided are decent and skilled, and that both women and men are encouraged to take them up.

⁸ The “Potenciar Trabajo” programme aimed to improve employment and social inclusion of those in social and economic vulnerability; It emphasizes the development of community care projects, contributing to care redistribution and gender equality by strengthening the role of the state and community organizations in care provision.

Recommendations

To harness the potential of EIIPs in supporting the care economy, EIIPs should integrate care in their work through the mechanisms identified in this brief, namely:

- **Provide care-related support for EIIP workers with care responsibilities:** Develop policies and measures within EIIPs to support workers with care responsibilities. Support measures could include, for instance, flexible work hours, access to on-site or nearby childcare facilities that are free of charge or low cost, breastfeeding breaks and facilities, job-protected maternity and paternity protection and family leave options. Such support can improve job and income opportunities, retention, productivity, and work-life balance for workers with family responsibilities.
- **Expand EIIP investments to care infrastructure:** Allocate public investments to essential care facilities, including childcare centres, disability support centres, recreational areas, and community care hubs. For traditional infrastructures, such as roads, ensure that the infrastructures contribute to reducing unpaid care work. This approach will create new employment opportunities in the care sector while relieving unpaid care responsibilities for workers.
- **Consider integrating care sectors into EIIPs:** Assess the need for and feasibility of integrating care sectors within EIIPs. This can offer a way of creating formal, skilled, decent jobs in the care economy and help to promote fair wages, safe working conditions, and secure jobs in care professions. However, it should not be used to replace public long-term care service provision, and measures need to be in place to ensure standards are adhered to and exit paths are available.

By leveraging its potential in these ways, EIIPs can strengthen integrated and coherent care policies and systems for decent work and gender equality, as called for by the ILO Resolution concerning decent work and the care economy (1), and contribute to more resilient, inclusive, and sustainable societies.

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► Impact of gender empowerment policies on social inclusion in rural infrastructure development in Ethiopia: Challenges and opportunities

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Abstract

In recent decades, Ethiopia has implemented various gender empowerment policies aimed at promoting social inclusion within rural infrastructure development. This study explored impacts of these policies on fostering equitable participation and enhancing the socio-economic status of marginalized groups, particularly women, in rural communities of North Showa Zone of Oromia regional State in Ethiopia. The study employed a mixed-methods approach, utilized survey and interview research designs. A total of 92 diverse participants, which included stakeholders, policymakers, community leaders and rural residents were selected to participate in the study using random sampling technique. Of this 48 were female and 44 were male. Questionnaire and interview were used to collect data. The quantitative data was analyzed using likert scale while the qualitative data was analyzed using thematic analysis technique. The data analysis showed that barrier to the effective implementation of gender empowerment policies in rural infrastructure development is prevalent in the study area at which lack of awareness among women about their rights and the available resources is the most significant one. The study also found that cultural norms and traditional gender roles have identified as systemic challenges that limited women's participation in decision-making processes related to infrastructure projects. The finding also highlighted significant gaps in resources and training opportunities for women, which hindered their effective engagement in the infrastructure initiatives. The study concluded a comprehensive approach that addresses systemic approach is essential. Also, vital implications were drawn from this study for policymaking and further research.

Keywords: gender empowerment, social inclusion, rural infrastructure, policy assessment

Background

Gender empowerment policies have been instrumental in promoting social inclusion and economic development, particularly in developing nations like Ethiopia. The Ethiopian government has recognized that gender equality is crucial for the realization of sustainable development goals; thus, it has made concerted efforts to develop and implement policies aimed at empowering women and promoting gender equality (World Economic Forum, 2020).

Ethiopia, characterized by a largely agrarian economy, has seen infrastructure development as a critical component of its Growth and Transformation Plans. The integration of gender considerations into rural infrastructure projects is essential, as infrastructure improvements can significantly affect women's mobility, access to services, and economic opportunities (World Bank, 2018). However, despite the existence of gender empowerment policies, challenges persist in effectively translating these policies into actionable improvements in rural infrastructure. Many rural areas continue to face barriers related to cultural norms, limited access to decision-making processes, and inadequate resources for women (Gebre et al., 2021).

The challenges also include insufficient alignment between gender empowerment initiatives and local practices, which can lead to a lack of community acceptance and sustainability of projects. This situation often results in gender-blind infrastructure development, undermining the potential for women to benefit equally from such improvements (Haile et al., 2019). Furthermore, issues of intersecting identities, such as ethnicity and socio-economic status, can further complicate the dynamics of social inclusion in these contexts (Assefa & Bozzoli, 2020).

On the other hand, several opportunities exist for enhancing social inclusion through gender empowerment policies in rural infrastructure development. Empowered women are more likely to engage in economic activities and contribute to community decision-making, leading to more inclusive and representative governance structures (UNECA, 2019). Additionally, successful case studies in various regions of Ethiopia have demonstrated that participatory approaches in project planning and implementation can lead to more equitable infrastructure development outcomes (Fischer et al., 2020).

In sum, examining impacts of gender empowerment policies on social inclusion in the context of rural infrastructure development in Ethiopia sheds light on both the challenges that need to be addressed and the opportunities that can be leveraged for a more inclusive development process. This study aims to explore these dynamics further, focusing on the implications for policy and practice.

Objective of the study

1. To evaluate how current gender empowerment policies are effective in improving social cohesion of rural communities in Ethiopia.
2. To identify the specific challenges and barriers to the effective implementation of gender empowerment policies in rural communities at the study area.

Methodology

Research design

This study adopted a mixed-methods research design combining both qualitative and quantitative approaches. This is aligned with Creswell (2014), who emphasizes that mixed methods provide a more comprehensive understanding of complex social phenomena. By employing a robust mixed-methods research design, this study aimed to provide comprehensive insights into the effectiveness of gender empowerment policies in rural Ethiopia. The findings contributed to policy discussions and provided actionable recommendations for enhancing social cohesion through improved gender empowerment initiatives.

Study location and population and sampling techniques

Study location

The study was situated in the North Showa Zone of the Oromia Region in Ethiopia, an area characterized by its diverse rural communities and ongoing infrastructure development projects. The location was selected due to its unique socio-economic dynamics and the recent implementation of gender empowerment policies aimed at fostering social cohesion. The North Showa Zone presented a compelling context for examining the interplay between these policies and community development, as it has experienced both challenges and successes in empowering women and enhancing community engagement.

Population and sampling techniques

The target population for this study consisted of local community members, women's groups, local government officials, and project implementers within the selected rural areas of North Showa Zone. To address the study objectives, a stratified random sampling technique was utilized to ensure representation across various demographics, including age, gender, and socio-economic status. This approach is supported by Trochim (2006), who notes that stratifying samples helps in obtaining a more accurate representation and comparability across subgroups. This method facilitated the selection of diverse participants who could provide valuable insights into the effectiveness of gender empowerment policies and the barriers to their implementation. Additionally, purposive sampling was employed to identify interview participants among local government officials and project implementers who possessed specialized knowledge about the policies in question.

Purposive sampling was used for interview for data collection. It allowed for the selection of participants who are particularly knowledgeable or experienced regarding gender empowerment and infrastructure development (Palinkas et al., 2015). This combined sampling approach enabled a comprehensive understanding of both the quantitative impacts of these policies on social cohesion and the qualitative challenges faced during their implementation.

Data collection tools

- a. *Surveys:* A structured questionnaire were developed to collect quantitative data on perceptions of gender empowerment and its impacts on social inclusion in infrastructure projects. The survey include Likert scale items to assess respondents' attitudes and experiences related to gender policies.
- b. *Interviews:* Semi-structured interviews were conducted with key informants, including local officials and women's group leaders, to gain in-depth insights into the challenges and opportunities presented by gender empowerment policies.

Data analysis

Quantitative Data Analysis: To assess the impacts of gender empowerment policies on social inclusion in rural infrastructure development projects in Ethiopia, a Likert scale, ranging from Strongly Disagree (SD) to strongly agree (SA), was structured to evaluate how current gender empowerment policies affect social inclusion in rural communities at the study area.

Qualitative Data Analysis: Thematic analysis was utilized for qualitative data obtained from interviews and focus groups (Braun & Clarke, 2006). This involved coding the data and identifying themes that emerge related to the objectives of the study.

Ethical considerations

Ethical approval was sought from relevant authorities, and informed consent was obtained from all participants. The study ensured confidentiality and anonymity of participants, as recommended by the World Health Organization (2011) regarding ethical considerations in social research.

Result and discussions

Results

The effect of gender empowerment policies on social inclusion in rural communities

The objective of this study was to explore the current state of gender empowerment policies within the context of rural infrastructure development, examining their effectiveness and implementation in fostering social inclusion.

► **Table 1: Results from some questionnaire item**

No	Likert Scale Statements	SD	D	N	A	SA
1	Perception of Gender Equality in Project Participation					
	Women and men have equal opportunities to participate on rural infrastructure development projects in my community.	86%	22%	0%	2%	0%
	The participation of women on infrastructure projects is supported by local leaders.	64%	28%	2%	6%	0%
2	Accessibility of Resources for Women					
	Women have adequate access to resources (e.g., funding, training) provided by infrastructure development projects.	84%	10%	2%	4%	0%
	The resources allocated for infrastructure projects are distributed fairly between men and women in my community.	60%	22%	12%	6%	0%
3	Influence of Women in Decision-Making Processes					
	Women have a significant role in decision-making processes related to rural infrastructure development in my community.	68%	28%	4%	0%	0%
	The input of women is considered important when planning and implementing infrastructure projects.	0%	0%	0%	10%	90%
4	Community Awareness of Gender Empowerment Policies.					
	Community members are well-informed about the gender empowerment policies that affect infrastructure development.	58%	40%	0%	1%	1%
	There are initiatives in place to raise awareness about gender empowerment policies among community members.	0%	0%	10%	40%	50%

Perception of gender equality in project participation

Table 1 revealed that there were disparities in opportunities for women and men within rural infrastructure development. 86% of respondents strongly disagreed that women and men have equal opportunities to participate, indicating a significant perception of inequality. Furthermore, 60% reported that local leaders did not encourage women's involvement in these projects, highlighting their participation was neither supported nor prioritized. This lack of encouragement from leadership suggests that barriers existed, hindering women's active engagement in community development initiatives.

Accessibility of resources for women

Table 1 also indicated that 84% of the respondents strongly disagreeing that women had adequate access to necessary resources such as funding and training. Additionally, 62% felt that the distribution of resources was unfairly skewed towards men, reinforcing the notion that women were systematically marginalized in accessibility of resources. This lack of equitable access to resources not only limited women's ability to participate fully in development projects but also perpetuated existing inequalities. The implication of this was a need for targeted interventions to ensure fair resource distribution.

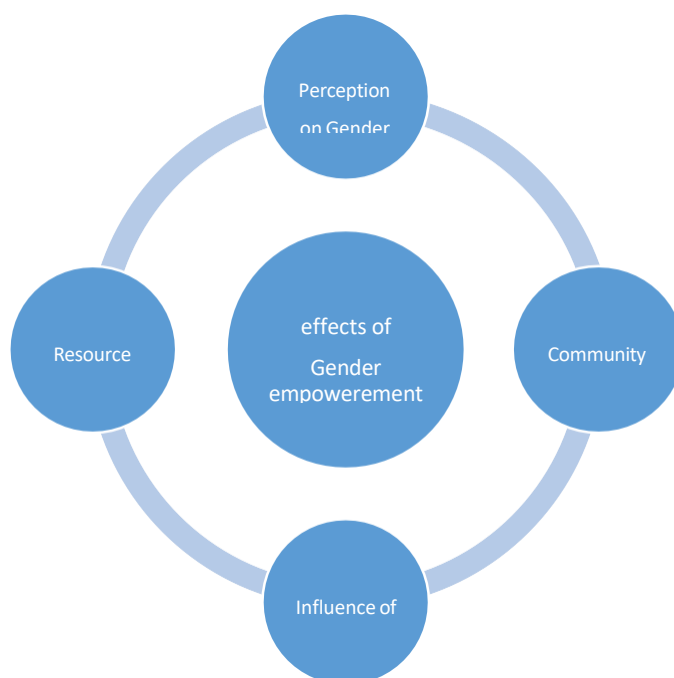
Influence of women in decision-making processes

Table 1 was revealed that the influence of women in decision-making processes revealed significant challenges, with 68% of respondents indicated that women did not play a significant role in decision-making related to rural infrastructure development. However, it 90% acknowledged the importance of women's input when planning and implementing these projects. This discrepancy highlighted a critical gap between recognition and actual participation, suggesting that while there was an understanding of the value women bring to decision-making, practical barriers continued to prevent their involvement. This called for a reevaluation of decision-making structures to ensure women's voices were not only heard but actively integrated into the planning processes.

Community awareness on gender empowerment policies

Table 1 further depicted that the level of community awareness regarding gender empowerment policies was low, with 58% of respondents feeling uninformed about policies that affected infrastructure development. Moreover, while 50% recognized the existence of initiatives aimed at raising awareness about these policies, only 40% felt adequately informed about them. This indicated a significant gap in knowledge and understanding among community members, which could hinder the effective implementation of gender empowerment strategies. Raising awareness and providing education about these policies is crucial to fostering an environment where gender equality can thrive, thereby enhancing participation and resource accessibility for women in rural infrastructure development.

► Picture 2: Contributing factors for the effects of gender empowerment on social inclusion



Challenges and barriers to the effective implementation of gender empowerment policies

Interviews were conducted to assess the challenges and barriers to the effective implementation of gender empowerment policies in rural area. The data gathered from the interviews served as the primary source of information, providing valuable insights into the experiences and perspectives of participants involved in these initiatives. For clarity of reporting the results obtained, interview data was put first. Following the collection of interview data, a thematic analysis was performed to identify and categorize key themes that emerged from the responses. This analytical approach enabled a deeper understanding of the specific obstacles faced in promoting gender empowerment within the context of rural infrastructure development.

Participant 1: Aisha (Community Leader, 45)

"I believe that the policies are there, but they are not effectively communicated to women in our community. Many women do not know their rights or the resources available to them. This lack of knowledge is a significant barrier."

Participant 2: Mohammed (Local Government Official, 38)

"While we have good intentions to include women in infrastructure projects, traditional beliefs often overshadow these efforts. Men are seen as the decision-makers, and this cultural norm is hard to change."

Participant 3: Fatima (Farmer, 30)

"I want to participate in these projects, but I lack the necessary training and resources. Even when I express interest, I feel overlooked in favor of men who have more experience or connections."

Participant 4: Jamal (NGO Worker, 29)

"One of the biggest challenges is funding. Projects often prioritize male-led initiatives because they are perceived as more reliable. Women-led projects struggle to receive the same level of support."

Participant 5: Leila (Village Elder, 52)

"Women are often not invited to meetings where decisions are made about infrastructure projects. Even when we have something to say, our voices are not heard, which makes it hard to advocate for our needs."

Participant 6: Idris (Youth Activist, 24)

"There is a lack of mentorship for young women interested in infrastructure development. Without role models, it's difficult for them to envision themselves in these fields or projects."

Participant 7: Hana (Teacher, 36)

"Awareness campaigns about gender empowerment policies are rare here. When they do happen, they usually target men more than women, which makes it hard for us to understand what we can demand."

Participant 8: Ahmed (Community Organizer, 41)

"The implementation of gender policies often lacks accountability. There are no clear mechanisms to ensure that women's voices are included in project planning and execution."

Now, the themes that emerged from the interview data regarding the challenges and barriers to the effective implementation of gender empowerment policies in rural infrastructure projects were discussed. The analysis revealed four key themes: a significant lack of awareness and communication surrounding gender empowerment initiatives, the pervasive influence of cultural norms and established gender roles that hindered progress, the disparities in resources and training opportunities that affected women's participation and effectiveness, and the limited representation of women in decision-making processes, highlighting the critical need for mentorship and support to foster greater involvement and leadership among women in rural areas.

Lack of awareness and communication

Interview data revealed that lack of awareness and communication were the major factors that hindered the effective implementation of gender empowerment policies in rural communities at the study area. The predominant theme suggested that initiatives aimed at promoting gender equality must prioritize education and outreach tailored specifically to women.

Cultural norms and gender roles

Cultural norms and gender roles emerged as significant barriers, indicating that effective policy did not address societal attitudes that in turn perpetuated inequality. This aligned with survey data that emphasized the importance of cultural change alongside policy implementation.

Resource disparities and training gaps

Funding disparities were identified as a significant barrier, suggesting that funding bodies must reassess their criteria and actively seek to support women-led initiatives to achieve balanced development outcomes.

Resource and training gaps was identified by participants highlight a critical area for intervention. Providing targeted training programs and resources for women could help bridge the gap in participation and empower them to take on leadership roles.

Limited representation and the need for mentorship and support

The theme of limited representation underscored the need for inclusive practices within decision-making process. The absence of women's voices in discussions not only perpetuated existing inequalities but also resulted in infrastructure projects that could adequately addressed the needs the communities. The need for mentorship and support, along with clear accountability mechanisms, indicated a pathway forward for the communities involved in rural areas. Establishing mentorship programs could encourage women to engage in these fields while accountability measures could ensure that policies translated into tangible outcomes for women.

Discussion of results

The results of the survey revealed critical insights into the perception of gender equality in rural infrastructure development, highlighting significant challenges that women face in participation, resource accessibility, decision-making influence, and awareness of gender empowerment. The finding revealed that women and men did not have equal opportunities to participate in rural infrastructure development projects. This finding underscores a pervasive belief that gender disparities are entrenched within community practices. Corroborating this, Mulugeta (2019) emphasized the need for transformative leadership that actively promotes gender inclusivity in community development initiatives in Ethiopia. Research by Abebe et al. (2020) highlights similar findings, noting that limited access to resources significantly hampers women's ability to engage in development projects, thereby reinforcing existing gender roles and economic disparities.

Women lacked significant roles in decision-making processes regarding rural infrastructure development at the study area. However, there is a strong acknowledgment of the importance of women's input in planning and implementing women empowerment initiatives. This dichotomy suggested that while there is recognition of women's value, practical barriers prevent their meaningful involvement. As noted by Tesfaye (2021), enhancing women's representation in decision-making roles is crucial for effective governance and project success, as diverse perspectives lead to more inclusive and sustainable outcomes. A similar study conducted Hailu et al. (2022) emphasizes the importance of community education and engagement in policy awareness to foster an environment conducive to gender equality and empowerment.

A significant barrier identified by participants was the lack of awareness among women regarding their rights and the resources available to them through gender empowerment policies. Many respondents expressed that without proper communication and outreach, women remain uninformed about their entitlements, resulting in underutilization of existing programs. This finding aligns with previous research indicating that effective communication is crucial for policy implementation (Mulugeta, 2019).

Cultural beliefs that prioritize male decision-making were frequently mentioned as a barrier to women's participation in infrastructure projects. Many women reported feeling sidelined due to entrenched gender roles that dictate who has a voice in community matters. This theme resonates with broader literature on gender dynamics, which emphasizes the need to challenge and transform cultural norms to facilitate women's empowerment (Kabeer, 2016). Research indicates that addressing funding inequities is essential for fostering gender-inclusive development (Gonzalez et al., 2021). A similar result was reported by (World Bank, 2018 & 2020) whose finding showed that targeted training can significantly enhance women's capabilities and confidence, enabling them to take on leadership roles

The need for mentorship programs and support was emerged as a critical area for intervention. Participants expressed that without role models and guidance, women struggled to envision themselves in leadership positions within infrastructure projects. Literature supports this notion, highlighting the positive impacts of mentorship on women's career development (Carli, 2007). Another study by Sullivan et al. (2020) highlight how traditional gender roles often sideline women's voices and contributions in rural economic development initiatives. Bishop (2017) stated that women often have limited agency in community planning and development.

Moreover, Kabeer (2015) discusses the importance of a multi-dimensional approach to empowerment that includes economic, social, and political spheres. In many cases, women's participation is restricted due to societal norms that dictate appropriate roles for women, which can impede their engagement in infrastructure projects. Thus, to enhance participation, it is crucial to create initiatives that actively involve women and ensure their perspectives are incorporated into the planning and execution phases of these projects. Cultural attitudes, often deeply entrenched within rural communities, present significant challenges. Golla et al. (2011) identify that social norms play a pivotal role in shaping women's engagement in development initiatives.

The consensus among respondents about the existence of barriers for women is corroborated by multiple literature sources. Cultural attitudes are frequently cited as a significant obstacle. A study by Ayalew and Kifle (2018) emphasizes that ingrained societal norms discourage women from leading or participating in infrastructure projects. This aligns with Gezahegn et al. (2017), who assert that such cultural perceptions often result in women's voices being marginalized in developmental discussions, directly impacting the success of these projects. Furthermore, the recognition of barriers suggests a growing awareness and acknowledgment of gender disparities within rural development strategies in Ethiopia (Mekonnen, 2021). Such initiatives could potentially challenge the status quo and facilitate more equitable participation in future projects.

The acknowledgment of these barriers is a necessary step toward creating solutions. As Mosedale (2005) points out, awareness is essential for accountability in development practices. Initiatives that include educational components to challenge and change cultural norms may be integral to fostering greater participation. Furthermore, Rowlands (1997) argues that empowerment should encompass challenging existing power dynamics, thus creating environments where women feel supported and capable of participating in infrastructure projects.

The work of Cornwall (2003) emphasizes that participatory approaches must be critically assessed to ensure they do not simply serve to maintain existing power disparities. Without addressing the underlying social, economic, and political inequities faced by marginalized groups, developmental

efforts risk reinforcing the very structures they aim to dismantle. Moreover, Brouwer & Van der Goot (2018) indicate that mere inclusion in participation initiatives is not sufficient if those initiatives do not address the unique barriers faced by different marginalized groups.

Agarwal (2010) emphasizes that women's participation in decision-making processes is crucial for sustainable development, yet many rural initiatives fail to actively engage them, reflecting systemic barriers. Furthermore, Blumberg (2005) suggests that such exclusion not only perpetuates gender inequality but also limits the effectiveness of development projects. A review by Quisumbing and Kumar (2011) supports this, indicating that integrating women's perspectives directly leads to more comprehensive project outcomes. This suggests that addressing these barriers can enhance both participation and the efficacy of rural infrastructure projects.

The significant underrepresentation of women in rural infrastructure development projects aligns with findings from various studies conducted in Ethiopia. Evidence suggests that even though development projects aim to be inclusive, women often face systemic barriers that hinder their full participation. For instance, Beshah and Shiferaw (2019) highlight that existing development frameworks often neglect the unique needs and contributions of women, leading to low participation rates in rural projects. This suggests a necessity for designing initiatives that prioritize women's involvement, recognizing their potential as active agents of change rather than passive beneficiaries (Beshah & Shiferaw, 2019). Moreover, Belayneh and Tassew (2020) contend that cultural norms play a pivotal role in shaping women's engagement in developmental activities. They argue that societal expectations and roles traditionally assigned to women limit their mobility and involvement in public life, thus perpetuating gender imbalances in project participation.

Aker (2012) discusses how marginalized groups often face compounded disadvantages that restrict their ability to engage meaningfully in development projects. This is supported by the work of Cornwall (2004), who notes that tokenistic participation rarely leads to genuine influence or decision-making power. The recognition of this disparity should prompt policymakers and development practitioners to create targeted strategies that not only include marginalized voices but also empower them to participate equally in the decision-making processes of rural infrastructure projects.

The discussion surrounding the participation of marginalized groups reveals an intricate landscape where perceived opportunities are not necessarily indicative of true equality. While there may be avenues for participation, research by Mesfin and Alemayehu (2022) suggests that systemic inequalities persist, preventing equitable access to such opportunities. They argue that marginalization is often compounded by further socio-economic factors, limiting both women's and other marginalized groups' ability to engage fully in development processes. Esubalew and Dembel (2020) hold a similar opinion when they emphasized lack effective implementation actively dismantle existing barriers and promote balanced participation among all groups.

Summary, conclusion and recommendation of the study

This study evaluated the impacts of existing gender empowerment policies on social inclusion in rural communities involved in infrastructure development projects in Ethiopia. Through quantitative and qualitative research methods, including survey and interviews, the finding revealed that while policies existed to promote gender equality, their effectiveness is often undermined by socio-cultural barriers, limited awareness among community members, and insufficient capacity-building initiatives. The findings indicated that these factors collectively hindered women's active participation and representation in infrastructure projects, thereby affecting the overall success of such initiatives.

The research concluded that the current gender empowerment initiatives have had the potential to enhance social inclusion in rural infrastructure development; however, their implementation was fraught with challenges. The study highlighted that without addressing the socio-cultural norms and barriers that restricted women's involvement, the intended benefits of the initiatives might not be realized. To foster social inclusion, it was essential for stakeholders to actively engage with rural communities, ensuring that women were not only informed about their rights but also empowered to take on initiatives that could empowered them.

To improve the effectiveness of gender empowerment initiatives in rural area, it is recommended that local governments and non-government organizations (NGOs) collaborate to develop targeted awareness campaigns that educate communities about the initiatives. Additionally, training programs should be established to equip women with the necessary knowledge and skills in decision-making processes. Creating mentorship networks should also provide support for women, helping to build confidence and leadership capabilities. Furthermore, integrating gender considerations into project planning and execution should ensure that women's voices are heard and valued.

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► An analysis of the impacts of drought on crop productivity and employment outcomes in Zambia

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Abstract

Droughts are among the most significant climatic stressors affecting agricultural productivity and livelihoods, particularly in developing countries reliant on rain-fed agriculture. This study examines the impacts of drought on crop productivity and employment outcomes in Zambia, a country where agriculture employs over 50% of the population and contributes substantially to rural incomes. Using a combination of satellite data, labour survey data, and crop indicators, the analysis aims to assess the impacts of drought in Zambia between years 2018 and 2020.

The findings indicate that droughts significantly reduce yield of maize, with Southern Zambia affected the most, one of the regions that is most vulnerable to water scarcity. Analysis from satellite data to map drought severity, coupled with information on crop patterns highlight an estimated 25% decrease in crop yield in wards impacted by drought. Labour force survey data between the years 2018-2020 was analysed to observe the effects on employment outcomes. In wards most affected by drought, a decrease in individuals' employment, wages and working time was observed.

This study demonstrates the value of innovative technologies in assessing drought impacts. Remote sensing and satellite data were employed to map cropland and classify crop types, while vegetation indices combined with crop phenology knowledge enabled crop yield estimations. The availability of quarterly and annual labour force survey data in Zambia facilitated an analysis of employment impacts without requiring field data collection. These methodologies showcase how drought effects can be studied effectively and efficiently in resource-constrained settings.

The results carry significant implications for policy formulation and planning. Identifying areas most affected by drought and understanding the resulting employment impacts can guide targeted interventions. This includes informing decisions on drought mitigation strategies such as investments in water management infrastructure and nature-based solutions that enhance climate resilience. The study underscores the critical need for climate-smart agricultural interventions and targeted policies to mitigate the socio-economic impacts of drought. By providing a understanding of the interplay between drought, agriculture, and employment in Zambia, this research offers valuable insights for policymakers, development practitioners, and researchers seeking to enhance resilience in climate-vulnerable contexts.

Introduction

The International Labour Organization (ILO) Employment in Investments Branch has a focus on promoting employment-intensive investments and by supporting programs that drive sustainable job creation. This in part includes conducting employment impact assessments of interventions to ensure that measures of quantity and quality of jobs are embedded in sectoral, trade and investment policies, programmes and projects. The ILO's STRENGTHEN2 project aims to maximize employment impact assessment (EmpIA) in sub-Saharan Africa, for the creation of more and better jobs. The project has been applying Geographic Information Systems (GIS) and satellite imagery to assess the employment impacts of infrastructure investments in sub-Saharan Africa. The application of spatial data and methodology developed as part of STRENGTHEN2 can be applied to not only measure the employment effects of infrastructure projects but other events that could influence employment outcomes.

The effects of climate change have intensified drought by increasing global temperatures, altering precipitation patterns, and accelerating evapotranspiration. Drought in sub-Saharan Africa impacts employment by reducing agricultural productivity through crop and livestock loss and displacing population. Measuring the employment effects of drought is crucial because it helps stakeholders design targeted interventions to mitigate these impacts. This paper presents an employment impact assessment of drought in Zambia, between the years 2018-2020. Using GIS and remote methods, combined with Labour Force Survey (LFS) data, the study assesses the impacts of drought on agricultural productivity and captures how this affects employment outcomes for the population.

In Zambia, the agricultural sector contributes to about 23.6% of the total employed population (Zambia Statistics Agency 2023). The majority of these are made up of smallholder farmers, which cultivate 60% of maize crops throughout the country, where 90% of these are rain-fed (Ngoma et al. 2021). Between 2018 and 2020, Zambia experienced one of its most severe droughts in decades, characterized by prolonged dry spells and erratic rainfall patterns. This led to significant crop failures, particularly in maize, resulting in an estimated 16% decline in national production compared to the previous season and led to 2.3 million people facing severe food insecurity (IOM, 2020). The Southern and Western provinces were most impacted, leading to crop failures, livestock loss, and economic hardship. (ACAPS, 2019). Crop failure, particularly in maize (with up to a 98% yield reduction in some areas), led to employment loss for seasonal and smallholder farmers who rely on rain-fed farming for employment (IOM, 2020).

Satellite imagery and remote sensing techniques have been extensively applied to measure and estimate crop productivity in the literature. Methods differ in complexity, ranging from applying indices such as the Normalized Vegetation Difference Index (NDVI) to assess vegetation productivity, to combining satellite data with crop models and statistical analysis (Arvor et al. 2019). These techniques provide an alternative to ground data collection, however would still benefit from the availability of ground-truth data to validate models and outputs. This study aims to present what can be done in the absence of primary data, to provide an estimate of crop yield in areas most affected by drought in the Southern and Western provinces in Zambia. Crop types are mapped using satellite imagery indices and crop data for Zambia. These areas of cropland are overlaid with drought severity to highlight wards (the smallest administrative unit in Zambia) that were most affected. Applying econometrics techniques and survey data, these wards were compared to those that were not as affected by the drought event, to understand the impacts on employment, wages and working time.

Data

GIS and remotely sensed satellite data were downloaded, processed and combined to conduct the assessment into the impacts on crop yield and employment outcomes from drought in Zambia between 2018 and 2020. The data was supplemented with agricultural information for Zambia, including a crop calendar to provide information on the phenology of different crop types.

Satellite vegetation indices

Normalized difference vegetation index (NDVI)

NDVI from Sentinel data is derived from the Sentinel-2 satellites, which are part of the European Space Agency's (ESA) Copernicus program. Sentinel-2 provides high-resolution multispectral imagery with a 10-meter spatial resolution, making it highly effective for detailed vegetation monitoring. The NDVI calculation is based on Band 8 (Near-Infrared, NIR) and Band 4 (Red), where healthy vegetation absorbs red light and reflects NIR, resulting in higher NDVI values.

Net primary productivity (NPP)

MODIS Net Primary Productivity data provides global-scale estimates of carbon assimilation by vegetation based on remote sensing observations from NASA's Terra and Aqua satellites. NPP represents the net amount of carbon absorbed by plants through photosynthesis after accounting for respiration losses, making it a critical indicator of ecosystem productivity, carbon cycles, and agricultural output. MODIS NPP data is derived from the MOD17 product series, which includes Gross Primary Production (GPP) and NPP estimates at 1km spatial resolution, updated every 8 days, monthly, and annually. It incorporates meteorological data, vegetation indices (such as NDVI), and radiation-use efficiency models to provide continuous global monitoring of plant growth.

Labour force survey data

The Zambia Labour Force Survey (LFS) is an annual assessment conducted by the Zambia Statistics Agency (ZamStats) in collaboration with the Ministry of Labour and Social Security (MLSS). The survey aims to collect comprehensive data on the labour market, including employment, unemployment, and other key indicators. Data was obtained for the years 2018, 2019 and 2020 which includes a panel component of wards and households surveyed across all three years. The survey data was processed at the ward level, to match to that of the drought intensity and yield data. Variables on employment, with a focus on agricultural employment and wages were extracted and disaggregated by gender. Demographic indicators on age and level of education were used as controls in the analysis.

Methods

Crop type mapping and drought intensity

Crop type was mapped by applying NDVI data and a clustering approach to classify different crop types. A crop calendar for Zambia was used for the preparation of a crop mask for each crop type. Sentinel 2 satellite data at 10 m spatial resolution and 5-12 days temporal resolution, was used for the growing duration of October 2017 - July 2018. Crop types were identified based on their phenological development and their corresponding spectral reflectance characteristics in the multitemporal satellite images. Erdas Imagine, Google Earth Engine (GEE) and System for Earth Observation Data Access, Processing and Analysis for Land Monitoring (SEPAL) platforms were used for processing the data.

The Agricultural Stress Index System (ASIS) is a remote sensing-based tool developed by the Food and Agriculture Organization (FAO) to monitor agricultural drought intensity globally. ASIS relies on satellite-derived vegetation health indices to assess the impact of drought on crops and pastureland in near real-time. ASIS classifies drought intensity using a percentage-based threshold system, where areas experiencing significant stress are identified based on deviations from normal vegetation conditions. Agricultural droughts are classified by their intensity and are categorized into four classes: Extreme, Severe, Moderate or Mild. The intensity of drought in ASIS is calculated through the weighted Mean Vegetation Health Index, indicating that the poorer the vegetation health the more severe the drought. This classification was used to map drought intensity and select the treatment group (wards affected by drought) for the study.

Estimations of crop yield

The absence of ground truth data makes estimations of crop yield only using remotely sensed data difficult, so the NPP was applied to provide a proxy for crop yield estimation. The FAO WaPOR (Water Productivity Open-access Portal) methodology was applied. Since NPP represents the net carbon assimilated by plants through photosynthesis, it serves as a key indicator of biomass production, which is directly correlated with crop yield. By integrating WaPOR's NPP data with crop-specific factors, productivity of crops can be assessed. To estimate yield, NPP is converted into total biomass production and then adjusted using the Harvest Index (HI), which represents the proportion of biomass that is harvestable (kgm²).

Econometrics

Based on the drought intensity maps, the 'treatment group' were identified as wards with at least 20 per cent cropland that experienced moderate – severe drought severity in the year 2019. The 'control group' was made up of wards with similar levels of cropland that were not impacted by the drought. The econometrics built upon previous literature looking at the impacts of drought on employment outcomes. In India, Mukherjee and Viz (2022) examined how droughts impact male and female agricultural workers differently. Using a difference in differences (DID) approach and individual-level panel data over five years, the research found that women's workdays decline by 19% more than men's during drought periods, primarily because women have fewer opportunities to transition into non-farm employment. A similar approach was applied to identify how prolonged droughts affect urban labour markets across 78 cities in Latin America (Desbureaux and Rodella 2019). Utilizing monthly labour force surveys, the research revealed that extended dry periods significantly reduce employment probabilities, hourly wages, hours worked, and overall labour incomes.

This approach is similar to the above in the sense it employs a DID approach with time and area fixed-effects, however uses ward level data instead of individual level data, which was not available with a panel component for the years of the study in Zambia. This was applied to first investigate the relationship between treatment (drought affected areas) and crop yield (biomass from NPP) and then employment outcomes in the form of employment, agricultural employment, wages and working time. This included time (year) and area (district-level) fixed effects to control for heterogeneity across wards over time. The regressions were disaggregated by gender.

The equation below presents the general econometric specification that was applied:

$$Y_{i,t} = \alpha + \beta_1 Treated_i + \beta_2 X_{it} + \lambda_i + n_t + \epsilon_{i,t}$$

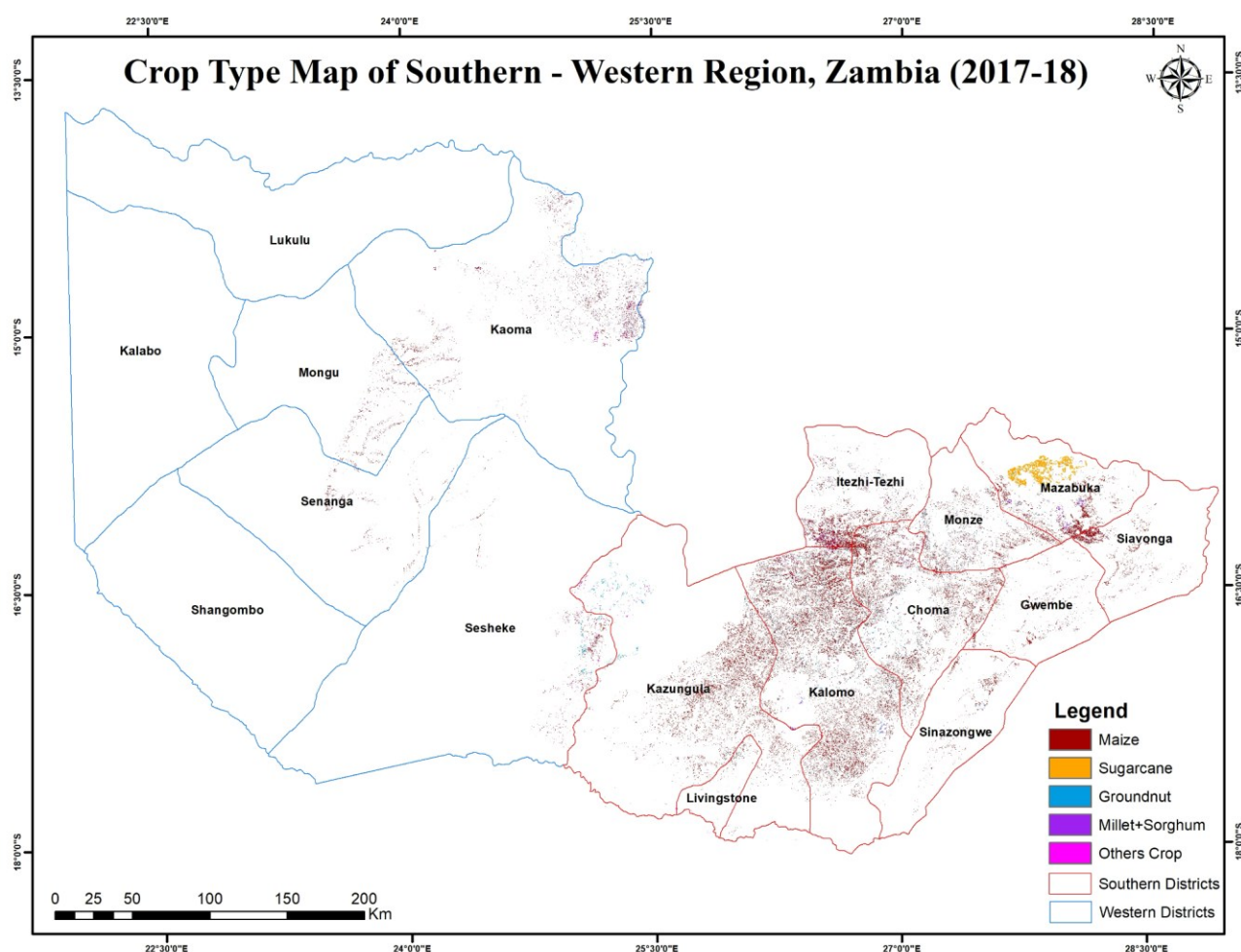
Where Y is the employment variable for the administrative unit, $Treated_i$ is the treatment variable that has a value of 1 for the wards that were affected by drought from 2019 onwards and 0 otherwise; λ_i is the administrative area fixed effects and n_t is year fixed effects; X_{it} is the control variables including age and education.

Results

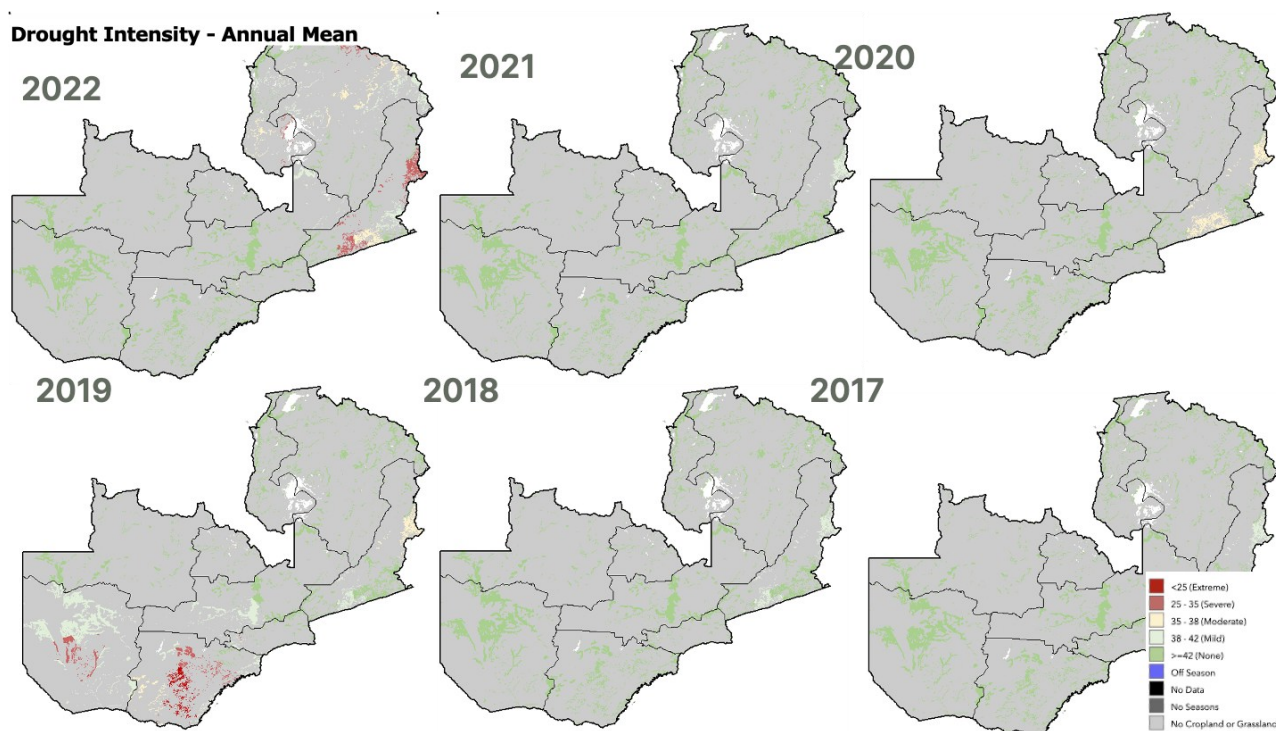
Crop type and drought intensity

Crop type mapping is essential for effective agricultural planning, resource allocation, and food security assessment. The crop type map (Figure 1) was prepared without ground data, as a proxy identification of agriculture areas in Sothern and western provinces of Zambia. Crop types (Maize, Groundnut, Sorghum, Sugarcane and Other crops) at 10-meter spatial resolution were mapped at national scale using NDVI time series derived from Sentinel-2 satellite imagery from October 2017 to July 2018. The main crop type in the study area identified before the drought event was Maize.

► **Figure 1. Crop type map for Southern and Western region in Zambia.**

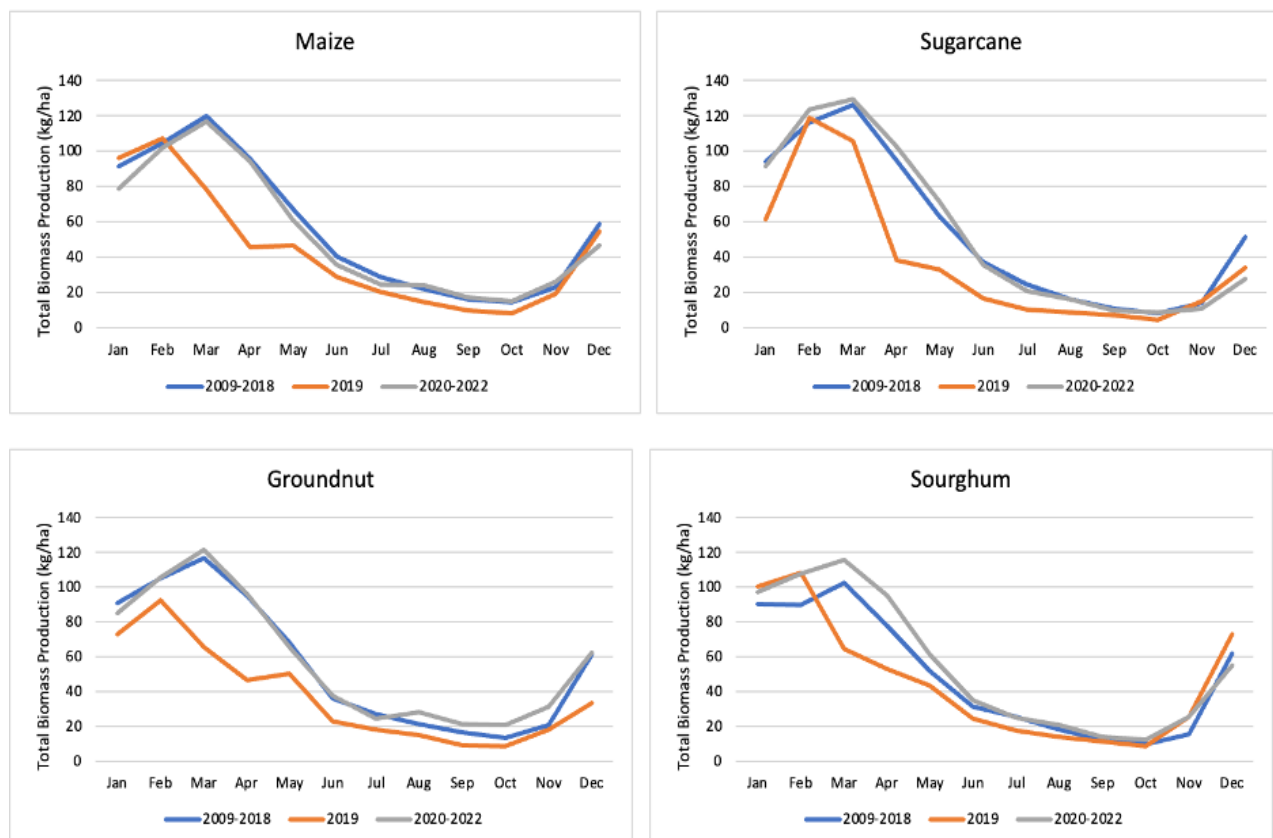


Drought intensity (DI) offers a measure of how severe the drought conditions are based on the balance between actual rainfall and potential evapotranspiration. A DI value of 0% suggests no drought, while values approaching 100% indicate severe drought conditions. From the mapping of DI in the study area, results showed that 30 % of the region was under moderate to severe drought in year 2019 (Figure 2).

► **Figure 2. Drought Intensity across Zambia, between the years 2017-2022.**

Crop yield estimations

As highlighted, ground truth data was not available for the study so the estimations of crop yield are to be interpreted with caution and it is recommended they should be further validated with field data. Using the NPP to look at total biomass production as a proxy for crop yield and using the classifications of different crop types, a reduction in yield can be observed for the drought year of 2019 across the majority of crops (Figure 3). By analysing the NPP values for all the classified crops, distinct patterns of productivity decline emerged. Certain crops exhibited a more pronounced reduction in NPP, such as maize and sugarcane, indicating severe yield losses attributable to the drought conditions.

► **Figure 3. Comparison of 2019 crop productivity (biomass derived from NPP) in 2019 and non-drought years.**

The regression results comparing wards with high drought severity and crop yield (biomass) estimate that there was a decrease in yield in areas affected by the drought in 2019. When exponentiating the coefficient, using $(\exp(X) - 1)$, we estimate a decrease in crop yield of 14% in wards impacted by drought compared to those that were not affected. This result underscores the negative relationship between drought severity and crop yield, emphasizing how climatic stressors directly affect agricultural output by reducing plant biomass accumulation and growth potential of crops.

Impacts on employment outcomes

All regression tables and full results from the below analysis can be available upon request.

Decreases were found across some of the variables in areas impacted by the drought event in 2019. The employment results indicate a statistically significant decrease of employment in individuals in wards impacted by drought, by an estimated 8%, when exponentiating the coefficient. This is inline with findings from other literature, that the impacts of drought results in a decline of jobs for the affected population. The decrease across both male and female employment was similar. In agriculture specifically, the share of employment fell by approximately 3%, however this result was not statistically significant.

The regressions for wages highlighted a similar decrease to employment, where areas that experienced drought saw an estimated 5% decrease in average daily wages. This could be explained by a reduction in crop yield due to the impacts of drought, which in turn negatively affects agricultural labour demand and income generated from the selling of crops. In drought-affected regions, the decline in rain-fed agricultural production results in fewer employment opportunities for farmworkers, as smallholder farmers and commercial agricultural enterprises scale down their labour needs in response to lower output. This reduction in demand not only leads to job losses but also puts downward pressure on wages, particularly in informal jobs.

Conclusions

Droughts remain one of the most severe climate events affecting agricultural productivity and employment in Zambia. The 2019 drought event in Zambia increased food insecurity and impacted the employment and livelihoods of the affected population. The findings of this study estimated that drought significantly reduced maize yields, particularly in Southern Zambia, where impacts were most pronounced. The estimated 14% decline in crop yield in affected wards underscores the severity of drought-induced agricultural losses and highlights the vulnerability of Zambia's rain-fed agricultural system. Given that agriculture employs over 50% of the population and serves as a critical component of rural livelihoods, these productivity declines have far-reaching economic and social consequences.

The labour market effects of drought, through the econometrics work utilising LFS data, as further emphasize the interconnectedness between climate shocks and employment outcomes. The analysis of survey data from 2017 to 2019 indicates that in wards most severely impacted by drought, employment, and wages saw a significant decline. The decrease in employment of an estimated 8% reflects a contraction in agricultural labour demand, as lower crop yields necessitate fewer workers during harvest periods. Furthermore, the small decline in daily wages illustrates how drought affects income security. These findings align with global research on climate-induced economic shocks, which indicate that climate variability affects workers, particularly those in the informal sector.

One of the key contributions of this study is its methodological approach, which integrates remote sensing techniques through the use of satellite data with econometrics to assess the employment impacts of drought. By utilizing satellite data to map drought severity and track crop yield changes, this study showcases the value of Earth observation tools in agricultural and employment research. The combination of vegetation indices, crop phenology information, and labour force survey data has allowed for an analysis without the need for costly and time-consuming field data collection. This demonstrates the potential of geospatial technologies in employment impact assessments of climatic events, particularly in resource-constrained settings where access to timely and accurate data is often limited.

The implications of these findings can be a valuable tool for policymakers, development practitioners, and researchers working on climate resilience in Zambia and similar contexts. The identification of drought-affected areas should inform targeted interventions to support agricultural productivity and employment stability. This includes investments in water management infrastructure, climate-resilient farming techniques, and irrigation systems that can enhance productivity in drought-prone regions. Developing nature-based solutions, such as soil moisture conservation, agroforestry, and improved watershed management, can further strengthen the resilience of smallholder farmers and employment in the agricultural sector. The study also highlights the urgent need for climate-smart agricultural interventions that go beyond short-term drought relief efforts. Building long-term adaptation strategies, such as crop diversification, improved seed varieties, and climate information services, can help farmers mitigate risks associated with recurrent droughts.

Addressing the employment and wage implications of drought requires a multi-sectoral approach that includes labour market adaptation strategies. The decline in employment in drought-affected areas suggests that many agricultural workers struggle to find alternative livelihoods when farming opportunities are reduced. Governments and development partners could implement skills development programs and employment diversification strategies to reduce rural communities' dependence on rain-fed agriculture. Expanding access to vocational training, non-farm employment opportunities, and climate-adaptive business models can help support workers during these climate induced shocks.

The study also reinforces the importance of early warning systems and data-driven decision-making in drought mitigation efforts. The integration of satellite data and employment information demonstrated in this research can serve as a blueprint for future climate risk assessments. Governments and stakeholders should invest in drought monitoring to support prevention and timely response. Understanding the effects on employment can enable stakeholders to put in place strategies to mitigate the effects on these outcomes for the population.

Beyond Zambia, the findings of this study have broader regional and global implications. Many sub-Saharan African countries face similar climate challenges, where agriculture-dependent economies are threatened by drought events. The methodologies and policy recommendations outlined in this research can be applied in other climate-vulnerable regions to improve agricultural resilience and employment. As climate change intensifies, addressing the socio-economic dimensions of drought will become increasingly urgent for sustainable development and poverty reduction efforts across Africa and beyond.

In conclusion, this study provides valuable insights into the complex relationship between drought, crop productivity, and employment in Zambia. The integration of remote sensing technologies with LFS data has enabled a detailed assessment of climate impacts on both agricultural employment. The findings highlight the need for climate-smart agricultural investments, labour market adaptation policies, and programmes to mitigate the effects of drought. By implementing targeted interventions and data-driven policy solutions, Zambia can enhance agricultural resilience, protect employment opportunities, and improve the livelihoods of its most vulnerable populations.

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► **Resilience and vulnerability of local communities livelihood to climate change in Dale district, Sidama regional state, southern Ethiopia**

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Acknowledgment

We would like to express our profound gratitude to Hawassa University Wondo Genet College of Forestry and Natural Resources for their financial support in accomplishing this paper. Also, we would like to thank the Ethiopian Meteorological Agency, which provided the meteorological data for this work, and the local communities for their information in data collection for this work.

Abstract

Introduction: The Ethiopian rain-fed agriculture system is becoming more vulnerable to the impacts of climate change. Climate change resilience and vulnerability depend upon various factors and differ between places, sectors, and communities. Thus, this study investigates the resilience and vulnerability of local communities' livelihoods to climate variability and change in the different agroecological zones of the Dale district using the Livelihood Vulnerability Index–Intergovernmental Panel on Climate Change (LVI–IPCC) methods. Data were collected from a representative of 351 sample households across two agroecological zones using a mixture of participatory methods. In addition, the data were collected by interviewing the randomly selected respondents, distributing questionnaires, and implementing focus group discussions.

Results: The findings reveal that the majority of the farmers in the study area have perceived changes in climatic parameters such as rainfall, temperature, extreme events occurrences, prolonged dry periods, and decreasing rainfall were more frequent across the agroecologies in the district. In the context of resilience and vulnerability of farmers' livelihood to the changing climate, there was a difference in a component's relative value across the two agroecology zones in the study area. The overall LVI indicates that farmers in lowlands were more vulnerable compared to midland Agroecology. Farmers who were heavily dependent on agriculture to meet their food and livelihood were more affected by climate change. The differences in the resilience and vulnerability level of agroecologies to climate change have resulted from a lack of community households' access to basic infrastructure, variations in livelihood strategies, a low level of income source diversification, and a lack of available technologies. In addition, the study

Identified the major climate change adaptation strategies employed by communities, such as changing the cropping calendar, planting high-yielding varieties, growing drought-resistant improved crop varieties, implementing soil and water conservation techniques, enhancing irrigation schemes, and income source diversification.

Conclusion: To enhance climate resilience or climate change adaptation strategies for vulnerable communities, there is a need to improve infrastructure facilities, diversify livelihood strategies, provide improved seed varieties, and enhance soil and water conservation practices, giving priority to more vulnerable communities. Decision-makers should plan adaptation in local contexts based on farmers' socioeconomic characteristics and livelihood strategies rather than adopting them at international levels.

Keywords: Dale district, climate change, resilience, vulnerability, adaptation strategy

Sub-theme 3: Creating more resilient urban infrastructure and communities

Introduction

Climate change is the dominant challenge across the world, which affects the earth's surface widely from tropical to arctic regions and from sea to land and atmosphere (20). Climate variability-induced hazards such as drought, flood, rainstorms, and cyclones are the major challenges adversely affecting human beings primarily due to their varying levels of vulnerability (12).

Ethiopia is the most vulnerable to the impacts of climate variability and changes due to high dependence on natural resources and climate-sensitive livelihoods coupled with the existence of rampant poverty and variable weather events (17). Evidence suggests that recurrent droughts and the associated food insecurity and famine in Ethiopia are mainly caused by climate, particularly rainfall variability (2), (12). In the country, the temperature has been increasing annually, resulting in a decline in agricultural production, and cereal production is expected to decline still further (by 12%) under moderate global warming (19). Moreover, it has led to a decline in biodiversity, a shortage of food, and increases in human and livestock health problems, rural-urban migration, and dependency on external support (14). Factors aggravating the impact of climate change in Ethiopia are rapid population growth, land degradation, widespread poverty, dependency on rainfed agriculture, lack of awareness by policy and decision-makers about climate change, and lack of appropriate policies and legislation (20). If the trend of warming and drying continues in Ethiopia, vulnerability among agricultural farming and pastoral livelihoods is expected to increase (19) (5).

The study area, Dale district in Sidama regional state, is one of the areas characterized by high population pressure, serious land shortage, continuous cultivation, deforestation, and land degradation (6). Small-scale agriculture with traditional technology and subsistence production is a typical production system in the area. Due to very high population growth, there is a shrinkage of cultivable land per household, and the land holding size for households is less than a quarter of a hectare (13). Furthermore, the arable land potential of the area is seriously threatened by erosion, resulting from the population pressure on land and climate variability. With this trend of population pressure and land fragmentation, ensuring a resilient livelihood system becomes a critical question. Dale district farming community is suffering from Climate disturbances, which have become common natural disasters, which are followed by erratic rainfall in the June to September rainy seasons, bringing drought and reduction in crop yields and plant varieties. The rainfall, especially in the later rains towards the end of the year, has been reported as coming in more intense and destructive downpours, bringing landslides, and soil erosion. Another issue is that there has been an increase in temperature, which disturbs the physiology of crops, the microclimate, and the soil system on which they grow (9).

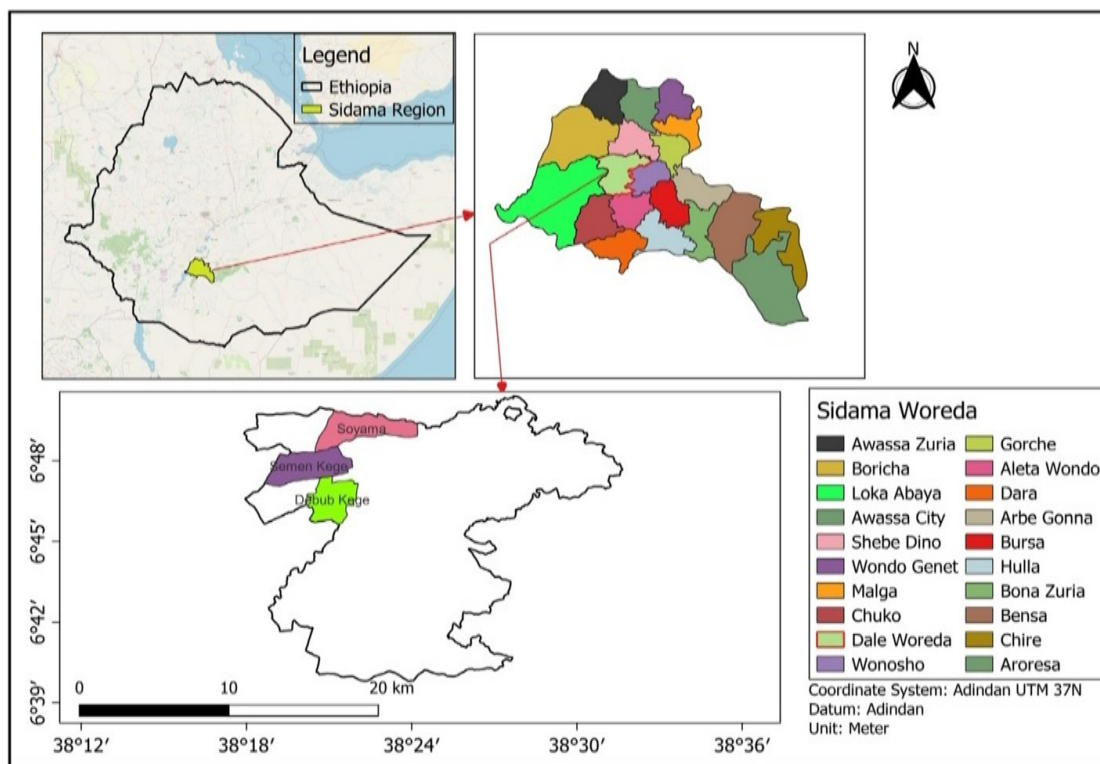
In general, this study was intended to investigate the vulnerability and resilience of local communities' livelihoods to climate change and their adaptation strategies in the Dale district. Specifically

- i. Investigating local community perception of climate change and variability
- ii. Determining the vulnerability and resilience status of the local community's livelihood to climate change
- iii. Identifying the adaptation strategies undertaken by the local community to climate change-related shocks and stresses.

Methodology

Study Area Map

► FIGURE 1. Map of the study area



Study Design

To conduct an effective and practical study, the study design used several features. First, the methodology should permit comparisons both at the household and agro-ecology levels. Second, the design should not be expensive to implement and should have a minimum turnaround time without unduly sacrificing the credibility of the results.

Considering these parameters, the design adopted the indicators method, which involves (i) identifying a range of indicators that reflect powerfully on the farmer's level of adaptive capacity, sensitivity, and exposure to climate change and variability and for which credible information can be quickly and inexpensively obtained; (ii) designing a different methodology that facilitates the collection of information on these indicators from households living in the study area and (iii) formulating index that combines information from the range of indicators and facilitates vulnerability comparisons at different agro-ecological levels.

The development of this indicator-based vulnerability assessment research design or tool was accomplished following some methodological steps. Initially, an expensive literature review and assessment of the general availability and use of vulnerability indicators was made, which enabled the researcher to select indicators for analysis.

This study employed purposive sampling and simple random sampling techniques for the selection of the agroecology, Kebele, and households. The researcher used a combination of qualitative and quantitative research data, which was collected from both primary and secondary sources. The primary data was collected from three hundred fifty-one household surveys, eight key informant interviews, and four focus group discussions. Thus, this

primary information is supplemented by researcher field observation secondary data sources, which were gained from books, journals, articles, and pertinent documents.

Finally, the data obtained through different data sources was analyzed through descriptive statistics using Statistical Package for social science, and the vulnerability status of the farmer's livelihood and their adaptation strategies was analyzed by using the chi-square test, and livelihood vulnerability index from the intergovernmental panel on climate change (LVI-IPCC). Then, the result was discussed based on the output value of the models, and lastly, the conclusion and the researcher suggested recommendations.

Sampling procedures

The strategy to identify the study area and sampling procedures was conducted depending on the agro-ecological zones according to the traditional climatic zone classification system of agro-ecology (7). The researchers purposively select two agroecologies based on the production system and climatic characteristics. From each Agroecology zone, two kebele were selected randomly. Since the selected kebeles are homogeneous in terms of their agricultural production, system (adopted plantation and livestock), and climatic conditions, the household selection was through a simple random sampling technique.

Sample size Determination

To calculate the sample size, the total number of households was obtained from the Dale District Finance and Economic Development Office (DDFEO), and an appropriate formula was used to determine the sample size. The formula used to determine the sample size was the Yamane formula (21):

$$n = \frac{N}{1 + N(e)^2}$$

Where: n – calculated sample size

N – Total number of households in Tembaro District

e – Level of precision

According to DDFEO, 3385 households were found in the selected sample Kebeles. The required sample size for the survey study, according to the formula, is 350.876 households, but the study used 351 households for the study. The Multistage sampling technique was applied to select the specific 351 households for the survey. In the first stage, four Kebeles (two Kebele from each agroecology in the district) were selected using simple random sampling techniques out of the total 35 Kebeles in the District. After that, 351 households were selected from the lists of households in the selected four Kebeles through systematic random sampling techniques depending on the total household proportion in each kebele.

Data Management and Analysis

To attain the intended objective of the study, both qualitative and quantitative methods of data analysis were employed. Descriptive statistics (means, frequency, crosstabs, percentage, count, etc) was used to represent the collected data results, and SPSS version 20 was used as a tool of analysis.

Farmers' Livelihood vulnerability analysis

The Livelihood Vulnerability Index Intergovernmental Panel on Climate Change (LVI- IPCC) was used to investigate the vulnerability and resilience status of farmers' livelihood in the study area. The researcher used an alternative method for calculating the LVI that incorporates the IPCC vulnerability definition. The LVI includes six major components: climate and the five livelihood capitals (natural, physical, financial, human, and social capitals). The researcher assumes that these components fully describe vulnerability in terms of exposure, sensitivity, and adaptive capacity.

It is dependent on several socio-economic factors such as financial, physical, human, and social capital. Assets, technologies, infrastructure, knowledge, skill, health, educational facilities, and institutions are examples of indicators of adaptive capacity (10). Once exposure, sensitivity, and adaptive capacity were calculated, the three contributing factors were combined using the following equation:

$$\text{LVI-IPCC} = (\text{E-Ac}) * \text{S}$$

Where: **LVI-IPCC**=LVI for district d expressed using the IPCC Vulnerability framework,

E=calculated exposure score for the agroecology (equivalent to the Natural Disaster and Climate Variability major component),

Ac=calculated adaptive capacity score for agroecology A (weighted average of the Socio-Demographic, Livelihood Strategies, and Social Networks major components)

S= calculated sensitivity score for agroecology A (weighted average of the Health, Food, and Water major components).

It scaled the LVI-IPCC from -1 (least vulnerable) to 1 (most vulnerable). The overall Steps to calculate the vulnerability index are broadly summarized as:

Step 1: Indicators

Values for all the indicators were standardized for the district.

$$\text{Indicator Index (Ix)} = \frac{IA - I(\min)}{I(\max) - I(\min)} \dots \dots \dots (1)$$

Where:

Ix = standard value for the indicator

Id = Value for the Indicator I for a particular agroecology, A.

I (min) = Minimum Value for the indicator across the agroecology

I (max) = Maximum Value for the indicator across the agroecology

Step 2: Profiles

Indicator Index Values were combined to get the values for the profiles

$$\text{Profile (P)} = \sum_{i=1}^n \frac{IX}{n} \dots \dots \dots (2)$$

Where P= profile

Ix= indicator index

n =number of indicators in the profile

i = Index of the ith indicator.

Step 3: Components

Values of the profiles under a component were combined to get the value for that component.

$$\text{Component (C)} = \frac{\sum_{i=1}^n \text{WPI} \cdot \text{Pi}}{\sum_{i=1}^n \text{WPI}} \dots\dots\dots (3)$$

Where,

WPI is the weightage of the Profile i

The weightage of the profile depended on the no of indicators under it such that within a profile, each indicator has equal weightage.

Step 4: Vulnerability Index

The combination of the values of the three components gave the vulnerability Index.

$$\text{Vulnerability Index} = (\text{Exposure} - \text{Adaptive Capacity}) \times \text{Sensitivity} \dots\dots\dots (4)$$

Scaling is done from -1 to +1, indicating low to high vulnerability.

Step 5: Resilience was measured as:

$$\text{Resilience Index} = \text{Ability to absorb shocks} - \text{Vulnerability} \dots\dots\dots (5)$$

Results and discussion

Local community's perception of climate change

Climate change adaptation needs farmers' perception that the climate has changed, after that, they isolate useful coping options and implement them. Farmers' perception of climate change is the condition for their initiation to implement adaptation practices. As many Ethiopian studies indicate, a large number of farmers already perceive that the temperature has become hotter and the rains have become less predictable and shorter in duration. Supported by the findings of (8); (22). Based on the household survey results, the below tables show how farmers perceive the climate changes in the study area.

► **TABLE 1: Households' perception of climate change**

Households' perception	Changes	Agroecology of the HH					
		Midland		Lowland		Overall	
		No	%	No	%	No	%
1 Climate change	Yes	138	93.7	198	96.2	336	95.5
	No	9	6.3	6	3.8	15	4.5
	Total	147	100	204	100	351	100
2 Temperature	Increase	136	92.4	193	94.3	329	93.5
	No change	11	7.6	11	5.7	22	6.5
	Total	147	100	204	100	351	100
3 Amount of rainfall	Decrease	133	90.3	191	93.3	324	92
	No change	14	9.7	13	6.7	27	8
	Total	147	100	204	100	351	100
	Yes	138	93.7	198	96.2	336	95.5
4 Length of the dry seasons	Increase	98	66.7	167	81.9	265	75.5
	Decrease	9	6.1	12	5.9	21	6
	No change	15	10.2	9	4	24	6.8
	I do not know	25	17	16	7.8	41	11.7
5 Length of the rain seasons	Increase	9	6.1	12	5.9	21	6
	Decrease	98	66.7	167	81.9	265	75.5
	No change	15	10.2	9	4	24	6.8
	I do not know	25	17	16	7.8	41	11.7
6 Occurrences of flooding	Increase	93	64.4	152	77.5	245	72.8
	Decrease	9	6.1	12	5.9	21	6
	No change	20	14.2	16	7.8	34	9.7
	I do not know	25	17	26	16.4	51	15.7
7 Frequency of drought	Increase	98	66.7	167	81.9	265	75.5
	Decrease	10	6.5	12	5.9	22	6.4
	No change	15	10.2	9	4	24	6.8
	I do not know	26	16.7	16	7.8	40	11.3

Analysis of the perception of farmers on climate change across the agroecology of Dale district showed that the majority of respondents (95.5%) perceived change in local climate, and about 4.5% of respondents claimed no change in climate for the last three decades.

Regarding temperature, the majority of respondents (93.5%) perceived that the temperature had increased, and about 6.5% of respondents claimed that the temperature had not changed three decades ago. Regarding the perception of households towards change in rainfall, the majority of the respondents (92%) perceived that rainfall has decreased, and 8% claimed no change in the amount of rainfall throughout the last three decades. In each agroecology, the majority of respondents perceived that rainfall had decreased. Thus, households who perceive climate change have undertaken adaptation strategies and have a better adaptive capacity, in turn, are less vulnerable. According to the result obtained from FGD and KII, in midland and lowland, perceived warming temperatures and declining rainfall. They also complained that rainy time has been shifting from what they had known 20 and 30 years ago.

They argued that 20 and 30 years ago, the rainy season was regular, and the soil was also very fertile hence, there was high product and productivity. Nevertheless, today's focus group discussant and key informant explained that they face a shortage and seasonal shift of rainfall during seeding and harvesting time, due to this, the product declines from time to time. Discussants in lowland agro ecology added that they were affected by ten more droughts (shortage of rain) and floods (due to their topography). FGD Participants complained that drought, erratic rainfall, and landslides are some of the extremes that frequently appeared since 1993. Farmers' self-reported climate perception is not sufficient to generalize about the actual trends of climate change and variability in the study area. Their perception of climate change is highly personal, site-specific, and influenced by several factors. Therefore, it is very important to compare farmers' climate change perception and the actual meteorological data observation in the study area to recommend the right adaptation strategies (17), (11), and (8).

As indicated in Table 1 above, the perception of households towards change in the length of dry seasons, the majority of the respondents (75%) perceived that the length of dry seasons increased. Only 6% perceived that the length of dry seasons has decreased, 6.8% claimed no change, and 11.7 % of respondents responded that they do not know whether the length of dry seasons either increased or decreased throughout the last three decades. In each agroecology, the majority of respondents perceived that the temperature had increased and the length of dry seasons had increased (6) and (9)

According to Table 1 above, the perception of households towards change in the length of rain seasons, the majority of the respondents (75.5%) perceived that the length of rain seasons has decreased. On the other hand, 65 and 6.8% claimed an increase in the length of rain seasons and no change, respectively, and 11.7 % of respondents responded that they do not know the length of rain seasons either increased or decreased throughout the last three decades. In each agroecology, the majority of respondents perceived that temperature has increased and the length of the rain seasons has decreased (7).

Regarding the perception of households towards the frequency of flooding and soil erosion occurrence, the majority of the respondents (72.8%) perceived that the occurrence frequency has increased, 6 % perceived that the occurrence frequency has decreased, 9.7 % claimed no change, and 15.7% respondents responded that they do not know the occurrence frequency either increased or decreased.

As indicated in Table 1 above, the perception of households' frequency of drought occurrence, the majority of the respondents (75.5%) perceived that the frequency of drought occurrence has increased. Only 6.4% and 6.8 % claimed a decrease and no change in the frequency of drought occurrence, and 11.3% of respondents responded that they did not know the frequency of drought occurrence either increased or decreased throughout the last three decades. In each agroecology, the majority of respondents had perceived as the temperature has increased and rainfall has decreased, the frequency of drought occurrence has increased. According to the results obtained from focus group discussions and key interview informants, they perceived warming temperatures and declining rainfall. In addition, they complained that rainy time has been shifting from what they had known 20 and 30 years ago. The focus group discussant and key informant explained that they face a shortage and seasonal shift of rainfall during seeding and harvesting time, due to this, the product declines from time to time. FGD Participants complained that drought and erratic rainfall are some of the extremes that frequently appeared since the 1993's. (22) supports this finding

Local communities livelihood resilience and vulnerability to climate change

To examine the proportion of vulnerability in terms of Agroecology, the Chi-square (χ^2) result confirmed statistically significant associations between more vulnerable and less vulnerable based on their different attributes. The independent variable agroecologies were computed to understand how those variables significantly affect the expected value of vulnerability with effect size, which indicates the magnitude of the effect imposed by independent variables on the dependent variable.

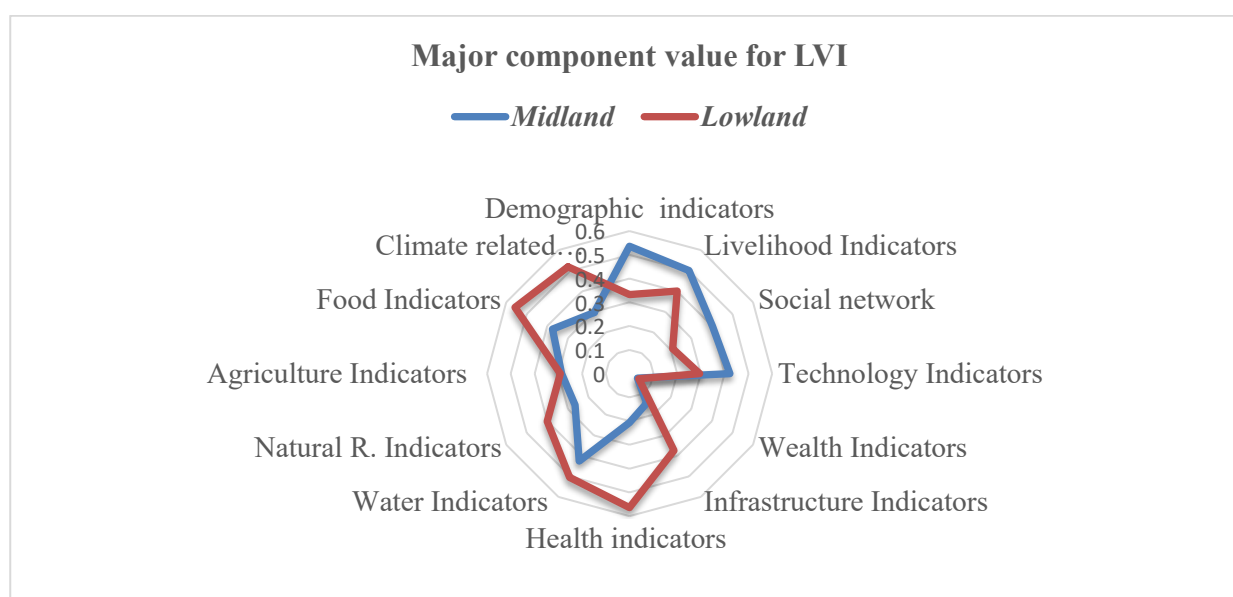
► **TABLE 2: Chi-square test result of an independent variable on the vulnerability status**

Vulnerability status				Chi-square	effect size
Variable	Description	More vulnerable	Less vulnerable	χ^2	
Kebeles	Midland	57	90	11.876**	0.31**
	Lowland	152	52		

The Chi-square analysis reveals that Agroecology has statistical significance at 5% on the vulnerability status of the communities (Table 2)

In general, the vulnerability indexes of the twelve major components are summarized in the spider diagram (Fig. 2) below.

► **FIGURE 2: LVI of major components representation in the form of spider diagram**



The spider diagram yielded a result as the lowland agroecology scored higher values in almost all exposure and sensitivity components indexes and lower values in adaptive capacity component indexes. However, midland agro ecology scored a higher value for adaptive capacity and a lower value for almost all exposure and sensitivity components. In general, the climate, health, infrastructure, natural resources, and water indicators were strong determinants of vulnerability. The demographic, technology, agriculture, and social network profiles were other determinants that played an intermediate role, with fewer differences among the agro ecologies. Wealth and livelihood strategies indicators were not major factors as there were few significant differences among the Agro ecology. This result is in line with the findings of (18) and (14), who presented different agro-ecologies having different scores of exposure, sensitivity, and adaptive capacity, which result in different vulnerability levels among the agro-ecology.

Overall vulnerability factors

The overall vulnerability index and a composite of LVI for each Agro ecology were calculated using the methodology in Eqn. (1) – (4), and that results in the overall vulnerability factors (exposure, sensitivity, and adaptive capacity) as presented in Table 4 below.

LVI-IPCC = (Exposure-Adaptive capacity)*Sensitivity

► **TABLE 4: Vulnerability factor index and overall vulnerability score for agro-ecologies**

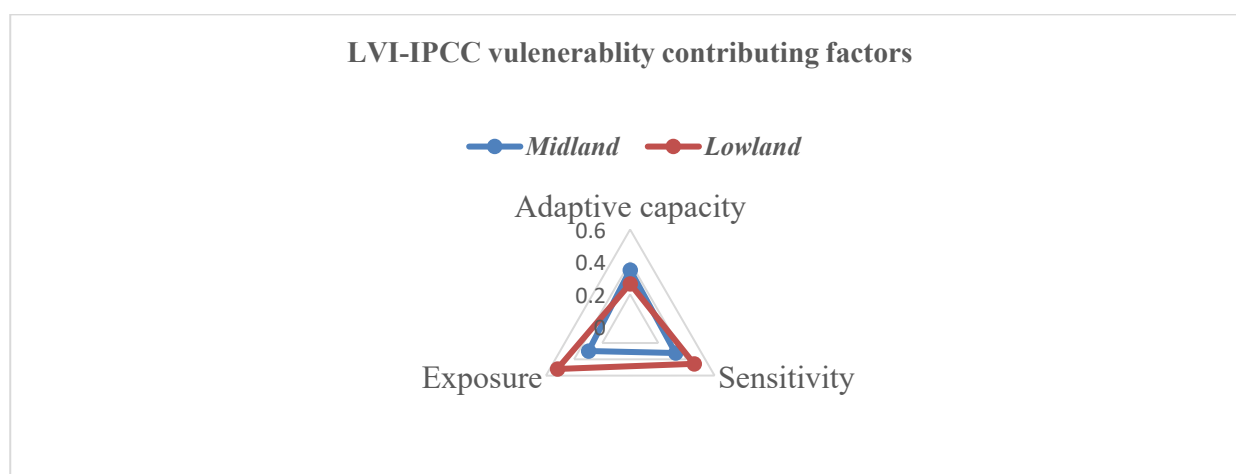
Contributing factors	Midland	Lowland
Adaptive capacity	0.351	0.266
Sensitivity	0.322	0.454
Exposure	0.297	0.519
Overall VI-IPCC	0.182	0.399
Resilience Index	0.149	-0.133

The study used the scale of vulnerability from -1 (least vulnerable) to + 1 (most vulnerable) and was based on the calculation of LVI-IPCC (Eq. 4). The high values of exposure relative to adaptive capacity yield positive vulnerability scores.

The sensitivity factor acts as a multiplier, such that high sensitivity in an agro ecology for which exposure exceeds adaptive capacity results in a large positive (i.e., high vulnerability) LVI-IPCC score. The analysis yielded an overall vulnerability of 0.182 and 0.399 for midland and lowland, respectively (Table 4). According to this result, the relative exposure is high (0.519), and adaptive capacity is low (0.266) for lowlands relative to other agroecology. This indicates the positive LVI-IPCC score, which was classified as more vulnerable since it indicates an adaptive capacity deficit and high exposure, having a higher score of sensitivity as a multiplier relative to midland agroecology. On the other hand, exposure is medium (0.297), and adaptive capacity is high (0.351) for midland, which shows the overall vulnerability is estimated to be low relative to lowland agroecology.

The lowland Agroecology exhibits a high vulnerability value. This result is similar to the findings of (5) and (15). (2) reported that lowland agroecologies were more vulnerable compared to highland and midland agroecologies. In general, the vulnerability triangle (Fig. 3) depicted the contributing factor scores in the form of the diagram as follows:

► **FIGURE 3: LVI-IPCC contributing factors diagram**



The estimated LVI-IPCC index further suggests that the lowland area with warm semiarid agroecology of the district is categorized as having the highest relative vulnerability.

Resilience

Resilience Index = Ability to absorb shocks – Vulnerability

= adaptive capacity of the agroecology – Vulnerability of the agroecology

Resilience Index midland = adaptive capacity of midland – Vulnerability of the midland

= 0.351 – 0.182= 0.149

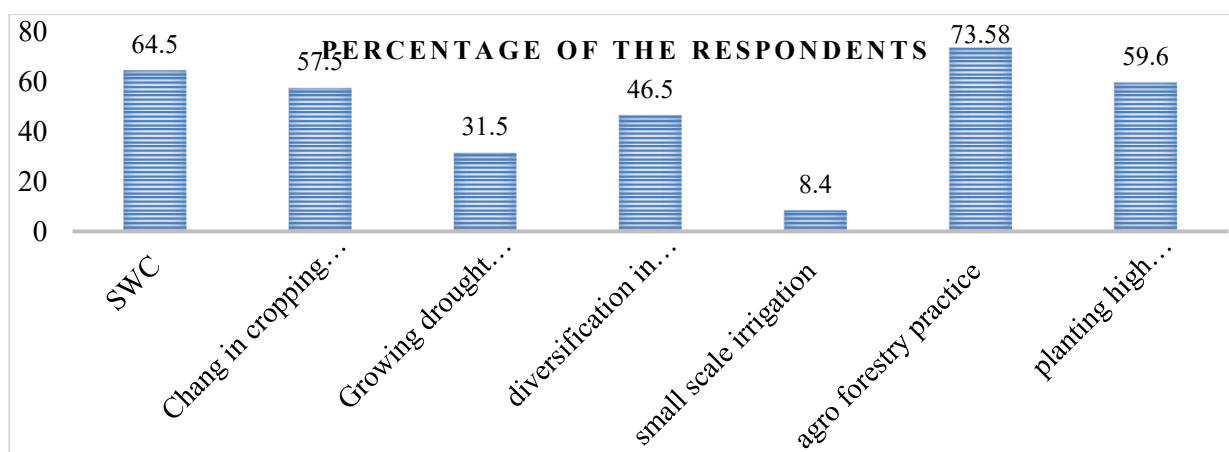
Resilience Index lowland = adaptive capacity of lowland – Vulnerability of the lowland

= 0.266 -0.399= -0.133

According to the resilience index result, the resilience value for lowland - 0.133 is low relative to the midland agroecology value of 0.149. This indicates that lowland agroecology is less resilient to climate change-induced impacts compared to midland agroecology. This is supported by the findings of (3), (18), and (5)

Farmers' main adaptation strategies

► **FIGURE 4: Farmers' main adaptation strategies in the study area**



The frequently used adaptation strategies in the study area were identified during FGD discussion and key informant interviews as well as during the HH survey. Adaptation strategies applied in the study area were not mutually exclusive because particular farmer uses different adaptation strategies together on a single plot of land. Some of the adaptation strategies identified in the study area were mentioned by many publications that were implemented in different parts of the country. The climate change adaptation strategies employed by households in the study area change in the cropping calendar, planting high-yielding varieties, diversifying income mostly into non-farm income sources, soil and water conservation (SWC) practices, use of small-scale irrigation, home garden agroforestry, and growing drought-tolerant crops were the main adaptation strategies in the study area by farmers.

Climate variability determines the potential agricultural yield of farmers. Climate variables are also important in determining what crops to grow and when they are planted (16). In the study area, about 57.5% of the farmers use shifts in planting dates of crops in response to climate change, and they use the strategy in different ways on different plots of land at different times. Mainly, farmers implement this measure when they are not sure about the starting period of rain, so they divide their land plot and sow/plant the crop at different times of the rainy season to maximize the probability of adaptation to climate change. Changing the planting dates and crop varieties (categorized under the agronomic adaptation strategies) were implemented and ranked as the primary adaptation respondents (4), and (11).

In the study area, to reduce their vulnerability to climate change, only 8.4 % of farmers use small-scale irrigation practices. This adaptation strategy was another option used by farmers, especially in the areas having access to a water source. Because most farmers agreed that rain becomes unpredictable, as a result, a few farmers use

irrigation for income diversification. Farmers also employed irrigation for crops that are planted/sowed during the beleg season (short rainy season) when the rain stops early or/and at the start of the keremt season (major rainy season) if the rain does not start early (17) and (8).

According to FGD and key informant interviews among the adaptation strategies implemented in the study area, one of the important strategies was planting high-yielding crop varieties. Farmers in the area also practiced using selected varieties of plantations to increase crop productivity under the stress of climate variability. About 59.6% of farmers use planting high-yielding varieties to increase the adaptive capacity of smallholder farmers in a way that can enhance productivity and incomes, the study by (1) and (9), supports this finding. The best strategies to cope with the changing climate were the implementation of using drought-tolerant crop varieties, as discussed during FGD and key informant interviews in the study area. About 31.5% of the respondents in this study area used this strategy for climate change adaptation, (11) finding support this study.

In response to climate change and variability, about 64.5% of farmers in the study area used soil and water conservation practices. Therefore, farmers mentioned that they used the SWC practices to reduce the loss of water and soil by runoff due to heavy rainfall. Farmers in the area applied soil bunds and terraces to reduce runoff, which brought sedimentation to their farm or eroded fertile topsoil from their farm. Practices like stone/soil bund, check dam, and related physical and biological land management practices were considered under this strategy, Similar to those (4) and (8) In the study area, farmers use diversification into non-farm activities as an adaptation strategy. They engaged in many activities as income diversification because crop production did not generate enough income to support their families as a consequence of climate change and variability. In the study area, about 46.5% of the respondents used diversification into non-farm activities as an adaptation strategy. Supported by (11).

Most farmers in the study area have a perception of climate change and its consequences on the farming system. The study showed that about 73.58% of farmers use home garden agroforestry practices for their agricultural production, which was used as an adaptation strategy. The adoption of agroforestry practices was used as an adaptation strategy to changing climate by farmers according to focus group discussions and key informant interviews, (11), (8), and (17) support this finding.

Conclusion and recommendations

Conclusion

From the study, it was concluded that the majority of the farmers in the study area have perceived changes in climate parameters such as rainfall, temperature, rainfall fluctuations, and extreme events like drought and flooding. In addition, there was a prolonged dry period, and decreasing rainfall was more frequent across the agroecologies in the district. Although there was a difference in a component's relative value across the two agroecological zones, the overall LVI indicates that farmers in lowlands were more vulnerable compared to midland agroecology. Farmers who were heavily dependent on agriculture to meet their food and livelihood were more affected by climate change. There are other indicators like poor infrastructure and land shortage, which were cited by farmers as a source of weak social capital in the study area. The study also summarized the differences in resilience and vulnerability level of agro-ecologies to climate variability and change, which resulted from a lack of community households' access to basic infrastructure, variations in livelihood strategies, low level of income source diversification, and lack of available technologies. In addition, the study identified the major climate change adaptation strategies employed by communities, such as changing the cropping calendar, planting high-yielding varieties, growing drought-resistant improved crop varieties, implementing soil and water conservation techniques, enhancing irrigation schemes, and income source diversification.

Recommendations

- Farmers perceive climate change as general but fail to understand individual weather events clearly, so providing weather information at a local level is critical with respective supplementary services.
- The key informants reported that lack of access to infrastructures (electricity, water resources, and health centers) was a major constraint that led farmers to become more vulnerable to climate change. Thus, there is a need for institutional support for the implementation of infrastructures like pipe water resources availability, health center accessibility, & access to electricity to cope with changing climate.
- Farmers in the lowland area were more vulnerable and less resilient to climate shocks than the midland community, so institutional support is needed by giving priority to coping with the changing climate.
- Based on the findings, decision-makers have to look away to provide critical inputs that can improve what farmers have already adopted adaption strategies for climate change and variability.
- In addition, policymakers and decision-makers have to look away from introducing new adaptation strategies and implementations.

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► **Évaluation des impacts sur l'emploi
du projet de réhabilitation de la
route Sénoba-Ziguinchor-Mpack et
de désenclavement des régions du
Sud**

Pamphile Sossa et Souleymane Mbaye

Remerciements

Les auteurs expriment leur reconnaissance à toutes les personnes ayant contribué à la réalisation de ce travail, en particulier aux travailleurs mobilisés sur les chantiers pour leur franche collaboration. Ils adressent également leurs remerciements aux personnes-ressources, dont la qualité de l'accueil et le soin apporté à répondre à toutes leurs interrogations ont été déterminants.

Nos remerciements s'adressent notamment à Codou Coly, Modou Diop (ZCCC), Fatoumata Seck (AREZKI), Lamine Sagna et Adama Badiane (CRSG), ainsi qu'à Yankhoba Thiam (SYNOHYDRO).

Le présent rapport a été relu avec soin par nos pairs Alioune Mané, Almamy Ndiaye et Ibrahima Lo, respectivement coordinateur, chargé environnementaliste et du suivi-évaluation à l'antenne de Ziguinchor de l'Agence des Travaux et de Gestion des Routes. Leur appui a facilité l'accès aux personnes-ressources des entreprises attributaires des différents lots.

Nous remercions par ailleurs Fidèle Ahouly Kouassi pour son précieux appui administratif.

Enfin, nous exprimons notre profonde gratitude à Mito Tsukamoto, cheffe de la branche Emploi dans les investissements (EMPINVEST/OIT), et à Ralf Krueger, conseiller technique principal du projet STRENGTHEN2, pour leurs conseils et orientations dans le cadre de la présente étude.

Ensemble, nous avons élaboré un rapport que nous espérons utile pour orienter les décisions d'investissement en faveur d'une croissance plus inclusive et sensible à l'emploi décent au Sénégal.

Ce rapport a été édité par Ahmadou Gaye.

Executive summary

The Employment Impact Assessment of the RN4 road investment project in Senegal — funded under STRENGTHEN2, a joint EU-ILO initiative — reveals significant job creation but also persistent deficits in job quality.

The project is estimated to have generated 8,877 jobs (1,660 direct and 7,217 indirect and induced)

Women account for 8.8% of the workforce, predominantly in low-skilled positions, while young people (aged 15–24) make up 20.7% of the workforce, below the national average (25.8%). Opportunities for training are limited, with only 10.9% of young workers benefiting from formal vocational training, and 70.8% employed in low-skilled jobs, resulting in a continued reliance on informal mechanisms for skills acquisition.

Wage levels remain modest: most workers earn between 100,000 and 200,000 CFA francs per month, working an average of 65 hours per week — 25 hours above the legal limit — reflecting a significant reliance on unpaid or poorly paid overtime.

In the context of a road project, the prevalence of fixed-term contracts (62.5%) is not surprising. However, it is concerning that 30.8% of respondents reported having no formal contract with their employer, working on the basis of verbal agreements without any social protection.

Even for workers with formal contracts, access to social protection remains limited: 44% have health insurance, 33% are covered by social security, and 30% have occupational accident coverage, with coverage significantly lower for young people and women.

Social dialogue is virtually non-existent: only 8.7% of surveyed workers are aware of a structure defending their rights. The main grievances relate to the absence of contracts, overtime management, non-compliance with wage scales, the payment of end-of-contract bonuses, and remuneration for public holidays.

In 2022, the mid-term evaluation estimated that two operational lots had generated 2,800 jobs, averaging 1,400 jobs per lot, while also revealing a significant decent work deficit. Two years later, with six lots in operation, this final evaluation estimates the impacts at 8,877 jobs (1,480 per lot), a modest increase of 80 jobs per lot. However, this quantitative increase has not been matched by qualitative improvement: job quality has remained unchanged, and in some cases, has even worsened.

These findings call for urgent reinforcement of compliance with labour legislation, by guaranteeing a formal contract for every worker, adherence to statutory working hours, and proper overtime compensation. It is recommended to establish measurable recruitment targets for youth and women, coupled with targeted training programmes tailored to the construction sector. Integrating a formal training component into infrastructure projects would help bridge the gap between informal learning and professional certification. Improving social protection coverage and establishing representative structures on construction sites would contribute to improve working conditions.

By systematically embedding employment impact assessments in investment projects and policies, while integrating measures to optimize the potential for decent job creation into public procurement, tender documents, and project management, infrastructure investments can be leveraged to generate not only higher volumes of employment, but also, more importantly, enhance job quality, in line with the ILO's goal of decent work for all.

Résumé exécutif

L'évaluation d'impact sur l'emploi du projet d'investissement routier RN4 au Sénégal — financé par STRENGTHEN2, une initiative conjointe UE-OIT — révèle une dynamique importante de création d'emplois importante, mais également des déficits persistants en matière de qualité de l'emploi.

D'après les résultats, le projet aurait généré 8 877 emplois (1 660 directs et 7 217 indirects et induits). Les femmes représentent 8,8 % des effectifs, occupant principalement des postes non qualifiés, tandis que les jeunes (15–24 ans) constituent 20,7 % de la main-d'œuvre, un taux inférieur à la moyenne nationale (25,8 %). Les opportunités de formation sont limitées : 10,9 % seulement des jeunes ont bénéficié d'une formation professionnelle formelle, et 70,8 % occupent des emplois non qualifiés. L'acquisition des compétences demeure donc largement informelle.

Les niveaux de rémunération restent modestes : la plupart des travailleurs gagnent entre 100 000 et 200 000 FCFA par mois, pour des semaines de travail atteignant en moyenne 65 heures — soit 25 heures de plus que la durée légale —, traduisant ainsi un recours important aux heures supplémentaires non payées ou mal rémunérées.

Pour un projet routier, la forte proportion de CDD (62,5 %) n'est pas surprenante. En revanche, il est préoccupant de constater que 30,8 % des personnes interrogées n'ont pas de contrat formel avec leur employeur, travaillant sur la base d'accords verbaux, sans aucune forme de protection sociale.

L'accès à la protection sociale, même pour des travailleurs disposant d'un contrat formel, reste limité : 44 % bénéficient d'une assurance maladie, 33 % de la sécurité sociale et 30 % d'une couverture en cas d'accident du travail. Ces taux sont sensiblement plus faibles pour les jeunes et les femmes.

Le dialogue social est quasi inexistant : seuls 8,7 % des travailleurs interrogés déclarent avoir connaissance d'une structure défendant leurs droits. Les principales revendications portent sur l'absence de contrats, la gestion des heures supplémentaires, le non-respect des grilles salariales, le paiement des primes de fin de contrat et la rémunération des jours fériés.

En 2022, l'évaluation à mi-parcours estimait à 2 800 le nombre d'emplois générés par deux lots opérationnels, soit en moyenne 1 400 emploi par lot, tout en révélant déjà un déficit substantiel en matière de travail décent. Deux ans plus tard, avec six lots opérationnels, la présente évaluation finale chiffre ces impacts à 8 877 emplois (1 480 par lot), soit une progression modeste de 80 emplois par lot. Cette hausse quantitative ne s'est toutefois pas traduite par une amélioration qualitative : la qualité des emplois est restée inchangée, et dans certains cas, s'est même dégradée.

Ces résultats mettent en évidence la nécessité urgente de renforcer l'application de la législation du travail, en garantissant un contrat formel à chaque travailleur, le respect des horaires légaux et le paiement des heures supplémentaires. Il est recommandé de fixer des objectifs chiffrés de recrutement de jeunes et de femmes, appuyés par des programmes de formation ciblés dans les métiers du BTP. L'intégration d'un volet de formation formelle dans les projets d'infrastructure permettrait de relier apprentissage informel et certification professionnelle. L'amélioration de la couverture sociale et la mise en place de structures représentatives sur les chantiers contribueraient à de meilleures conditions de travail.

En intégrant systématiquement les évaluations d'impact sur l'emploi dans les projets et politiques d'investissement, et en incorporant les mesures d'optimisation du potentiel de création d'emplois décents dans les marchés publics, les dossiers d'appel d'offres et la gestion des projets, nous sommes convaincus que les investissements en infrastructures pourront générer non seulement plus d'emplois, mais surtout des emplois de meilleure qualité, en ligne avec l'objectif de travail décent pour tous de l'OIT.

Introduction

Sur le plan démographique, le Sénégal se caractérise par la jeunesse de sa population, avec un âge médian de 19 ans (ANSD, 2024b). Au troisième trimestre de 2024, l'ANSD (2024a) estimait le taux d'emploi à 42,8 %, contre un taux de chômage élargi de 20,3 %. Par ailleurs, 34,1 % des jeunes âgés de 15 à 24 ans se trouvent dans la catégorie NEET, c'est-à-dire sans scolarisation, emploi ou formation.

Ainsi, l'un des défis majeurs auxquels le pays doit faire face demeure celui de l'insertion, aussi bien pour les jeunes que pour le cas spécifique des femmes. Ces dernières représentent en effet plus de la moitié de la population en âge de travailler, mais leur taux d'insertion (28,8 % selon l'ANSD) reste bien inférieur à celui des hommes (56,42 %). Face à cette situation, la création d'un nombre important d'emplois et de qualité devient une impérieuse nécessité¹.

Parmi les sources de création d'emplois, il y a les infrastructures, notamment routières. Dans une optique keynésienne, les dépenses publiques en infrastructures constituent non seulement un moyen pour relancer l'activité économique, mais également un levier pour atteindre le plein emploi². Les théories de la croissance endogène ont permis de faire le lien entre infrastructures et croissance économique. Hirschman (1958) met l'accent sur les effets d'externalité que les infrastructures diffusent au sein de l'économie³. Pour Barro (1990) et Barro et Sala-I-Martin (1992), les infrastructures publiques sont considérées comme le moteur de la croissance à long terme. De ce point de vue, les infrastructures routières occupent une place de choix grâce à leurs effets structurants. Non seulement elles assurent la continuité territoriale (rôle de désenclavement), mais elles constituent également un levier important de création d'emplois. C'est le cas notamment des projets d'infrastructures orientés sur l'emploi, plus connus sous l'appellation d'approche à « haute intensité de main-d'œuvre (HIMO) », qui mettent l'accent sur les emplois non qualifiés.

Dans le cadre de la coopération internationale, le gouvernement du Sénégal, via l'AGEROUTE, veut s'intéresser particulièrement à la maximisation des emplois générés, mais également à leur évaluation. C'est dans ce contexte qu'intervient le projet STRENGTHEN2, une initiative conjointe de l'Union européenne et de l'Organisation internationale du Travail (OIT).

La présente étude s'inscrit dans le cadre de cette initiative. Elle a pour objectif principal d'évaluer les emplois créés grâce aux investissements considérables consentis par l'Etat du Sénégal avec le concours de la Banque africaine de développement (BAD), de l'Union européenne (UE) et de la Banque européenne d'investissement (BEI) dans le projet SZM.

Le rapport s'ouvre sur une brève introduction, suivie d'une présentation du cadre d'intervention (section II). L'approche méthodologique adoptée est développée dans la section III, tandis que les principaux résultats de l'évaluation sont exposés dans la section IV, accompagnés d'une comparaison avec ceux de l'évaluation à mi-parcours réalisée en 2022. La section V offre une synthèse des conclusions, et la section VI formule des recommandations tirées des enseignements de l'étude et des contraintes rencontrées lors de la collecte des données. La bibliographie (section VII) et les annexes (section VIII) complètent le rapport.

¹ Selon l'ANPEJ, environ 200 000 nouveaux demandeurs d'emplois arrivent chaque année sur le marché du travail, alors que l'offre est estimée à environ 30 000 nouveaux emplois.

² Pour Keynes, le plein emploi correspond à l'absence de chômage volontaire.

³ Hirschman définit les infrastructures comme des « biens et services contribuant à l'activité productive ».

Cadre d'intervention

Description succincte du projet routier Sénoba-Ziguinchor-Mpack (SZM) ou RN4

Parties intégrantes de la Casamance naturelle, au sud du Sénégal, les régions administratives de Ziguinchor et de Sédhiou disposent d'un potentiel économique et naturel important, favorable à leur développement économique et social. Malgré cet atout, elles font partie des principales zones de fragilité du pays. Le conflit qui sévit dans cette partie sud du pays a causé la destruction de nombreuses infrastructures sociales et économiques, entraînant ainsi une faible exploitation de ce potentiel économique considérable, avec comme corollaire une dégradation notable du bien-être des populations.

C'est donc tout naturellement que l'État du Sénégal, avec l'appui de ses partenaires techniques et financiers (PTF), mène, depuis un certain nombre d'années, d'importantes initiatives pour redynamiser l'économie de ces deux régions (pénalisées par leur enclavement) et réduire la pauvreté et le chômage qui frappent une grande partie de la population. Parmi ces initiatives figure le projet de réhabilitation de la route Sénoba-Ziguinchor-Mpack et de désenclavement des régions du sud (plus connu sous le nom de projet RN4). Ce projet a pour objectif général de contribuer au renforcement de l'intégration et du commerce sous-régional et à la réduction des pertes de production alimentaires dans le secteur primaire, du fait du désenclavement des régions sud du Sénégal. De façon spécifique, le projet vise à améliorer le niveau de service de la route Sénoba-Ziguinchor-Mpack (à la frontière avec la Guinée Bissau), ainsi que l'accessibilité et les conditions de vie des populations dans la Zone d'Impact du Projet (ZIP), tout en levant une partie des obstacles à la circulation des biens et des personnes, en particulier les multiples contrôles et escortes douaniers.

Pour le financement du projet, l'État du Sénégal a sollicité l'assistance de ses PTF, dont la Banque africaine de développement (BAD), la Banque européenne d'investissement (BEI) et l'Union européenne. Le suivi de l'exécution du projet est assuré par l'Agence des Travaux et de Gestion des Routes (AGEROUTE).

Zone d'impact direct du projet

Les routes visées par ce projet sont situées précisément dans les départements de Bounkiling (région de Sédhiou), de Bignona et de Ziguinchor (région de Ziguinchor). Ensemble, ces trois départements forment la Zone d'impact direct du projet (ZIDP) qui couvre une superficie de 9 277,38 km², soit 4,72 % de la superficie du pays, et abrite une population de 756 296 habitants, soit près de 4,17 % de la population du Sénégal. L'axe routier Sénoba-Ziguinchor-Mpack traverse les trois départements, tandis que la boucle des Kalounayes (Tobor-Coubalan-Coubanao-Ouonk-Ndiéba), une sorte de ceinture, permet de relier plusieurs communes rurales du département de Bignona.

Présentation du projet STRENGTHEN 2

L'implication de l'OIT à travers le projet [STRENGTHEN 2](#)⁴ témoigne de l'importance accordée à la dimension « emplois décents » générés grâce aux investissements. À la suite de « STRENGTHEN 1 », également financée par l'UE, l'objectif global de la seconde phase est de « mener des études d'impact sur l'emploi pour promouvoir la création d'emplois à la fois nombreux et de qualité dans les pays d'Afrique subsaharienne ». Les deux secteurs d'investissement structurants/stratégiques visés par l'UE sont l'énergie et le transport. C'est cette dernière composante qui fait l'objet de la présente étude et de la mission qui nous a été confiée.

⁴ <https://www.ilo.org/projects-and-partnerships/projects/employment-impact-assessment-maximize-job-creation-africa>

Approche méthodologique

Collecte de données relatives aux emplois directs

Pour évaluer les emplois directs générés par le projet, l'AGEROUTE, avec l'aide de l'OIT, lors des travaux d'évaluation à mi-parcours, a mis à la disposition des entreprises attributaires un modèle de fiche de suivi mensuel des emplois. En effet, le volet suivi-évaluation du projet incluait déjà une composante « emploi », matérialisée par ces fiches destinées à recenser le nombre de personnes mobilisées dans les diverses activités du projet. Les entreprises attributaires ont l'obligation de les renseigner.

Toutefois, pour garantir une collecte de données plus exhaustive et conforme aux exigences du cahier des charges, une fiche complémentaire a été élaborée (fiche de collecte « Entreprises/sous-traitants » ou fiche « Emplois »). Cette fiche est destinée à recueillir directement, auprès des personnes-ressources, les informations relatives aux emplois créés, notamment leur répartition selon le genre, la catégorie socioprofessionnelle, le type et la durée des contrats, la couverture sociale des travailleurs, etc.

► Collecte de données auprès des travailleurs

Outre l'estimation des emplois directement créés par les entreprises attributaires et leurs sous-traitants, il est attendu du rapport l'identification des caractéristiques socio-économiques des travailleurs recrutés, des types d'emplois occupés, etc. L'accent est mis sur la notion d'emploi décent⁵, notamment en ce qui concerne les jeunes et les femmes.

► Questionnaire « travailleurs »

Pour ce faire, un questionnaire a été élaboré et validé par l'OIT. L'exploitation des fiches de suivi mensuel des emplois a permis de constituer une base de sondage regroupant l'ensemble des travailleurs actifs au moment de l'enquête. À la date du 10 décembre 2024, cette base comprenait 529 travailleurs répartis sur les six (6) lots du projet. À partir de cette population mère, un échantillon a été tiré sur la base de la formule détaillée en annexe.

Estimation des emplois indirects et induits

Outre les travailleurs et travailleuses que les titulaires des six (6) lots doivent directement recruter, l'exécution des marchés concernés nécessite l'approvisionnement en intrants essentiels à la réalisation des ouvrages, tels que le ciment, le fer, le béton, le sable et divers équipements. Ces intrants, commandés auprès d'entreprises tierces (« **effet demande** »), locales ou étrangères (importations), sont susceptibles de générer des emplois. On parle alors d'*emplois indirects*. Il convient dès lors de distinguer les approvisionnements réalisés localement de ceux issus des importations.

Les salaires versés aux travailleurs employés directement par les entreprises attributaires, ainsi qu'à ceux mobilisés dans le cadre de la fourniture d'intrants et d'équipements, génèrent une activité supplémentaire dans les secteurs de l'alimentation, du logement, des loisirs, des transports, etc. Cette dynamique engendre de nouveaux emplois par le biais des revenus supplémentaires qui sont partiellement réinjectés dans l'économie. On parle alors d'un « **effet revenu** ». Ces emplois générés par la demande de consommation des travailleurs constituent ce que l'on appelle les *emplois induits*.

⁵ Selon l'OIT, un emploi décent doit répondre aux critères suivants :

- Rémunération convenable (par rapport aux heures de travail)
- Sécurité sur le lieu de travail (EPI)
- Protection sociale pour la personne et sa famille (élargir la protection sociale)
- Perspective d'insertion sociale (formation, employabilité)
- Égalité de traitement, surtout hommes-femmes
- Dialogue social (défendre les droits des travailleurs)

L'outil le plus utilisé pour estimer ces emplois indirects et induits est la matrice « Input-Output »⁶ ou matrice « entrées-sorties ». Cet outil est d'inspiration keynésienne car il s'inscrit dans le cadre général de l'évaluation de l'impact des dépenses publiques. Historiquement, le modèle a été conçu par François Quesnay (1759) et développé par Wassily Léontief (1941). Il part du principe qu'il y a une interdépendance entre les différents secteurs de l'économie (la production d'un secteur est utilisée comme consommation intermédiaire pour produire un autre bien). La méthodologie est plus détaillée est annexe.

Collecte de données relatives aux caractéristiques socioéconomiques

Dans la mesure où le cahier des charges de l'étude prévoit des entretiens avec les principales personnes-ressources au niveau des entreprises attributaires et au niveau des travailleurs, nous avons inclus une dimension qualitative dans l'approche méthodologique. Il s'agit précisément des entretiens organisés avec les personnes-ressources⁷ et les travailleurs.

Outils et dispositifs de collecte de données

Pour chaque type d'enquête, un outil spécifique a été conçu pour recueillir les données dans les meilleures conditions. Ainsi, les outils de collecte suivants ont été utilisés après leur validation :

- La fiche « Entreprises/sous-traitants » pour les emplois directs ;
- La fiche « Structure des dépenses » fournie par l'OIT pour les emplois indirects et induits ;
- Un questionnaire pour l'enquête auprès des travailleurs ;
- Un guide d'entretien pour les personnes-ressources ;

Pour la collecte de données, l'application *Kobocollect* a été utilisée, permettant ainsi un suivi en temps réel du processus de collecte. Cette application a également été utilisée pour enregistrer directement les entretiens semi-directifs avec les personnes-ressources. Le logiciel SPSS a été utilisé pour traiter et analyser les données.

⁶ Manin Godfrey, *New approaches to employment planning*, OIT, 1996.

⁷ Il s'agissait pour l'essentiel des responsables des ressources humaines, des environnementalistes et des responsables genre qui sont au cœur de la politique de recrutement et de suivi des emplois, notamment sur les thématiques liées à l'emploi décent et à l'adéquation emploi-qualification.

Résultats de l'étude

Emplois directs exprimés en nombre de personne

À la date du 31 décembre 2024 (date initialement prévue pour la livraison des chantiers), soit presque 45 mois après le démarrage des premiers travaux avec le lot 4 (avril 2021), **1 660** emplois directs ont été créés par les entreprises titulaires des six (6) lots. Ces emplois directs sont répartis comme suit :

► **Tableau 1. Répartition par lot des emplois directs**

Lot	Effectifs
LOT 1 (AREZKI)	395
LOT 2 (CRSG)	160
LOT 3 (ZCCC)	376
LOT 4 (CRSG)	313
Piste lot 1	213
Piste lot 2	203
Total	1 660

Source : fiche de collecte emplois « Entreprises/sous-traitants »

Il s'agit pour l'essentiel d'emplois temporaires⁸ d'une durée de 6 mois renouvelable. Le temps de travail hebdomadaire est de 40 h, mais dans la pratique, il est largement dépassé car les résultats de l'enquête montrent que la durée moyenne est de plus de 65 h heures par semaine. En effet, certaines personnes, surtout celles dont les profils sont assez rares, travaillent très souvent tous les jours de la semaine.

Estimation des emplois indirects et induits

À partir de la MCS 2019 et des données sur la structure des dépenses contenues dans le tableau 2, la simulation de chocs sectoriels estime à 7 217 le nombre d'emplois indirects et induits.

► **Tableau 2. Structure des dépenses : national vs importations (en milliards de francs CFA)**

Produit/Service/Secteur	National	Importation	Total
Ciment, gravier, Béton, plâtre, etc.	17,844	2,186	20,030
Acier/fer	1,579	0,370	1,949
Produit pétrolier (Essence, Diesel) et gazier	12,156	0	12,156
Fils et câbles	0,232	0,094	0,326
Produits métalliques fabriqués (poteaux, colonnes, tubes)	0,971	0,084	1,056
Véhicules à moteur	0	10,413	10,413
Equipements de production d'électricité	0,261	0	0,261
Transport (maritime/terrestre/routier)	1,838	0	1,838
Location et/construction de bureau	0,544	0,281	0,825
Autres coûts	10,580	1,768	12,348

⁸ Selon la définition de l'OIT, l'emploi temporaire est un emploi « ... dans lequel les travailleurs sont engagés pour une période donnée, comprend les contrats conclus pour une durée déterminée, pour la réalisation d'une tâche ou d'un projet défini, le travail saisonnier ou le travail occasionnel, y compris journalier ».

Total	46,005	15,196	61,201
Total (%)	75 %	25 %	100 %

Source : fiche de collecte « Structure des dépenses »

Le projet pourrait générer jusqu'à 8 877 emplois : 1 660 directs et 7 217 indirects et induits. Ce potentiel quantitatif, bien que remarquable, doit toutefois s'accompagner d'emplois de qualité, critère prioritaire pour l'OIT et ses mandants.

Caractéristiques socioéconomiques des travailleurs et spécificités des emplois directs

Pour mieux comprendre les dynamiques à l'œuvre, une enquête a été menée auprès des travailleurs des 6 lots. Cette étude vise à identifier les caractéristiques socioéconomiques des travailleurs et certains aspects de la qualité des emplois directs créés.

► Place des jeunes dans le recrutement : au sens de l'OIT, les jeunes sont sous-représentés

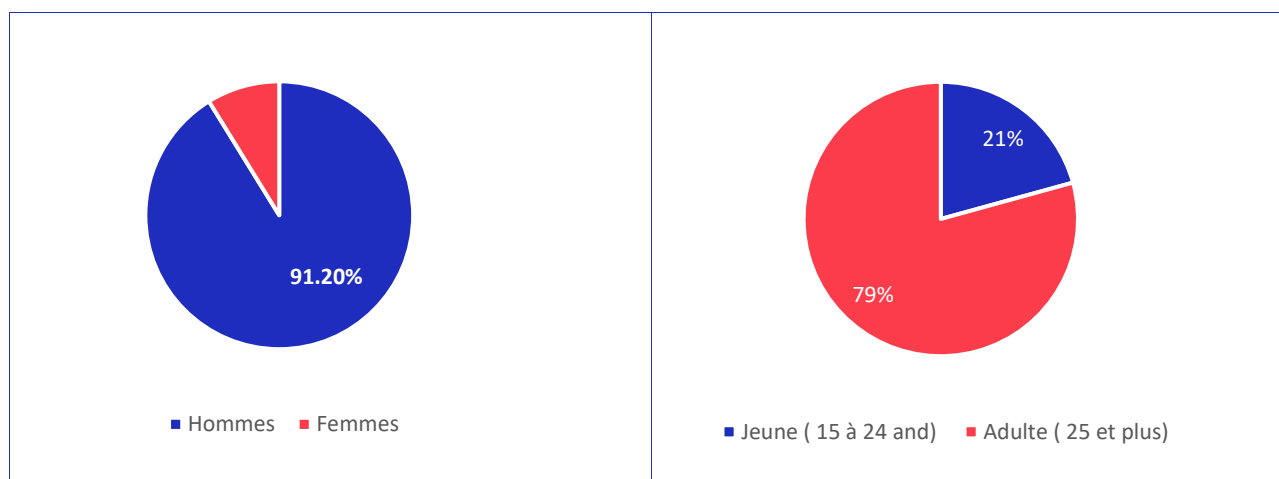
L'exploitation des fiches de collecte « Entreprises/sous-traitants » (fiches emplois) montre que sur les 1 660 travailleurs recrutés, seuls 344 ont entre 15 et 24 ans, soit **20,72 %** des employés, et donc moins que la moyenne nationale (25,8 %)⁹. Il faut noter que c'est au niveau de CRSG (31,25 % pour le lot 2 et 22,04 % pour le lot 4) que l'on retrouve le plus de jeunes. Cependant, c'est à AREZKI (82,28 %) et à SINOHYDRO pour le lot de pistes n°2 (82,27 %) où on a le personnel le plus âgé.

Toutefois, si on se base sur le critère retenu par la Charte de la jeunesse de l'Union africaine (15-35 ans), les jeunes représentent **45,54 %** des travailleurs recrutés. Ici également, 51,9 % des travailleurs chez AREZKI ont plus de 35 ans.

► Répartition des emplois par genre : les femmes sont peu représentées

Au niveau des fiches de collecte « Entreprises/sous-traitants », sur 1660 emplois, seuls 146 sont occupés par des femmes, soit un taux 8,80 %.

► Graphique 1. Répartition des emplois par sexe et par âge



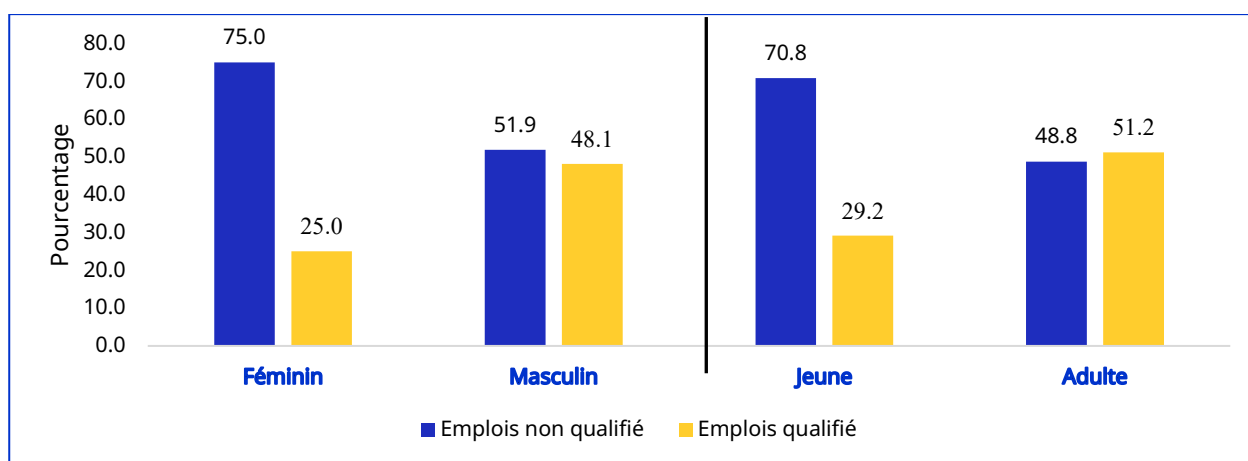
Source : fiches emplois « Entreprises-/sous-traitants »

⁹ ILOSTAT (Data explorer employment sex and age, 2022).

► **Les jeunes et les femmes en particulier occupent des emplois non qualifiés¹⁰**

Le graphique 2 révèle une forte concentration d'emplois non qualifiés parmi les femmes (75 %) et les jeunes (70,8 %), tandis que les postes qualifiés sont largement dominés par les hommes adultes, probablement en lien avec leur niveau d'instruction et de formation. Il importe donc de favoriser ou de soutenir les initiatives visant à promouvoir les formations professionnelles des jeunes et des femmes dans le secteur du BTP, en particulier sur les métiers des travaux routiers.

► **Graphique 2. Répartition des emplois selon la qualité de l'emploi et l'âge**



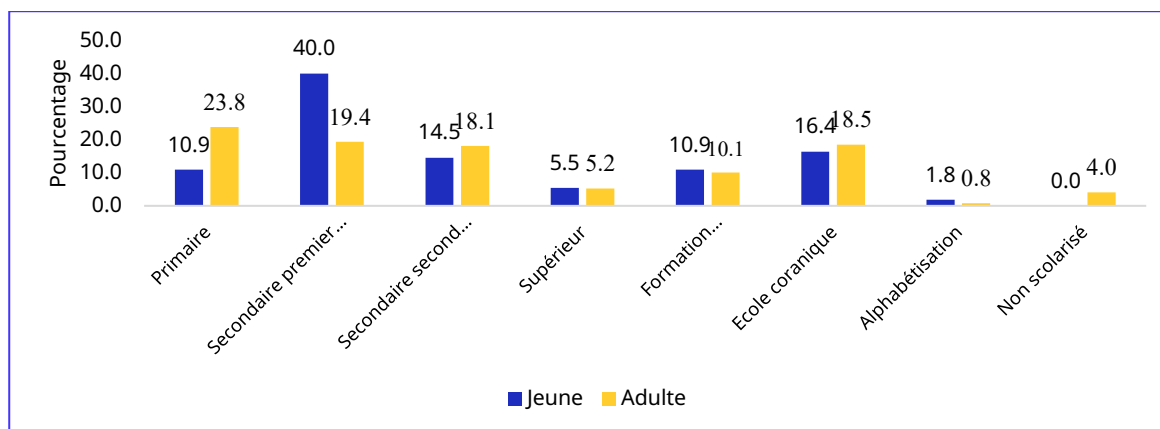
Source : enquête travailleurs

► **La moitié des jeunes ne dépasse pas le premier cycle du secondaire (niveau moyen)**

Bien que plus instruits que les adultes, de nombreux jeunes de la ZIDP restent cantonnés à des emplois non qualifiés, faute de formation technique adaptée. Près de 40 % s'arrêtent au premier cycle du secondaire, insuffisant pour accéder à des formations comme le BTS en BTP. Les entreprises locales, telles que CRSG, peinent ainsi à recruter des profils qualifiés et doivent parfois recourir à une main-d'œuvre externe. Le chargé du recrutement affirme : « [...] on a du mal à trouver des profils répondant à nos attentes. Les gens n'ont pas de qualification ; c'est difficile de trouver de la main-d'œuvre qualifiée au niveau local et parfois nous sommes obligés de faire appel à une main-d'œuvre hors de la ZIDP. Cette situation est liée à un manque de formation de la plupart des jeunes de ces localités. Il est difficile de trouver, au niveau local, des topographes, des laborantins, des conducteurs d'engins, etc. ».

¹⁰ Pour mieux saisir les dynamiques en termes socioprofessionnels, les différents métiers ont été regroupés en 6 catégories : Cadres supérieurs et ingénieurs, Employés, techniciens et agents de maîtrise, Ouvriers qualifiés et contremaîtres, Manœuvres et ouvriers spécialisés, Agents de propreté et agents de sécurité, Autres (aide cuisinier, etc.). Les trois premières catégories correspondent à des emplois qualifiés et les trois dernières des emplois non qualifiés

► **Graphique 3. Niveau d'étude selon l'âge**



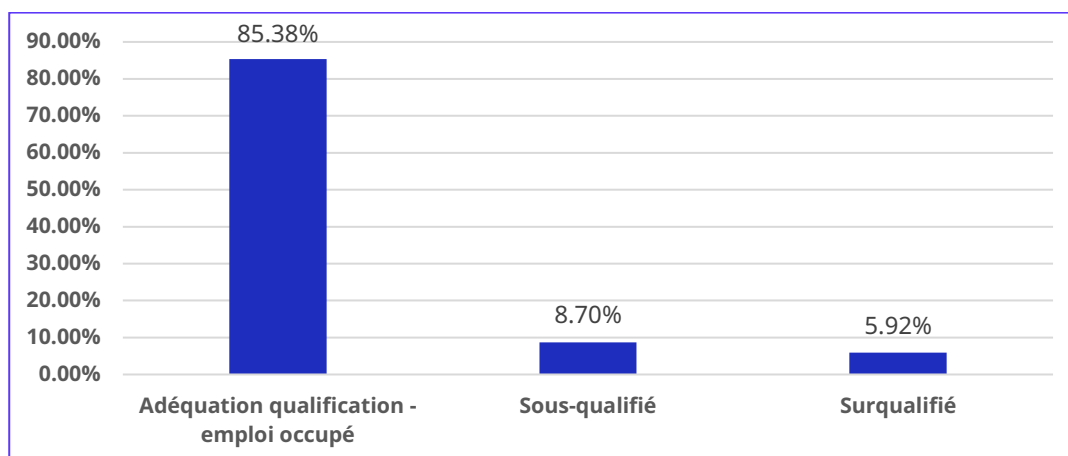
Source : enquête travailleurs

► **Adéquation qualification-emploi occupé**

Comme souligné plus haut, la plupart des travailleurs ont été formés dans un cadre informel. Dans ce système, on débute avec le statut d'apprenti pendant un certain nombre d'années au cours desquelles on acquiert au fur et à mesure des compétences pratiques dans le métier considéré. Le processus peut aboutir au statut de maître-artisan, après celui de compagnon qui confère déjà un certain niveau de qualification. En principe, c'est sur la base de ces compétences que la plupart des travailleurs du projet sont recrutés.

Par conséquent, la grande majorité des travailleurs enquêtés (85,38 %, n = 216) estiment que les postes qu'ils occupent sont en adéquation avec les compétences acquises, qualification très souvent obtenue à l'issue d'une formation sur le tas.

► **Graphique 4. Adéquation qualification acquise et emploi occupé**



Source : enquête travailleurs

Les travailleurs s'estimant en situation de sous-qualification (8,7 % n = 22, dont 6 jeunes sur les 22, soit 27,27 %) occupent tous des emplois temporaires non qualifiés, principalement en tant que manœuvres, paveurs ou applicateurs d'enrobés. Aucun d'entre eux n'a suivi de formation professionnelle, mais tous expriment le souhait de recevoir une formation formelle, notamment dans la fabrication et la pose de pavés ou comme conducteurs de tractopelle, de chargeuse, d'engin Poclain (pelle hydraulique), etc.

Place de l'emploi décent : une forte précarité des situations

Pour rappel, selon l'Organisation internationale du Travail (OIT), un travail décent est un « emploi qui fournit un revenu permettant un niveau de vie décent, dispose de conditions de travail correctes, respecte les normes internationales sur le droit du travail et donne aux travailleurs (euses) la possibilité de s'inscrire dans un dialogue social pour défendre leurs droits et leurs intérêts ».

De façon spécifique, les piliers du travail décent sont donc :

- une rémunération convenable
- la sécurité sur le lieu de travail
- la protection sociale pour la personne et sa famille
- une perspective d'insertion sociale (formation, employabilité)
- l'égalité de traitement
- le dialogue social (défendre les droits des travailleurs)

C'est donc sous cet angle que nous avons analysé les données collectées.

En termes de rémunération, les jeunes (hommes et femmes) ont une situation moins favorable

En matière de rémunération, la majorité des travailleurs interrogés (62,8 %) perçoivent un salaire compris entre 100 000 et 200 000 FCFA, à peine au-dessus du SMIG¹¹ mensuel. Dans la tranche de 50 000 à 100 000 FCFA, 69 % sont des travailleurs non qualifiés, tandis que dans celle au-delà de 500 000 FCFA — catégorie représentant seulement 0,4 % de l'échantillon —, tous les employés sont qualifiés. Dans la fourchette de 200 000 à 500 000 FCFA, on observe la présence de travailleurs non qualifiés (35 %). Ceux-ci compensent souvent la faiblesse de leur salaire de base en travaillant plus de 50 heures par semaine, y compris le week-end. Il faut également noter que certains sont rémunérés sans contrat de travail ni bulletin de salaire.

L'analyse des salaires, confrontée aux normes et standards du travail, met en évidence un déficit marqué en matière de travail décent. Une part importante des travailleurs, notamment les non qualifiés, perçoit une rémunération à peine supérieure au minimum légal, souvent sans protection (contrat formel de travail) ni bulletin de paie, et au prix d'horaires excessifs. Cette situation traduit un écart significatif par rapport aux critères fondamentaux du travail décent définis par l'OIT.

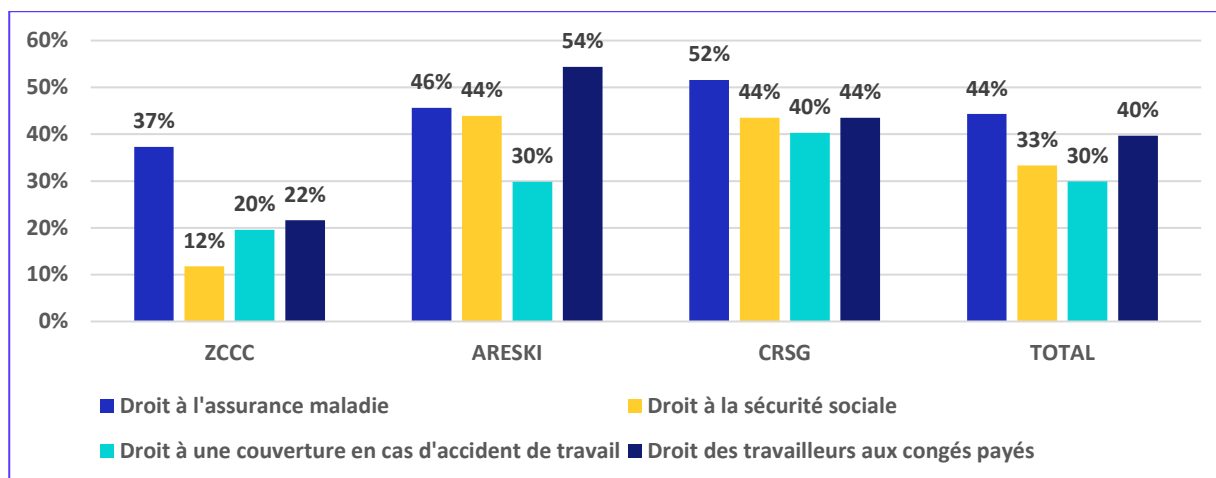
Il convient donc d'assurer de meilleures conditions de travail et de vie aux travailleurs sur les chantiers d'infrastructures routières en faisant respecter les législations nationale et internationale sur le droit du travail. Des visites sur le terrain doivent régulièrement être effectuées par l'inspection du travail de chaque localité concernée.

Protection sociale : une couverture plus faible pour les jeunes et les femmes

Dans toutes les entreprises que nous avons visitées, les responsables nous ont expliqué que tous les travailleurs titulaires de contrats en bonne et due forme jouissent d'une couverture complète. C'est la raison pour laquelle les travailleurs employés sur la base d'un accord verbal ont été exclus de l'échantillon analysé. Malgré ce filtre, il ressort de la déclaration des travailleurs interrogés que 44 % d'entre eux ont droit à l'assurance, 33 % à la sécurité sociale (allocation familiale), 30 % à une couverture en cas d'accident de travail et 40 % à des congés payés. Ces statistiques sont reflétées dans le graphique 5 ci-dessous.

¹¹ Le Salaire Minimum Interprofessionnel Garanti (SMIG) au Sénégal est de 64 223 FCFA par mois

► **Graphique 5. Les différents niveaux de couverture sociale**



Source : enquête travailleurs

AREZKI, emploie un plus grand nombre de travailleurs permanents et CRSG fait plus d'effort à ce niveau. À l'instar d'AREZKI, ZCCC dispose d'une infirmerie sur la base de chantier où les premiers soins peuvent être assurés. Toutefois, le renouvellement du stock de médicaments est souvent problématique. Les médicaments achetés dans les officines privées sont en principe remboursés, mais tous les travailleurs ne profitent pas pleinement du système d'assurance maladie (IPM), bien que les cotisations soient prélevées sur leurs salaires. Chez SINOHYDRO, aucun travailleur n'a déclaré disposer d'une quelconque couverture.

► **Dialogue social : les travailleurs sont globalement insatisfaits.**

Dans une organisation (entreprise, administration, etc.), le dialogue social contribue à instaurer un climat de travail apaisé, propice à l'engagement et à la performance, en favorisant des conditions de travail adéquates. Il repose souvent sur des échanges réguliers entre les décideurs et les représentants du personnel, notamment les syndicats de travailleurs. Ce dialogue social peut prendre plusieurs formes, comme la négociation, la communication d'informations, y compris lors de réunions ou par courrier, la consultation (ex : boîte à idées), etc.

Pour le projet qui nous concerne, les résultats de l'enquête travailleurs ont montré que pour l'ensemble des entreprises, le moyen de communication privilégié est le contact direct individuel. Il est cité par 76,5 % des employés interrogés au niveau de CRSG, 76,2 % de ceux de SINOHYDRO, et 51,7 % des travailleurs interrogés à AREZKI. Les dirigeants de l'entreprise ZCCC recourent davantage aux réseaux sociaux que ceux des autres entreprises.

À la question de savoir s'il existe une structure chargée de défendre les droits de travailleurs, seuls 8,7 % (n=22) des personnes interrogées ont répondu par l'affirmative. Au sein des entreprises, on peut remarquer que les employés interrogés à ZCCC sont mieux informés sur cette question.

Globalement seuls 18,6 % des employés interrogés sont satisfaits du dialogue social. Selon les entreprises, cette proportion s'élève à 23,3 % pour AREZKI, 17,6 % pour CRSG, 11,1 % pour ZCCC.

Sur tous les chantiers où des enquêtes ont été réalisées, les travailleurs se considèrent comme des laissés-pour-compte. Il n'existe pas réellement de cadre adéquat leur permettant d'exprimer leurs revendications.

Les points de tension tournent souvent autour de la question des contrats (beaucoup de travailleurs sont sans contrat alors qu'ils sont payés à la fin du mois), du système de pointage des heures de travail et donc des heures supplémentaires, du non-respect des grilles salariales (avec l'absence de différenciation par échelon), des modalités de paiement des 7 % dus en fin de contrat, souvent impactés par les arrêts de travail (notamment pendant la période hivernale), et de la rémunération des jours fériés.

Conclusion et recommandations

Conclusion

Le projet de réhabilitation de la route nationale SZM et de désenclavement du Sud présente un potentiel de création estimé à 8 877 emplois (1 660 directs et 7 217 indirects ou induits). Toutefois, des déficits persistent en matière d'inclusion, de qualité des emplois et de protection sociale.

La participation des femmes (8,8 %) et des jeunes (20,7 %) demeure limitée, ces derniers disposant souvent de qualifications insuffisantes pour répondre aux besoins des entreprises.

Les conditions de travail observées mettent en évidence un déficit marqué en matière de travail décent : rémunérations souvent modestes, faible accès à la protection sociale et horaires excessifs.

Si les impacts positifs sur la création d'emploi, la mobilité et le commerce sont indéniables, la promotion du travail décent dans les projets d'investissement requiert un cadre institutionnel solide, garantissant le respect des normes nationales et internationales du travail, ainsi que le développement de formations adaptées aux besoins du secteur routier.

Les recommandations ci-dessous visent à faire des projets et politiques d'investissement de véritables leviers de création d'emplois décents pour toutes et tous au Sénégal.

Recommandations opérationnelles et politiques

► Recommandation politiques

- 1. Institutionnaliser l'évaluation d'impact sur l'emploi (EmpIA) :** Intégrer systématiquement les évaluations d'impact dans la conception et la mise en œuvre des projets d'infrastructures, ainsi que dans les marchés publics, afin d'optimiser la création d'emplois décents.
- 2. Intégrer le travail décent dès la planification :** Introduire explicitement la dimension emploi et travail décent dans les études de faisabilité, et organiser des conférences d'entreprises pour sensibiliser les soumissionnaires aux enjeux pro-emploi des investissements.
- 3. Renforcer la législation et son application :** Garantir à chaque travailleur un contrat formel, le respect des heures légales, le paiement des heures supplémentaires et des mécanismes de contrôle renforcés.
- 4. Améliorer la protection sociale :** Étendre la couverture santé, la sécurité sociale et la protection contre les accidents du travail, avec une attention particulière aux travailleurs vulnérables.
- 5. Renforcer les capacités institutionnelles :** Investir dans le développement des compétences techniques et organisationnelles des institutions nationales et locales pour mieux intégrer le travail décent dès la conception des projets.
- 6. Mettre en place un comité mixte tripartite :** Créer un comité réunissant l'État, les travailleurs et les employeurs, chargé de suivre la conformité des projets.

► Recommandations opérationnelles

- 7. Favoriser l'inclusion des jeunes et des femmes :** Définir des objectifs chiffrés de recrutement et développer des programmes de formation ciblés pour leur insertion dans le secteur de la construction.
- 8. Développer la formation professionnelle :** Intégrer des volets de formation qualifiante dans les projets d'infrastructures, afin de professionnaliser l'apprentissage informel.
- 9. Renforcer le dialogue social sur les chantiers :** Mettre en place des structures représentatives favorisant la concertation et la défense des droits des travailleurs.
- 10. Renforcer la coordination locale :** Accroître la collaboration entre autorités locales, partenaires techniques et acteurs communautaires pour une meilleure mise en œuvre des approches à haute intensité de main-d'œuvre (HIMO).

- 11. Impliquer les collectivités territoriales** : Associer davantage les collectivités dans la planification et le suivi des interventions HIMO, notamment à travers leur intégration dans les plans communaux de développement.
- 12. Sensibiliser les autorités locales et regionals** : Former et mobiliser les maires et élus locaux pour l'intégration systématique des EmpIA et des approches HIMO dans les documents de planification.

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Annexe

► **Tableau 3. Attributaires des six (6) lots et répartition du coût du projet**

Lot	Attributaire	Montant HT (FCFA)	Montant TTC (FCFA)
Sénoba-PK40 (lot1)	AREZKI	13 530 853 251	16 184 283 146
PK40-PK80 (lot2)	CRSG	14 068 921 147	17 144 766 068
PK80-Mpack (lot3)	ZCCC	27 738 975 449	32 899 720 949
Kalounayes (lot4)	CRSG	15 519 485 896	19 014 342 949
Lot de piste 1	SINOHYDRO	2 219 416 641	2 618 911 637
Lot de piste 2	SINOHYDRO	2 120 604 312	2 502 313 159
TOTAL		75 198 256 696	90 364 337 908

Source : fiche de collecte emplois « Entreprises/sous-traitants »

► **Tableau 4. Répartition des travailleurs (emploi direct) selon le lieu de résidence habituelle (en %)**

	Employeur					Total
	ZCCC	ARESKI	CRSG ¹²	SINOHYDRO	Autres (sous-traitants)	
Bignona	54,0 %	16,7 %	56,5 %	61,9 %	58,3 %	47,0 %
Boukiling		10,0 %	11,8 %		4,2 %	6,7 %
Dakar	1,6 %	3,3 %	3,5 %			2,4 %
Diourbel	4,8 %					1,2 %
Fatick	1,6 %	1,7 %	1,2 %			1,2 %
Kaffrine				4,8 %		0,4 %
Kaolack	3,2 %	3,3 %	3,5 %	19,0 %	4,2 %	4,7 %
Kédougou			3,5 %			1,2 %
Kolda	3,2 %	13,3 %				4,0 %
Louga	3,2 %	1,7 %				1,2 %
Matam	1,6 %	1,7 %				0,8 %
Saint Louis			4,7 %	4,8 %	4,2 %	2,4 %
Sédhiou	4,8 %	13,3 %	3,5 %			5,5 %
Tambacounda		1,7 %	1,2 %			0,8 %
Thiès	4,8 %	3,3 %	2,4 %		12,5 %	4,0 %
Ziguinchor	15,9 %	23,3 %	2,4 %	4,8 %	4,2 %	11,0 %
Guinée Bissau		3,3 %	1,2 %		12,5 %	2,4 %
Mali	1,6 %		4,7 %			2,0 %
Gambie		1,7 %		4,8 %		0,8 %
Côte d'Ivoire		1,7 %				0,4 %
Total	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %	100,0 %

Source: enquête travailleurs

¹² Les travaux du Lot 4 étant quasiment terminés (seuls 22 travailleurs actifs en décembre 2024), nous avons fusionné les deux (2) lots de CRSG.

► Échantillonnage

À partir de cette population mère, un échantillon a été tiré sur la base de la formule suivante¹³ :

$$n = \frac{Z_{(1-\frac{\alpha}{2})}^2 * N}{Z_{(1-\frac{\alpha}{2})}^2 + (2 * e)^2 * (N - 1)}$$

Avec : n = taille de l'échantillon ; e = marge d'erreur ; N = taille de la population (N = 529) et $Z_{(1-\alpha/2)}$ = quantile de la loi normale d'ordre 1-alpha/2.

Ainsi, un échantillon de 223 personnes a été obtenu. En appliquant une marge de + 10 %, on obtient une taille de 245 travailleurs à enquêter, que nous avons finalement fixée à 250 personnes. Pour tenir compte du poids de chaque entité, un échantillonnage stratifié proportionnelle aux effectifs des entreprises a été réalisé, comme le montre le tableau ci-après :

► **Tableau 5. Répartition de l'échantillon par lot**

Lot	Nombre de travailleurs à enquêter
Lot 1 : AREZKI	69
Lot 2 : CRSR RN4	71
Lot 3 : ZCCC	76
Lot 4 : CRSR - Kalounayes	11
Lots 1 et 2 Pistes : SINOHYDRO	23
Total	250

Source : fiche de collecte emplois « Entreprises/sous-traitants »

Le tirage de l'échantillon s'est fait de manière aléatoire dans chaque strate sur la base des listes des travailleurs actifs fournies par les entreprises. Finalement, 253 travailleurs ont été enquêtés directement sur les chantiers.

► Estimation des emplois indirects et induits.

Le tableau 6 donne un aperçu de ces liaisons à partir d'un exemple sur trois (3) secteurs.

► **Tableau 6. Structure du tableau entrées-sorties**

Entrée		Sortie	Demande intermédiaire			Demande finale	Importations	Production nationale totale
			Production des secteurs					
			1	2	3			
Consommation intermédiaire	Production des secteurs	1	X11	X12	X13	F ₁	−M ₁	X ₁
		2	X21	X22	X23	F ₂	−M ₂	X ₂
		3	X31	X32	X33	F ₃	−M ₃	X ₃
Facteurs de production primaires			V ₁	V ₂	V ₃			
Total des entrées			X ₁	X ₂	X ₃			

Source : OIT, 1996

¹³ <https://fr.checkmarket.com/calculateur-taille-echantillon/>

Dans ce tableau, le secteur de production 1 achète des intrants intermédiaires aux secteurs de production 2 et 3, mais également à lui-même (intra-consommation) (X11, X21, X31). Sa production est X1 et la valeur ajoutée créée est constituée des paiements issus de la vente des consommations intermédiaires aux autres secteurs (V1). En ligne, le tableau présente les ventes intermédiaires par produit, réparties entre les différents secteurs de production. Compte tenu de cette interdépendance, tout accroissement de la production d'un secteur se traduit par une augmentation des consommations intermédiaires des différents produits, c'est-à-dire par une demande supplémentaire qui doit être, elle aussi, satisfaite par un accroissement de la production de ces secteurs. De cette manière, la matrice permet notamment d'étudier l'impact d'une variation de la demande finale d'un produit sur l'ensemble du système de production.

Si l'on suppose que les coefficients des intrants (y compris la main-d'œuvre) par rapport à la production sont fixes, il est possible d'utiliser cette structure pour déduire les implications, sur l'emploi, des variations de la demande finale.

Pour pouvoir évaluer les emplois indirects et induits générés par ce projet, les différentes entreprises attributaires des six (6) lots ont été sollicitées pour connaître la répartition de leurs dépenses en fournitures divers (ciment, gravier béton, fer, carburant, électricité, etc.), équipement (véhicules, matériel de bureau, matériel informatique, etc.), main-d'œuvre, etc. Cela s'est fait à travers la fiche « Structure des dépenses » envoyée à chacune d'elles.

► **Tableau 7. Répartition des emplois directs selon le lieu de résidence habituelle**

Localité	Nombre d'emplois	En %
Bignona	780	47,00%
Boukiling	111	6,70%
Dakar	40	2,40%
Diourbel	20	1,20%
Fatick	20	1,20%
Kaffrine	7	0,40%
Kaolack	78	4,70%
Kédougou	20	1,20%
Kolda	66	4,00%
Louga	20	1,20%
Matam	13	0,80%
Saint Louis	40	2,40%
Sédhiou	91	5,50%
Tambacounda	13	0,80%
Thiès	66	4,00%
Ziguinchor	183	11,00%
Guinée-Bissau	40	2,40%
Mali	33	2,00%
Gambie	13	0,80%
Côte d'Ivoire	6	0,40%
Total	1660	100%

Source : fiche de collecte emplois « Entreprises/sous-traitants »

► **Tableau 8. Liste des personnes-ressources**

Lot	Prénom	Nom	Fonction
LOT - ARESKI	Fatoumata	Seck	Environnementaliste
	Ibrahima	NDIAYE	Responsable des ressources humaines
LOT 2 - CRSG	Adama	BADIANE	Assistant RH
	Fidèle	DIATTA	Environnementaliste
	Khardiatou	BADIANE	Responsable genre et social
LOT 3 - ZCCC	Codou	COLY	Environnementaliste
	Modou	DIOP	Responsable administratif et financier (Staffrica intérim)
LOT 4 CRSG	Lamine	SAGNA	Responsable administratif et financier (Staffrica intérim)
LOT 1 et 2 Pistes SINOHYDRO	Yankhoba	THIAM	Environnementaliste

Source : fiche de collecte emplois « Entreprises/sous-traitants »

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