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► Employment impact assessment of the Bwanje Valley Irrigation Scheme, Malawi

Co-funded by the
European Union



► **Employment Impact Assessment of the Bwanje Valley Irrigation Scheme, Malawi**

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Acronyms and abbreviations

BVIS	Bwanje Valley Irrigation Scheme
BVIMC	Bwanje Valley Irrigation and Marketing Cooperative
DiD	Difference-in-Differences
EmplA	Employment Impact Assessment
EU	European Union
FGD	Focus Group Discussion
GIS	Geographic Information Systems
GoM	Government of Malawi
IHPS	Integrated Household Panel Survey
IHS	Integrated Household Survey
ILO	International Labour Organization
MWK	Malawian Kwacha
JICA	Japan International Cooperation Agency
KIIs	Key Informant Interview
LSWI	Land Surface Water Index
NDVI	Normalized Difference Vegetation Index
NSO	National Statistical Office
SME	Small and Medium Enterprise
WFP	World Food Programme
WUA	Water Users Association

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Executive summary

This report presents an ex-post employment impact assessment (EmPIA) of the Bwanje Valley Irrigation Scheme (BVIS) in Dedza District, Malawi. The assessment was conducted under the STRENGTHEN2 project, a joint initiative of the European Union (EU) and the International Labour Organization (ILO), which aims to maximize the use of EmPIAs to promote the creation of more and better jobs through infrastructure investments in sub-Saharan Africa. The BVIS is one of Malawi's largest public irrigation schemes, this assessment focuses on the employment and agricultural productivity effects within the BVIS following the completion of the EU-financed Bwanje Valley Dam in 2019, which expanded water storage capacity and enabled more reliable dry-season irrigation across the scheme.

The EmPIA adopts a mixed-methods approach to capture long-term changes in agricultural activity employment and livelihoods. Econometric analysis based on household survey data was used to assess early labour market outcomes following completion of the dam. Satellite-based remote sensing analysis examined changes in irrigated area and vegetation productivity over time. Qualitative fieldwork, including focus group discussions, key informant interviews and case studies, provided insights into employment effects, scheme governance, labour arrangements, gender dynamics and livelihood impacts.

The econometric analysis compares labour market outcomes in Dedza District before the completion of the dam and in the short period following its completion in 2019, to those in a neighbouring rain-fed district, using a difference-in-differences framework. Given the limited post-intervention period currently available in household survey data, the results capture early adjustments rather than long-term impacts. The findings indicate no statistically significant change in overall employment following the completion of the dam. However, the analysis identifies a statistically significant increase in agricultural labour intensity, with farmers working more hours in agriculture relative to the comparison district.

Satellite-based analysis provides clear evidence of changes in agricultural activity within the scheme following the completion of the dam. Dry-season irrigated area within BVIS expanded substantially after 2019, increasing from 25 per cent of the command area¹ to approximately 92 per cent of the command area receiving irrigation at some point during the dry season in 2025. Vegetation productivity, proxied by the Normalized Difference Vegetation Index (NDVI), improved within the scheme and outperformed comparable rain-fed control areas, increasing by approximately 25 per cent during the dry season compared to the controls. These results suggest that improved water reliability was associated with both an expansion of cultivated area and improved vegetation condition during the dry season. These findings are consistent with external evidence reporting increased dry-season utilization of irrigable land following completion of the dam. The analysis reveals declines in irrigated area in recent years, suggesting a need to rehabilitate irrigation infrastructure.

Fieldwork evidence shows that the scheme supports employment by increasing labour intensity and extending the agricultural season for farmers. In the absence of a formal baseline for pre-intervention employment within the scheme prior to dam construction, qualitative evidence suggests that livelihoods were previously centred on rain-fed, single-season subsistence agriculture with limited opportunities for paid work. The scheme currently involves 2,067 farmers across 14 villages, with women representing 53 per cent of participants. The fieldwork suggests that the scheme supports approximately 7,500 seasonal jobs during the dry season, primarily through casual agricultural labour. Employment generated through the scheme is primarily in the form of own-account and family-based agricultural work, complemented by seasonal hired labour during land preparation, transplanting, weeding and harvesting. Farmers reported that improved dry-season water availability following the completion of the dam has increased the number of days and hours worked in agriculture each year. Hired labour is predominantly low-skilled and informal, with youth commonly engaged in physically demanding tasks, while a smaller number of semi-skilled roles have emerged related to water management and processing. In addition, the scheme has supported indirect employment along the rice value chain.

Overall, the assessment finds that the BVIS has begun to generate positive employment and livelihood effects by enabling more reliable dry-season cultivation and increasing agricultural labour demand. However, employment outcomes remain constrained by low job quality, scheme governance challenges, uneven water distribution and limited market access. To strengthen and sustain employment impacts, priority should be given to improving scheme governance and water management, strengthening compliance with labour standards and minimum wage regulations, expanding cooperative marketing and value-chain development, and supporting skills development and small enterprise growth in areas such as agri-processing, transport and input supply. Promoting inclusive participation of women, youth and persons with disabilities within trainings will be key to support inclusion. These measures will be particularly important as the scheme prepares for its Phase II expansion, providing an opportunity to maximize the decent work potential of irrigation investments in Malawi.

¹ The total land region that can be reliably served and cultivated using water from a specific source, such as a dam, reservoir, or canal system.

Résumé exécutif

Ce rapport présente une évaluation ex post de l'impact sur l'emploi (EmplA) du système d'irrigation de la vallée de Bwanje (Bwanje Valley Irrigation Scheme - BVIS) dans le district de Dedza, au Malawi. Cette évaluation a été réalisée dans le cadre du projet STRENGTHEN2, une initiative conjointe de l'Union européenne (UE) et de l'Organisation internationale du travail (OIT) visant à maximiser l'utilisation des EmplA afin de promouvoir la création d'emplois plus nombreux et de meilleure qualité grâce aux investissements dans les infrastructures en Afrique subsaharienne. Le BVIS est l'un des plus grands systèmes publics d'irrigation du Malawi. L'évaluation examine les effets sur l'emploi et la productivité agricole à la suite de l'achèvement du barrage de la vallée de Bwanje en 2019, financé par l'Union européenne, qui a augmenté la capacité de stockage d'eau et permis une irrigation plus fiable pendant la saison sèche.

L'EmplA adopte une approche méthodologique mixte afin d'analyser les évolutions à long terme de l'activité agricole, de l'emploi et des moyens de subsistance. Une analyse économétrique basée sur des données d'enquêtes auprès des ménages a été utilisée pour évaluer les premiers résultats sur le marché du travail après l'achèvement du barrage. Une analyse par télédétection satellitaire a examiné les changements dans les superficies irriguées, la productivité de la végétation au fil du temps. En complément, des travaux de terrain qualitatifs, incluant des discussions de groupe, des entretiens avec des informateurs clés et des études de cas, ont permis de mieux comprendre les effets sur l'emploi, la gouvernance du système, les modalités de travail, les dynamiques de genre et les impacts sur les moyens de subsistance.

L'analyse économétrique compare les résultats du marché du travail dans le district de Dedza avant l'achèvement du barrage et dans la période suivant son achèvement en 2019 à ceux d'un district voisin dépendant de l'agriculture pluviale, en utilisant une méthode de différences-en-différences. Compte tenu de la période post-intervention encore limitée dans les données disponibles, les résultats reflètent des ajustements initiaux plutôt que des impacts à long terme. Les conclusions n'indiquent pas de changement statistiquement significatif dans l'emploi global après l'achèvement du barrage. En revanche, l'analyse met en évidence une augmentation statistiquement significative de l'intensité du travail agricole.

L'analyse par satellite apporte des preuves claires de changements dans l'activité agricole au sein du système après l'achèvement du barrage. La superficie irriguée pendant la saison sèche dans le BVIS a fortement augmenté après 2019, passant de 25 % de la zone commandée à près de 92 % de la superficie irriguée à un moment donné pendant la saison sèche en 2025. La productivité de la végétation pendant la saison sèche, mesurée par l'indice de végétation par différence normalisée (NDVI), s'est également améliorée au sein du système et a dépassé celle des zones de contrôle comparables dépendant de l'agriculture pluviale, avec une augmentation d'environ 25 % pendant la saison sèche. Ces résultats suggèrent que l'amélioration de la fiabilité de l'approvisionnement en eau a permis à la fois une expansion des superficies cultivées et une amélioration de l'état de la végétation. L'analyse révèle un recul des superficies irriguées ces dernières années, ce qui souligne la nécessité de réhabiliter les infrastructures d'irrigation.

Les données issues des travaux de terrain montrent que le système soutient l'emploi principalement en augmentant l'intensité du travail et en prolongeant la saison agricole. En l'absence de données de référence formelles sur l'emploi avant l'intervention, le système concerne actuellement environ 2 067 agriculteurs répartis dans 14 villages, dont 53 % de femmes. Les résultats suggèrent que le système soutient environ 7 500 emplois saisonniers pendant la saison sèche, principalement sous forme de travail agricole occasionnel. Les emplois générés sont majoritairement des activités agricoles indépendantes ou familiales, complétées par du travail saisonnier pour la préparation des terres, le repiquage, le désherbage et la récolte. Les agriculteurs indiquent que l'amélioration de la disponibilité de l'eau pendant la saison sèche, à la suite de la construction du barrage, a augmenté le nombre de jours et d'heures consacrés à l'agriculture chaque année. La main-d'œuvre salariée est majoritairement peu qualifiée et informelle, tandis qu'un nombre limité d'emplois semi-qualifiés est apparu dans des domaines tels que la gestion de l'eau. Le système a également soutenu la création d'emplois indirects le long de la chaîne de valeur du riz.

Dans l'ensemble, l'évaluation montre que le BVIS a commencé à générer des effets positifs sur l'emploi et les moyens de subsistance en permettant une culture plus fiable pendant la saison sèche et en augmentant la demande de main-d'œuvre agricole. Toutefois, les résultats en matière d'emploi restent limités par la faible qualité des emplois, les défis de gouvernance, les inégalités dans la distribution de l'eau et l'accès limité aux marchés. Pour renforcer et pérenniser les impacts sur l'emploi, il est essentiel d'améliorer la gouvernance et la gestion de l'eau au sein du système, de renforcer le respect des normes du travail et du salaire minimum, de développer la commercialisation coopérative et les chaînes de valeur agricoles, et de soutenir le développement des compétences et des petites entreprises dans des domaines tels que l'agro-transformation, le transport et l'approvisionnement en intrants. Il sera également essentiel de promouvoir la participation inclusive des femmes, des jeunes et des personnes handicapées dans les formations et les activités économiques. Ces mesures seront particulièrement importantes dans le cadre de l'expansion prévue du système lors de la phase II, qui offre une opportunité de maximiser le potentiel de création d'emplois décents des investissements dans l'irrigation au Malawi.

1. Introduction

The STRENGTHEN2 project is a joint initiative of the European Union (EU) and the International Labour Organization (ILO) that aims to leverage the potential of employment impact assessments (EmplAs) to promote the creation of more and better jobs in sub-Saharan Africa through investment-led strategies. The BVIS aims to expand access to reliable irrigation infrastructure in Dedza district, one of Malawi's key agricultural regions. The scheme centres on the construction of the Bwanje Valley dam, financed by the EU and completed in 2019. It includes irrigation infrastructure designed to support year-round agricultural production, reduce dependence on rain-fed farming and enhance resilience to climate shocks. By enabling more intensive and reliable cultivation, the scheme is expected to influence employment and livelihoods for the benefiting farmers, with spillover effects for the local labour market.

The scheme is one of the largest irrigation schemes in Malawi and represents a long-standing public investment in irrigated agriculture. It covers approximately 800 hectares and primarily supports irrigated rice production under a cooperative organizational model. Initially developed with support from the Japan International Cooperation Agency (JICA) in the late 1990s, the scheme experienced persistent water shortages which limited effective irrigation to a fraction of the command area. To address this, the EU financed the construction of the Bwanje Valley Dam, completed in 2019 at a cost of approximately €11 million. The dam substantially increased water storage capacity and enabled reliable year-round irrigation, raising utilization of the irrigable area. A second expansion phase is currently being planned to further increase the irrigated area and storage capacity, beginning in 2026.

This report presents an ex-post EmplA of the BVIS. It adopts a mixed-methods approach to capture both the mid to long-term employment, livelihoods and productivity effects of the irrigation. Quantitative econometric analysis based on Malawi's Integrated Household Survey (IHS) data is used to document early post-construction labour market responses and to set the empirical baseline following for this and future analyses, following the completion of the dam. To assess the productivity of the scheme, satellite imagery and remote sensing methods are applied to examine changes in irrigated area and vegetation productivity over time. In addition, qualitative fieldwork in the form of focus group discussions with scheme participants and local stakeholders provides insights into longer-term effects, livelihood impacts and operational dynamics of the scheme. Together, these complementary methods allow the assessment to combine evidence across data sources and time horizons, providing a more comprehensive understanding of how the irrigation investment is affecting employment, agricultural practices and rural livelihoods.

The following section provides a review on irrigation and employment in Malawi. Section 3 describes the details of the irrigation scheme and dam construction. Section 4 presents the different datasets and methodologies applied. Section 5 presents the results from the analysis and conclusions and recommendations are made in Section 6.

2. Country situation analysis

Malawi's labour market is characterised by high labour force participation alongside widespread informality and low job quality. While employment rates are high in aggregate terms, most jobs are concentrated in own-account work and contributing family labour, with limited access to stable wage employment, particularly in rural areas (World Bank 2023; DTDA 2023). As a result, underemployment and labour market underutilization are pervasive, especially among young people and rural workers. Malawi has a very young population, with close to three-quarters of the population under the age of 35, yet youth face particular challenges in accessing decent work, including high unemployment, short working hours and limited employment benefits (Benson et al. 2019; Mussa 2016).

Agriculture remains the dominant source of employment in Malawi and plays a central role in shaping labour market outcomes. The sector absorbs the majority of the workforce but contributes a relatively small share of gross domestic product, reflecting low labour productivity and the predominance of subsistence-oriented production systems (World Bank 2023). Agricultural employment is highly seasonal and largely dependent on rainfed farming, with labour demand concentrated during planting and harvesting periods. During the dry season, employment opportunities decline sharply, contributing to periods of labour market underutilization and income insecurity among rural households. Many households therefore rely on a combination of subsistence farming, casual labour (ganyu) and informal non-farm activities to smooth incomes across seasons.

Climate variability further exacerbates these labour market challenges. Malawi's agricultural system depends on a single rainy season between November and April, followed by a prolonged dry season (May-October), making both production and employment outcomes highly sensitive to rainfall patterns. Recurrent droughts and floods have repeatedly disrupted agricultural output, undermined food security and weakened rural livelihoods (Nkhata et al. 2014; Harrison 2015). Between 1967 and 2008, multiple extreme weather events affected millions of people, highlighting the vulnerability of rainfed agriculture and the employment it supports (World Bank 2018). These shocks reinforce existing structural constraints and limit the capacity of agriculture to provide stable and productive employment.

In response, irrigation has emerged as a key policy priority to reduce climate-related risks and stabilize agricultural production, while also supporting the strategic prioritization of the agri-food sector as a driver of employment creation under Malawi 2063 and its First 10-Year Implementation Plan, particularly in light of persistent decent work deficits in rural labour markets. The National Irrigation Policy introduced in 2024 aims to expand irrigation infrastructure, promote public-private partnerships and improve access to affordable irrigation technologies for smallholders, while strengthening sustainable water resource management and climate resilience (Government of Malawi 2024). From an employment perspective, irrigation investments are expected to influence labour markets through several channels, including increased cropping intensity, expansion of cultivated areas and a gradual shift from subsistence farming towards more labour-intensive and market-oriented production systems (Lipton et al. 2003; Bassini et al. 2023).

3. Project description

The BVIS is located in the Dedza district of central Malawi. It covers approximately 800 ha and the scheme primarily facilitates irrigated rice production under a cooperative organizational structure. The scheme aims to boost agricultural productivity, enhance food security, and increase household incomes, by strengthening economic resilience and livelihoods for smallholder farmers in the region. JICA funded the initial scheme in the late 1990s with an investment of US\$15 million. It also supported rehabilitation efforts between 2005 and 2007 after flood damage, at a cost of US\$320 000 (Nkhata et al. 2014; Government of Malawi and European Union 2024).² A primary pipeline diverts water from the Namikowe River to the scheme area. Secondary canals then distribute water to the head of farm plots, the point where the water enters the field, through dedicated inlet structures. A tertiary canal system, spaced at 150-meter intervals, delivers water by gravity flow directly to series of typically five adjacent paddies, each measuring 30×30 meters.

However, due to water shortages, the existing scheme could not irrigate the full 800 ha during the dry season. Unstable water flows in the Namikokwe river resulted in only 100-150 ha of the scheme's area being irrigated, between 2007-2017. In 2017, the European Union funded the construction of the Bwanje Valley Dam with an investment of €11 million to enhance the utilization of the irrigation scheme during the dry season (referred to as Phase I). An extension project is planned for 2026, aiming to expand the existing scheme and increase the dam's water storage capacity (referred to as Phase II).

While the BVIS irrigation scheme predates the intervention examined in this study, the construction of the Bwanje Valley Dam in 2019 was designed to improve the reliability of water supply to the scheme. The dam therefore acts as an enabling investment that allows the irrigation scheme to operate more effectively, particularly during the dry season. The employment impacts assessed in this report arise primarily from agricultural production and related activities within the BVIS itself, rather than from the construction of the dam.

Phase I: Construction of Bwanje Valley Dam (800 ha irrigated area) - 2019

The Bwanje Valley Dam, captures water from the Namikokwe River and channels it through gravity into a river diversion system to irrigate plots in the surrounding area. The dam addresses the challenge of low water flows from the Namikokwe River during the dry season, ensuring a stable water supply for year-round agricultural activities. It has a storage capacity of 5.6 million m³, is 40 metres high and 150 metres long. The dam and its water diversion structure was completed in 2019 after two years of construction. Since the dam became operational, water reliability has significantly improved during the dry season, according to EU reports and expectations. Figure 1 presents photos of the dam and scheme, taken from field site visits.

► **Figure 1. Photos of the Bwanje Valley Dam and irrigation scheme**



Source: Photos from site visits.

Phase II: Extension of Bwanje Valley Dam and Scheme (+1,490 ha irrigated area) 2025

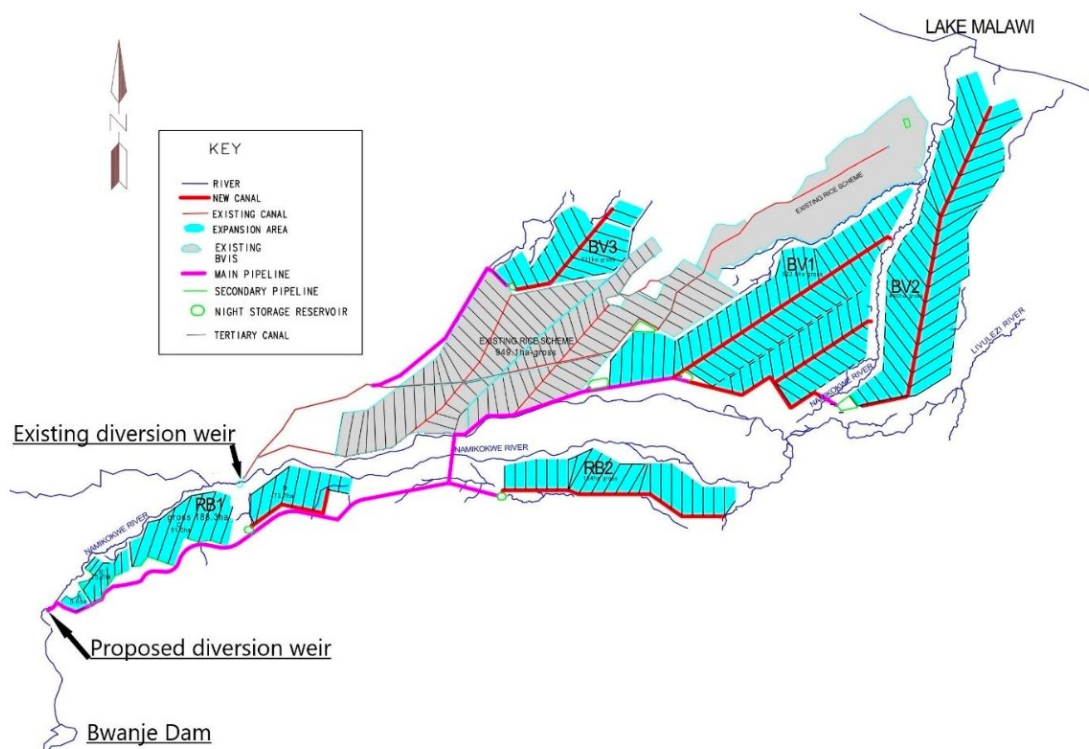
Phase II of the BVIS project will expand the irrigated area by 1,490 ha, bringing the total gross area to 2,290 ha. This phase involves constructing a second water diversion system and raising the dam height (by 18m) to increase water storage capacity to 31 million m³. Construction is scheduled to begin in 2026, with completion anticipated within 24 months. Comprehensive feasibility studies assessing the technical, financial, and economic viability were completed in 2017. According to a 2023 socio-economic survey, approximately 3,000 land-owning families across 14 villages expressed interest in the project and were registered, with arrangements made to

² The rehabilitation involved headwork (which refers to the water intake and control structures that divert and regulate water from the river into the irrigation system) and settling basin rehabilitation, main canal relocation, and land levelling (Nkhata 2014).

ensure each household could maintain their existing farm size (Government of Malawi and European Union 2024). Figure 2 presents the map of the existing scheme and proposed expansion area.

The cost of land development and irrigation system installation for Phase II is estimated at US\$43.3 million³, funded by the EU. The project is expected to generate substantial employment, creating approximately 4 000 jobs during the construction phase—comprising 1,600 skilled and 2,400 unskilled positions—resulting in an estimated US\$1.5 million in wages (per annum). Once operational, the scheme will employ around 700 labourers per year, in addition to beneficiary farmers, contributing approximately US\$400 000 to local incomes. In addition to direct employment, the project is projected to stimulate regional economic activity through multiplier effects and the growth of small and medium enterprises (SMEs). Approximately US\$8 million will be injected into local businesses via contracts and subcontracts, in alignment with Malawi's Public Procurement and Disposal Act. Moreover, the initiative will promote skills development through targeted training programmes and improve regional infrastructure, fostering long-term economic growth and resilience.

► **Figure 2. Existing (Phase I) and proposed extension area (Phase II) of the BVIS**



Source: Government of Malawi and European Union 2024.

Operation of the scheme under Phase I

The BVIS is owned by the Government of Malawi and operated through the Water Users Association (WUA) and the Bwanje Valley Irrigation and Marketing Cooperative (BVIMC). The existing scheme benefits around 2,067 farmers in 14 villages surrounding the BVIS. These numbers were similar before and after construction of the dam in 2019. 47 per cent of farmers are male and 53 per cent are female. Farmers from the surrounding 14 villages can participate in the BVIS by cultivating irrigated plots within the scheme. Water distribution and irrigation management are overseen by the WUA, which consists of elected representatives from the participating farmers. In addition, some farmers choose to join the Cooperative, which supports collective marketing and access to inputs. Membership in the cooperative is voluntary and therefore does not include all farmers participating in the scheme. Participation in the scheme involves several fees at the start of each agricultural season including annual subscription and water fees. Each farmer is typically allocated five plots (totaling 1 acre) during the rainy season. In the dry season, plots can be rented at MWK 4 000 per plot, with flexible access depending on availability.

Farmers in the BVIS typically engage in two production cycles per year. In recent years, rising rice prices have established it as the primary commercial crop in the area. Most farmers cultivate rice rain-fed during the summer season and irrigated during the winter season. In upland areas unsuitable for rice, some farmers diversify with alternative crops such as maize, beans, and sweet potatoes. On average farmers of the BVIS harvest 7,400

³ €38,171,964 according to project documents (Government of Malawi and European Union 2024).

kg/ha paddy rice, according to a 2023 survey, which is above the national average of 6,000 kg/ha (Government of Malawi and European Union 2024). Around two thirds of farmers sell their un-milled rice (paddy) directly to vendors in the open market, while one third of farmers sell their paddy to the BVIMC cooperative, which aggregates and processes rice for sale to a World Food Programme (WFP) school feeding initiative (Government of Malawi and European Union 2024; Nkhata et al. 2014).

Scheme functionality is shaped by a governance model in which the WUA is governed by an elected executive committee. Members of this committee are elected by participating farmers every three years and are responsible for overseeing water allocation, scheme maintenance and overall management. The WUA ensures that water is fairly and efficiently shared in the scheme. It coordinates irrigation schedules, maintains canals, and resolves disputes when they arise. The WUA also collects fees from plot allocation that help keep the system running smoothly by maintaining and safeguarding the infrastructure. The association has 34 members, of which 82 per cent are male and 18 per cent are female, which may reflect underlying inequalities in access to resources and formal leadership positions that tend to limit women's involvement. The association also acts as a bridge between farmers and government or development partners with the help of a scheme manager.

The cooperative helps members access seeds, fertilizers, and loans more easily, and it organizes the sale of produce so farmers can earn better prices. In terms of the structure, the cooperative has a president, vice president, secretary general, treasurer as well as subcommittees on finance, maintenance, business and productive. The cooperative's membership is 63 per cent male and 37 per cent female, out of a total of 103 members.

4. Methodology

This assessment adopts a mixed-methods approach to examine the employment and productivity impacts of the BVIS. To understand the employment effects, capture decent work dimensions and given the limited post-intervention coverage of available household survey data, analysis based solely on this survey data is insufficient to capture the full range of impacts associated with the irrigation investment. The analysis therefore combines three complementary components: (i) econometric analysis of individual-level labour outcomes using nationally representative survey data; (ii) satellite-based remote sensing analysis to assess changes in irrigated area and agricultural productivity over time; and (iii) qualitative fieldwork based on focus group discussions and stakeholder interviews to capture long-term effects and perceptions that are not yet observable in the quantitative data. Together, these methods provide a comprehensive understanding of how the irrigation scheme is affecting employment, agricultural practices and livelihoods. These insights can inform the planned expansion of the scheme.

4.1. Integrated Household Survey (IHS)

The Integrated Household Survey (IHS) Malawi is a nationally representative survey conducted by the National Statistical Office (NSO) of Malawi to monitor household welfare and inform evidence-based policy formulation. The data is structured as a cross-sectional survey with a panel component (Integrated Household Panel Survey, IHPS), though the panel is limited to subsets of households tracked across waves. A stratified two-stage sampling design ensures representativeness at national and district level. The IHS offers detailed information on employment, including labour activities, time use, wages, and secondary occupations, alongside comprehensive agricultural data. This study draws on data from IHS3 (2010), IHS4 (2016/2017) and IHS5 (2019/2020). The IHS3 and IHS4 data capture conditions prior to the construction of the Bwanje Valley Dam (2017 - 2019), while IHS5, collected shortly after, allows us to observe the effects shortly after the completion of the dam's construction.

The analysis applies a difference-in-differences (DiD) framework. Dedza district, where the irrigation scheme is located, is treated as the intervention area, while neighbouring Ntcheu district which relies on rainfed agriculture but does not have a large irrigation scheme in place, serves as the comparison area. The baseline specification compares changes in employment outcomes for individuals in Dedza before and after 2019 to individuals in Ntcheu, controlling for area and survey-year fixed effects.

The analysis utilizing the IHS is subject to limitations arising from the short post-intervention period available following the completion of the Bwanje Valley Dam in 2019. With only one post-construction survey round (2019 - 2020) currently observed, the estimates capture early insights rather than long-term impacts of the irrigation scheme. The analysis is therefore intended to set the scene by documenting initial adjustments in agricultural labour use and related behaviours, rather than to identify longer-term effects on employment outcomes. These individual-level findings are complemented by satellite-based analysis and fieldwork to assess broader changes in land use, agricultural activity, employment and livelihoods over time. As additional post-intervention data become available, including the forthcoming IHS6 round which will represent 2024-2025, the analysis can be extended to examine long-term impacts and assess whether the early patterns identified here evolve further.

4.2. Remote sensing

The analysis uses satellite imagery from the Sentinel-2 mission, which provides high-resolution (10-20 m) optical data suitable for monitoring agricultural landscapes. Imagery was obtained during each month of the dry and wet agricultural seasons for each year between 2016 - 2025. To account for changes in seasonality, images were downloaded as close to the same date as possible within the months of the dry and wet season, dependant on cloud cover. Changes in irrigated area were assessed using ArcGIS Pro, using a machine-learning classification model based on a U-Net architecture, which is designed to recognise patterns in imagery at the pixel level. The model was trained using examples of cultivated and non-cultivated land that were labelled through visual interpretation of satellite imagery in Malawi and knowledge of locations of fields within the scheme. The model was applied to map irrigated land in images, which was calculated monthly and combined to produce a composite of irrigated area across the dry/ wet season for each year. Particular emphasis was placed on dry-season cultivation, which was the main objective of the scheme as this is most directly influenced by regulated water availability from the dam. Comparing dry-season cultivated area within the scheme to rainfed control areas allows irrigation-enabled changes in agricultural activity to be distinguished from broader climatic or seasonal trends.

Two standard vegetation indices were derived from the imagery. The Normalized Difference Vegetation Index (NDVI) measures how green and dense vegetation is by comparing reflected red and near-infrared light, where higher NDVI values generally indicate healthier, more productive crops. This was applied as a proxy for agricultural productivity. Land Surface Water Index (LSWI) compares near-infrared and shortwave infrared reflectance and is sensitive to moisture in vegetation and surface soil, with higher (or less negative) values indicating wetter conditions. All of these indicators were calculated separately for the BVIS and two comparable

control areas. Control areas were selected based on areas that relied on rain-fed agriculture (defined using NASA's Landsat-derived Global Rainfed and Irrigated Cropland Product) that were of a similar size in hectares to the BVIS. Although irrigation infrastructure existed in the BVIS prior to the construction of the dam, water shortages meant that the scheme was not fully functioning and as a result, agricultural production within the scheme remained largely dependent on rainfall for much of the year, making production conditions broadly comparable to the predominantly rain-fed systems observed in the selected control areas. The analysis therefore captured changes associated with improved irrigation reliability and intensity in the BVIS relative to nearby areas where agriculture continues to rely primarily on rainfall. Control Area 1 is to the North of the project and Control Area 2 is in the South, which were also selected to examine if the scheme produced any changes up-or downstream. Locations of the study areas are presented in Figure 3.

Irrigated area and the indices were analysed using time-series trends and pre-/post-2019 comparisons, corresponding to the completion of the dam. To isolate scheme-related effects, changes observed within the BVIS were compared to changes in the control areas using a framework similar to the DiD approach. NDVI was interpreted as a proxy for crop productivity, while LSWI was used as a supporting indicator of moisture availability. As with all satellite-based analyses, the results are subject to limitations, including potential cloud contamination, classification uncertainty in irrigated area mapping and the fact that NDVI captures vegetation condition rather than actual harvested output. However, by combining multiple indicators and benchmarking against control areas, the approach provides evidence on relative changes in agricultural performance of the scheme over time.

► **Figure 3. BVIS and two control areas used in the satellite imagery analysis**



Source: Author's research. Data: Esri, Vantor, Earthstar Graphics.

4.3. Fieldwork data collection

The fieldwork component of the EmPIA combined qualitative methods to capture employment, livelihood and inclusion outcomes associated with the BVIS. Primary data were collected through three Focus Group Discussions (FGDs) with members of the cooperatives, to represent men, women, youth and persons with disabilities. In addition, nine Key Informant Interviews (KIIs), direct field observations, and interviews for case studies were carried out. Participants were purposively selected from different blocks of the irrigation scheme to reflect variation in farming experience, employment roles, and access to irrigation. It should be noted that the small sample size of the FGDs and KIIs means the results may not be representative for the full set of farmers and beneficiaries. However, the discussions brought to light some of the impacts and key challenges faced surrounding employment effects that should be addressed further.

KIIs were conducted with stakeholders at both district and scheme levels, including irrigation engineers, agricultural extension officers, labour and trade officials, youth officers, and scheme management staff. These interviews provided in-depth insights into scheme governance, water management, employment conditions, institutional support, and market dynamics. Direct observations at the dam and within the scheme complemented interview data by documenting infrastructure conditions, water distribution practices, labour arrangements, and on-site activities. Furthermore, five case studies were developed to illustrate lived experiences of women, men, youth, and persons with disabilities engaged in farming and related value-chain activities, providing contextualized evidence of employment creation, income changes, and long-term outcomes on local businesses.

5. Results

5.1. Econometrics

Table 1 presents weighted summary statistics for individuals in Dedza district and the neighbouring comparison district in the pre-intervention period. The table highlights broadly similar demographic characteristics across the two districts, including age structure, household size and gender composition and agricultural profile. Levels of participation in agricultural activities and agricultural employment are high in both districts, consistent with the predominance of smallholder farming in central Malawi. Dedza exhibits slightly higher agricultural engagement and labour intensity, as reflected in hours worked in agriculture (weekly), while differences in overall employment rates and subsistence participation are relatively modest. The relatively low average number of hours worked in agriculture reflects that the indicator is calculated across all individuals in the sample, including those who did not engage in agricultural activities during the reference week. Given the seasonal nature of farming in Malawi, weekly averages therefore understate labour input during peak agricultural periods.

► **Table 1. Summary statistics for Dedza (BVIS location) and Ntcheu districts in 2016/17**

	Dedza	Ntcheu
Population	575 719	407 902
Observations	213	167
Average age (years)	33	31.7
Female (%)	53.3	58.5
Years of schooling	5.5	6.1
Household size	5.5	5.5
Employed (%)	73.7	73.1
Unemployed (%)	14.5	15.7
Out of labour force (%)	11.7	11.2
Any agriculture activity (%)	87	96
Subsistence agriculture (%)	62	59
Employed in agriculture sector (%)	96	98
Hours in agriculture (weekly)	4.71	3.81

Source: Authors' research; Data: IHS.

Table 2 reports DiD estimates of early labour market impacts following the completion of the Bwanje Valley Dam in 2019. As mentioned, the timeline may be too early to assess the long-lasting effects of the scheme but give some insight and can be further expanded once the updated IHS data become available. The results show no statistically significant change in overall employment or in the probability of being employed in agriculture, suggesting that the irrigation investment has not yet altered employment participation at the extensive margin. The analysis points to a statistically significant increase in agricultural labour intensity among those engaged in farming. The level specification indicates an increase of approximately 2.7 additional hours worked in agriculture for those in Dedza, compared to before the construction of the dam. The log specification is positive but not statistically significant. Given relatively low baseline levels of agricultural working hours, these estimates are consistent with irrigation enabling more intensive and sustained agricultural activity rather than inducing immediate shifts in employment status. This could be consistent with expected short-term impacts following the introduction of reliable irrigation infrastructure.

► **Table 2. Coefficient estimates of the early post-intervention impacts**

DID estimates	
Employed	-0.022
Employed in agriculture	0.021
Subsistence agriculture	-0.029
Monthly wages (MWK)	23 679
Hours worked in agriculture	2.720*
Hours worked in agriculture (log)	0.347

Note: * $p < 0.1$; ** $p < 0.05$;

*** $p < 0.01$

Source: Authors' research.

5.2. Remote sensing

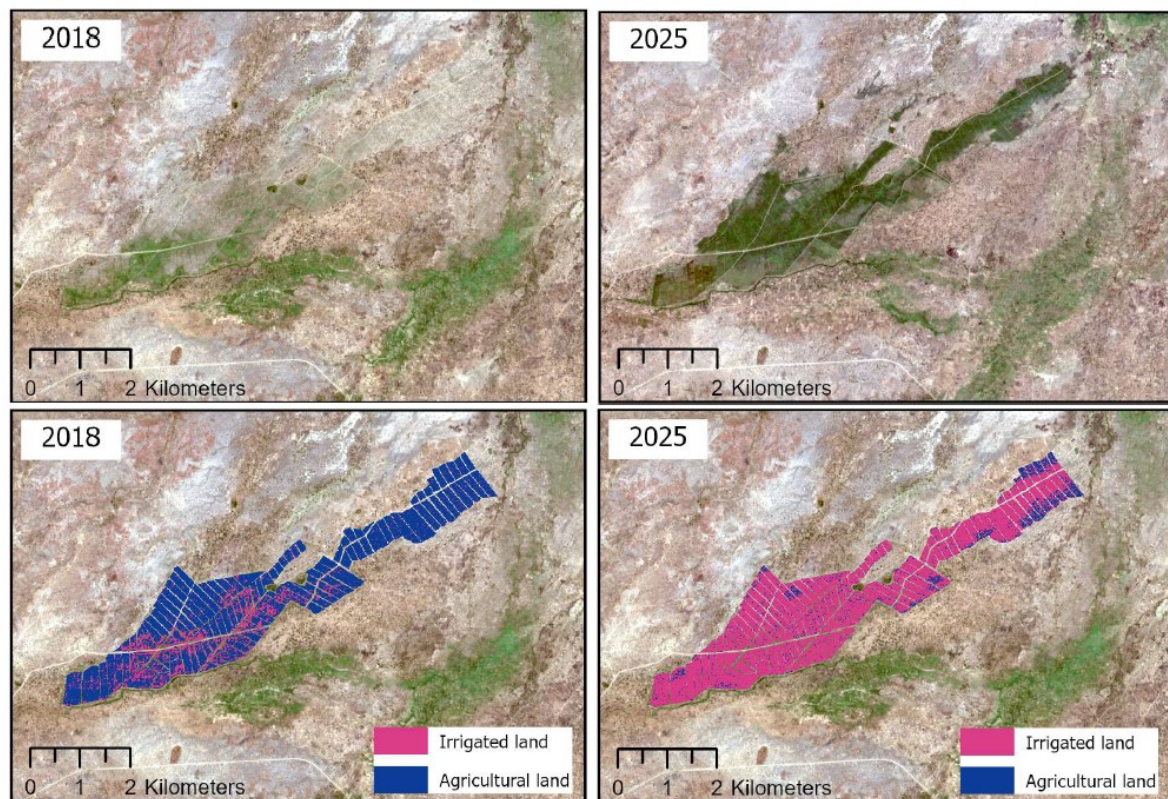
5.2.1. Irrigated area

Satellite imagery analysis of the irrigated area during the dry season indicates a marked expansion of irrigation within the BVIS after 2019. Irrigated area was assessed using monthly satellite imagery and combined to estimate cumulative seasonal utilization, defined as the share of the command area irrigated at any point during the dry season. Average dry-season irrigated area increased from approximately 240 ha in the pre-2019 period (around 25 per cent of the command area, the total area that can be irrigated) to up to 760 ha post-2019, equivalent to approximately 95 per cent seasonal utilization. As of 2025, cumulative irrigated area across the dry season is estimated at approximately 725 ha, or around 92 per cent of the command area. This represents a clear intensification of dry-season agricultural activity within the scheme and indicates that the scheme is close to achieving its objective of providing full utilization of irrigated land during the dry-season.

Based on monthly satellite imagery, utilization in any given dry-season month ranged from 40 to 95 per cent following completion of the dam, depending on the time period within the dry-season. Inspection of the annual time series suggests that this expansion was sustained in the years immediately following completion in 2019, before declining in 2024 and 2025. This may reflect sensitivity to climatic shocks or water availability constraints. Stakeholders reported that the dilapidation of some canal sections in recent years has rendered them non-functional, limiting water conveyance and preventing full utilization of the irrigation area.

For the year of 2025, dry season irrigated land derived from satellite analysis is estimated at approximately 92 per cent. This is broadly consistent with measurements by the Department of Irrigation, which report that 88 per cent of the scheme area was utilized in 2025, with approximately 96 ha unable to be irrigated. This satellite imagery analysis could be complemented by these field measurements in the future to calibrate the model and improve the observed overestimation. Figure 4 presents classified irrigated area within the BVIS scheme before and after implementation of the Bwanje Valley Dam.

► **Figure 4. Satellite images and corresponding cumulative irrigated area across the dry season, for years before (2018) and after construction (2025) of the dam**



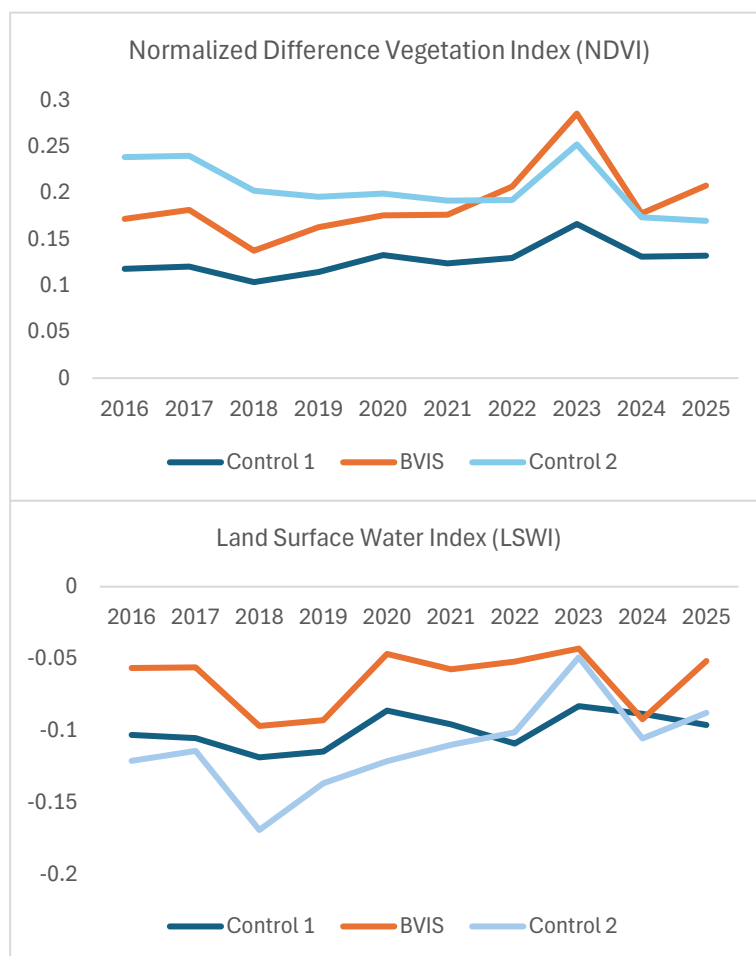
Source: Author's research. Data: Esri, Vantor, Earthstar Graphics.

5.2.2. Crop productivity

Dry-season crop productivity, proxied by NDVI averages across the months of the dry season, shows a clear improvement within the BVIS after 2019. Mean dry-season NDVI increased from 0.163 in the pre-2019 period to 0.205 post-2019, corresponding to an absolute increase of 0.042. Expressed relative to the baseline, this represents an approximate 25 per cent increase in dry-season vegetation productivity within the scheme. Mean NDVI values in the pre-2019 period are consistent with predominantly fallow or sparsely vegetated land during the dry season (typically NDVI values between 0.05 and 0.20), while post-2019 values indicate increased vegetation cover associated with more consistent cropping activity. As NDVI reflects vegetation condition at the pixel level rather than total cultivated area, substantial increases in irrigated land are not expected to translate proportionally into higher scheme-wide NDVI values.

Relative to control areas, dry-season productivity gains in the BVIS are substantial (Figure 5). NDVI increased by 0.022 in the upstream control area (approximately 19 per cent increase relative to its baseline), while the downstream control area experienced a decline of -0.023 (approximately a 10 per cent decrease). As a result, the BVIS achieved an additional dry-season NDVI gain of 0.020 compared to the upstream control and 0.064 compared to the downstream control. These differences indicate that post-2019 productivity improvements in the BVIS exceed background trends in the study area. While this divergence is consistent with the possibility of downstream water availability being affected by the BVIS above, the analysis does not provide causal attribution but should be explored further.

Despite these gains, the NDVI time series also points to increased volatility after 2023. While productivity remains higher on average than in the pre-2019 period, the decline observed in 2024 suggests that dry-season productivity gains are not immune to climatic stress. This pattern is consistent with the observed contraction in irrigated area over the same period and may reflect drought conditions or reduced water availability resulting from non-functional canal sections.

► **Figure 5. NDVI and LSWI values during the dry season, across the years of study, BVIS and control areas**

Source: Authors' research.

5.2.3. Surface moisture conditions

Changes in LSWI provide additional context for interpreting productivity outcomes. During the dry season, LSWI increased modestly across all zones, rising by 0.018 in the BVIS (a 24 per cent increase relative to baseline), 0.017 upstream, and 0.043 downstream. Control-adjusted differences in LSWI are small compared to NDVI and irrigated area changes, indicating that BVIS productivity gains are not driven by disproportionately higher surface moisture alone. Rather, they are likely associated with the interaction of irrigation expansion and management practices.

Annex A.1 presents results during the wet season, where it was found that irrigated area still increased in the BVIS, by approximately 16 per cent compared to pre-2019. Across NDVI and LSWI, effects remained relatively stable across years, except for a decrease in 2024 which is in line with the other results. This highlights that the BVIS mainly influenced irrigated area expansion and subsequent crop productivity during the dry season, which is what the scheme aimed to achieve.

5.3. Employment and livelihoods

5.3.1. Employment creation and diversification

In the absence of a baseline specific to pre-dam construction conditions within the scheme, qualitative fieldwork provides important insights into how employment and livelihoods have evolved. Evidence from FGDs and KIIs indicates that prior to the construction of the dam, agricultural activity was largely limited to a single rainy season and was predominantly subsistence-oriented, with households producing mainly for their own consumption and generating only limited surplus for sale. Employment opportunities were scarce, as low and seasonal production reduced the need for hired labour and constrained income-generating activities beyond smallholder farming. While the number of farmers participating in the scheme has remained broadly unchanged, improved water availability following the construction of the dam has enabled more continuous and intensive agricultural production, particularly during the dry season. Information from the FGD and KII discussions indicates that the BVIS has generated employment primarily through on-farm agricultural production, scheme management, and downstream value-chain activities such as processing (Table 3).

Following completion of the dam, which enabled more reliable dry-season irrigation within the BVIS, employment effects have become predominantly seasonal and agriculture-based. The scheme currently supports approximately 7,500 seasonal jobs during the dry (winter) cropping season, mainly through casual farm labour. These jobs are concentrated in labour-intensive agricultural activities including land clearing, tilling, transplanting, planting, weeding, harvesting, threshing, and winnowing and are without formal contract with no recorded access to social protection. Casual labourers typically earn around MWK 15 000 (US\$9) per plot on a task-based (piece-rate) payment basis, corresponding to a daily wage of approximately US\$2.2, given that most plot-level activities take an average of four days to complete. These wages fall below the government-set general minimum wage of US\$2.8 per day, indicating that while employment creation is substantial, job quality remains a concern in light of decent wage standards in the sector (ILO 2023). No evidence of child labour was identified during fieldwork visits to the scheme however given that poverty and seasonal labour demands can increase reliance on family labour in smallholder systems, continued monitoring is advisable to ensure alignment with national legislation and ILO standards.

In addition to casual employment, the scheme has generated a smaller number of permanent jobs. The WUA employs 11 permanent staff (10 men and 1 woman) in roles including clerks, water guards, security personnel, and scheme management. The cooperative employs a further 4 workers (3 men and 1 woman) as cleaners, mill operators, and security guards, without formal contract. These cooperative employees work an average of 12 hours per day and earn a monthly salary of approximately MWK 60 000 (US\$32), which is below the national minimum wage of MWK 126 000 (US\$72) per month. This highlights a persistent gap between employment creation and compliance with national wage standards. Whilst extended hours may reflect seasonal demands, the ILO sectoral guidelines emphasize the importance of regulating hours of work and ensuring adequate rest (ILO 2023).

► **Table 3. BVIS job creation expressed as the headcount**

Occupation	Total (headcount)	Men	Women	Skill level
Scheme Management Staff	1	1	0	Skilled
Clerk	1	1	0	Skilled
Cleaners	2	0	2	Unskilled
Water Guards	2	2	0	Unskilled
Dam Security Guards	4	4	0	Unskilled
Office security guards	3	3	0	Unskilled
Farmers	2 067	978	1 089	Skilled
Casual Labourers (Land preparation, Weeding, Harvesting, Threshing)	7 500	No data	No data	Unskilled
Mill Operators	2	2	0	Skilled
Total	9 582	991	1 091	-

Source: Authors' research.

The BVIS directly supports 2,067 active farmers (978 men and 1,089 women). During the dry-season irrigation period. Gender patterns differ by employment type where men account for 91 per cent of formal employment within the WUA and 75 per cent within the cooperative, while women represent the majority (52 per cent) of informal agricultural workers through their direct engagement in farming activities. Labour-intensive tasks such as transplanting, threshing, and winnowing are predominantly undertaken by women, while men are more frequently involved in harvesting, marketing, and leadership roles. The workforce in the scheme is predominantly unskilled, with the largest share being casual labourers and smallholder farmers. Skilled roles such as management, clerical work, and mill operation account for less than 1 per cent of total employment and are held entirely by men.

The irrigation scheme enables cultivation during both the rainy (rain-fed) and dry (irrigated) seasons, allowing farmers to grow crops twice per year instead of once. The main crops cultivated include rice, maize, soybeans, sweet potatoes, and beans. While there has been limited diversification in crop types, with small-scale introduction of paprika, tomatoes, wheat, and horticultural crops, the principal employment effect stems from increased cropping intensity rather than changes in crop composition. Rice remains the primary cash crop, marketed locally through cooperatives and informal vendors, while crops such as sweet potatoes contribute to both household consumption and income generation.

The expansion of irrigation has also strengthened institutional employment and revenue generation. Annual revenue for the WUA increased from approximately MWK 8 million (US\$5 000) prior to scheme expansion to around MWK 200 million (US\$114 200) following the construction of the dam. This increase has enabled the WUA to finance scheme operations, maintenance, and management functions, supporting longer-term employment sustainability.

5.3.2. Gender, youth and disability inclusion

The Government, through the Department of Agriculture Gender Roles Extension Support Services (AGRESS) makes efforts to mainstream gender and inclusion through capacity-building trainings and promotion of household approaches for shared roles and decision-making within families. These trainings which are informed by a gender analysis, are crucial because farming decisions, labour, and income use are typically shaped at the household level and because gender norms strongly influence who benefits from agricultural activities. These approaches aim to make agriculture more productive, equitable, and sustainable. Women comprise about 35 per cent of the cooperative membership and actively engage in leadership and labour roles. FGD participants noted that gender equality has improved significantly through the interventions of the EU-funded KULIMA project, which has provided training to farmers across Malawi. These initiatives have helped shift traditional mindsets, encouraging men and women to make joint household and farming decisions.

According to FGDs, youth face challenges including capital scarcity and lack of skills, limiting year-round engagement. AGRESS, in collaboration with the department of social welfare and the Malawi Council for Disability Affairs (MACODA), conducted disability inclusion campaigns aimed at shifting mindsets and encouraging participation of persons with disabilities.

5.3.3 Spillover effects

The scheme has produced positive spillover effects, including increased local trade, employment in transport and milling, and better access to energy via solar power installations funded by other partners. Self-Help Africa have supported this through solar farm interventions where farmers in the area are now able to purchase electricity units and light their homes because of the income earned from farming. Employment impacts also extend beyond on-farm activities into agricultural value chains and informal enterprises. Annex 2 presents interviews or 'case studies' of beneficiaries of the scheme. The expansion of irrigation has stimulated downstream employment in rice milling, transport services (including bicycle and motorcycle taxis), produce trading, and small businesses such as tailoring and mobile money services. Casual labourers engaged across these activities earn approximately MWK 80 000 (US\$45) per month on average, though wages remain below the national minimum wage. In some cases, labour is remunerated partly through in-kind payments such as maize, reflecting continued income insecurity among the poorest workers. The scheme has also attracted people from other areas such as Mangochi, Zomba and Mchinji who have secured formal employment as security guards and farm/field supervisors and informal employment as casual labourers.

5.4. Scheme functionality and challenges

During the FGDs and interviews, a large amount of information on the functionality of the scheme and opinions on remaining challenges were collected. Despite the positive employment and productivity outcomes associated with the BVIS, several persistent challenges constrain its effectiveness and sustainability. Weaknesses in water management, governance, market access, climate resilience, and labour conditions continue to undermine the full realization of benefits. These challenges have direct implications for agricultural productivity, employment stability, income generation, quality of employment, and inclusion of marginalized groups.

Water management inefficiencies represent one of the most significant constraints facing the scheme. Although the dam was designed to supply sufficient water to the full command area, effective distribution is hampered by poor maintenance of largely earth-lined canals, siltation, prolonged water transit times, and unauthorized water diversion by some farmers. Fieldwork findings indicate that vandalism of canals and informal water abstraction practices reduce water availability, particularly for downstream users, resulting in irregular and sometimes inadequate irrigation during critical planting and growth periods. Water sharing between schemes and prolonged dry spells further exacerbate these challenges, especially during the dry season when demand for irrigation peaks. These inefficiencies directly affect crop maturation, reduce yields, and introduce uncertainty into dry-season employment, particularly for casual labourers and smallholder farmers who rely on consistent irrigation.

Governance and leadership challenges within the WUA compound water management problems and have become a major source of tension within the scheme. Participants in FGDs and KIIs reported that some WUA leaders have remained in office beyond constitutionally defined terms, contributing to mistrust among farmers and weakening accountability. Financial management practices were widely criticized, with concerns raised about plot rental fees being handled informally rather than deposited in formal banking systems. Farmers expressed frustration over the lack of transparency and accountability for large sums of money, sometimes amounting to millions of kwacha, which they believe should be reinvested in infrastructure maintenance and scheme operations.

During FGDs, farmers reported that access to land during the winter (irrigated) season is increasingly restricted for local community members, with priority often given to companies and private investors. This practice has limited opportunities for smallholder farmers to participate in dry-season cultivation, despite paying plot fees in advance. These practices not only erode trust but also reduce self-employment opportunities and seasonal labour demand for local households. Although cooperative networks play an important role in organizing farmers for collective marketing, resource mobilization, and capacity building, their effectiveness is constrained by weak coordination with the WUA and unresolved governance disputes.

Market access constraints further limit the income and employment benefits of irrigation. In the absence of reliable formal market channels, farmers rely heavily on middlemen and vendors who purchase produce, particularly rice, at prices below market value. Many transactions occur at the farm gate or household level, reducing farmers' bargaining power and depressing incomes. Weak adherence to business, quality, and food safety standards restricts the cooperative's ability to access higher-value or distant markets. As noted by a district trade officer. Although business centres have been established within the scheme as aggregation points, cooperative members reported that production is largely undertaken individually rather than collectively due to challenges including plot allocation constraints and water scarcity, limiting the effective use of these facilities.

Climate change and environmental degradation pose growing risks to the sustainability of the scheme. Erratic rainfall patterns and prolonged dry spells have increased pressure on limited water resources, while deforestation in the dam's catchment area has accelerated siltation, reducing the dam's water-holding capacity. These environmental pressures intensify water scarcity, particularly during the dry season, and threaten the long-term viability of irrigation-dependent livelihoods. Without targeted interventions such as enhanced quality of employment, catchment restoration, reforestation, and climate-smart water management, the scheme's capacity to support decent jobs and agricultural productivity is likely to decline, increasing vulnerability among smallholder farmers and casual workers.

Labour-intensive farming practices and limited mechanization further constrain productivity, where most agricultural activities within the scheme rely on manual labour using hand tools, which limits efficiency and scale-up potential. This disproportionately affects women, who already carry a heavy workload due to their combined productive, reproductive, and care responsibilities, and persons with disabilities, who face physical barriers to participation in labour-intensive tasks. Although persons with disabilities are visible in some leadership roles within cooperatives, targeted interventions to support their meaningful participation, such as accessible infrastructure, adapted tools, or specialized training are largely absent.

Limited involvement of the Ministry of Labour and weak enforcement of labour standards was also noted. Fieldwork evidence indicates that casual labourers, WUA employees, and workers employed by private investors, such as mill operators, frequently earn wages below the government-mandated minimum of US\$72 per month. The absence of regular labour inspections, data collection, and monitoring reduces protections for workers and allows poor labour practices to persist.

6. Conclusion and recommendations

This EmplIA examined the employment, productivity, and livelihood effects of the Bwanje Valley Irrigation Scheme (BVIS) following the completion of the Bwanje Valley Dam in 2019. Using a mixed-methods approach combining household survey analysis, satellite-based remote sensing, and qualitative fieldwork, the assessment provides a comprehensive picture of how the irrigation investment has affected agricultural activity, employment patterns, and local economic dynamics over time.

The findings indicate that the primary employment impacts of the BVIS have materialized through intensification of agricultural activity rather than expansion of employment participation at the extensive margin. Although the econometric analysis based on household survey data was limited by data availability for the post-intervention period, initial results show that agricultural labour intensity, measured by working hours, increased in Dedza.

Satellite-based analysis corroborates these findings by documenting a substantial expansion of dry-season irrigated area and associated improvements in crop productivity within the BVIS. The average dry-season utilized irrigated area increased relative to the pre-2019 period, raising operational use of the scheme from up to 25 per cent to an estimated 92 per cent of its total command area, with an estimated 725 ha operational in the most recent year of analysis of 2025.

Satellite indicators of vegetation productivity also improved, dry-season Normalized Difference Vegetation Index (NDVI) increased by approximately 25 per cent, indicating higher average vegetation productivity. These gains exceed those observed in comparable rain-fed control areas, suggesting that the dam has enabled meaningful increases in dry-season agricultural activity and output. However, interannual variability, with a decline in the past two years, highlights the scheme's vulnerability to climatic shocks and the need to rehabilitate parts of the infrastructure. When comparing the results to measurements from the Department of Irrigation, who estimate 88 per cent of utilized area over the 2025 dry season, there is an overestimation from the satellite imagery analysis. This could be from the accumulation of some false positives of irrigated land when combining monthly composites. These estimates could be improved in the future through further training and calibrating of the model, through incorporation of field data measurements of irrigated cropland.

The fieldwork evidence provides further insight into how these changes translate into employment and livelihoods. In the absence of a baseline capturing pre-construction conditions within the scheme, qualitative evidence provides important context on how employment and livelihoods have evolved. Findings from Focus Group Discussions (FGDs) and Key Informant Interviews (KIIs) suggest that agricultural activity was previously limited to a single rainy season and largely subsistence-oriented, with few opportunities for paid work. Following completion of the dam, improved water availability has enabled more continuous and intensive agricultural production, particularly during the dry season, contributing to increased labour demand and expanded income-generating opportunities, even though participation in farming itself has not increased. Data from the discussions and interviews highlighted that the scheme currently supports approximately 7,500 seasonal jobs during the dry season, primarily through casual farm labour, alongside permanent employment within the Water Users Association (WUA) and the cooperative. Irrigation has enabled farmers to cultivate crops twice per year, strengthening income stability and supporting downstream employment in milling, transport, and small businesses. At the same time, job quality remains a concern where wages for casual labourers and scheme employees frequently fall below national minimum standards, formal contracts are limited, with no access to social protection and employment is highly seasonal and informal. Women account for a large share of field labour and benefit from expanded agricultural activity, yet they remain underrepresented in formal and leadership roles, while persons with disabilities face persistent barriers to participation, such as inaccessible irrigation infrastructure and the absence of targeted interventions to make farming less labour intensive. These challenges could be mitigated by undertaking a gender and disability analysis at the outset of the programme.

Overall, the assessment concludes that the BVIS has generated substantial employment and productivity benefits during the dry season, consistent with its original objectives, but these gains remain constrained by governance weaknesses, water management inefficiencies, and weak enforcement of labour standards. Addressing these constraints will be critical to sustaining employment impacts and ensuring that the planned Phase II expansion delivers inclusive and decent work outcomes. With this in mind, the following recommendations are proposed for key stakeholder groups involved in the BVIS and its planned expansion.

Donors and development partners (EU, ILO, cooperating agencies)

Donors and development partners should prioritize integrating employment and decent work objectives into irrigation investments, ensuring that future financing for Phase II of the BVIS links infrastructure development with measurable improvements in job quality. Financing agreements could include conditions related to compliance with minimum wage regulations, use of written contracts, and basic occupational safety provisions. Development partners should also support complementary investments that strengthen employment outcomes, including value-chain development, SME support and skills training in irrigation management and agri-

processing, while continuing to invest in water governance and climate resilience to safeguard employment gains. Synergies with existing EU-supported programmes, such as the previously mentioned KULIMA project, could further support value-chain development and address barriers faced by women in irrigation, leadership and agricultural markets. EmplA findings should be embedded into project appraisal, monitoring, and evaluation frameworks to ensure that employment quantity and quality outcomes are tracked systematically over time.

Government of Malawi (Ministries of Agriculture, Labour, Water, Local Government)

The Government of Malawi has a central role in strengthening institutional capacity and regulatory oversight. Priority should be given to enhancing the capacity of the WUA through governance reform, leadership renewal and improved financial management systems, including mandatory banking of fees and transparent reporting. The Ministry of Labour should increase its engagement with the scheme through regular inspections, data collection on employment conditions, and enforcement of labour standards, particularly for casual workers and cooperative employees. Coordination between agricultural, water, and labour authorities will be essential to align irrigation expansion with employment and decent work objectives.

Water Users Association and the Cooperative

The WUA and cooperative should prioritize improving governance, transparency and market access within the scheme. Key actions include enforcing leadership term limits, strengthening internal accountability mechanisms and ensuring transparent allocation of irrigated plots, particularly during the dry season. Improving canal maintenance and water distribution will support productivity and employment stability across the scheme. At the same time, the cooperative should strengthen its collective marketing and business functions, including improved aggregation, compliance with quality standards and development of formal market linkages to reduce reliance on middlemen and improve farmer incomes. Promoting greater participation of women and marginalized groups in leadership roles should also be actively pursued.

Private sector actors, civil society and training institutions

Private investors, employers and value-chain actors operating within the BVIS should improve employment practices and skills development to strengthen job quality and expand economic opportunities. This includes greater use of written contracts, compliance with minimum wage regulations and provision of basic occupational safety equipment. Partnerships with cooperatives and training institutions could support skills development in irrigation management, climate-smart agriculture and agri-processing, while also encouraging the growth of SMEs along the rice value chain, including milling, transport and input supply services. Civil society organizations and training providers can further support inclusive participation, particularly for women, youth and persons with disabilities, through targeted training programmes, improved awareness of labour standards and investments in accessible technologies and infrastructure.

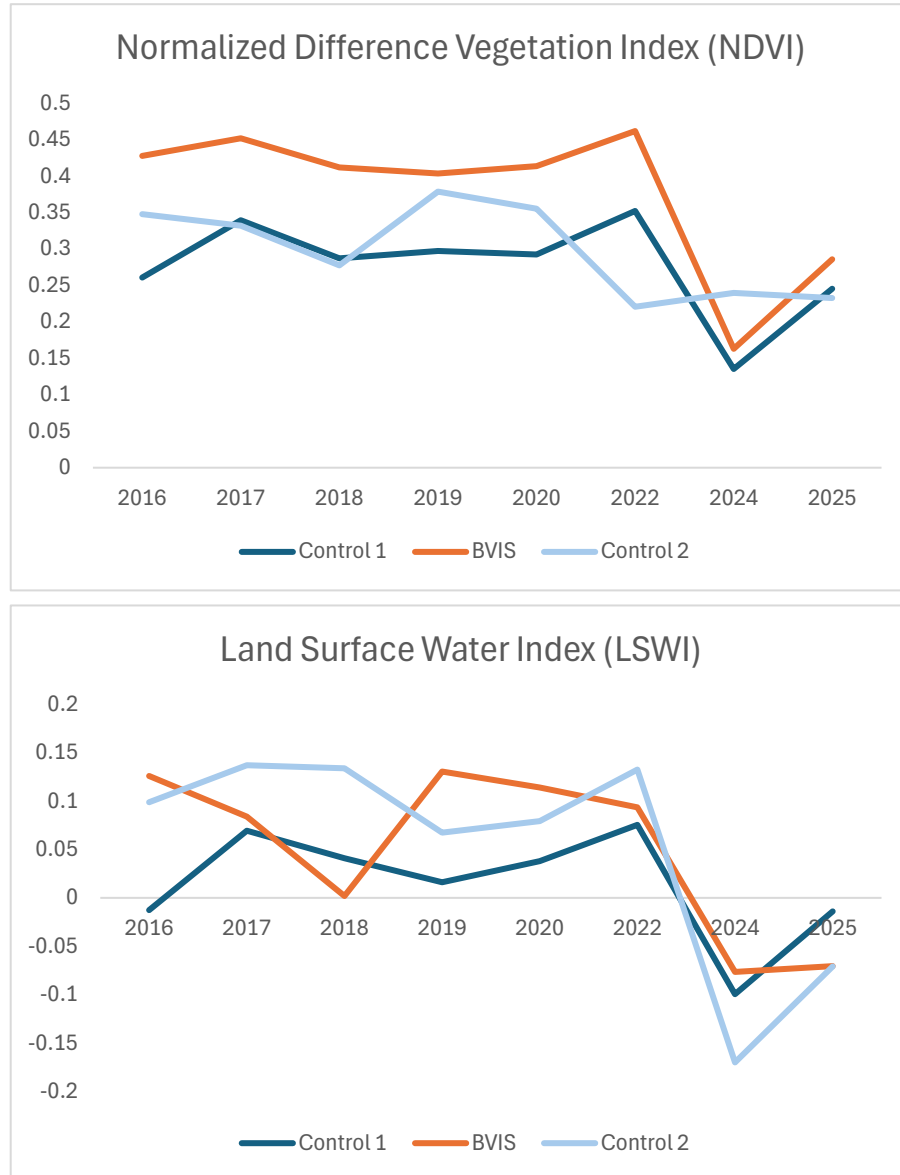
The BVIS demonstrates the potential of irrigation investments to increase agricultural activity and generate meaningful employment during the dry season in a highly climate-vulnerable context. However, the assessment also highlights that employment impacts depend on governance quality, water management, market integration and labour regulation. As the scheme is prepared to be expanded under Phase II, there is a clear opportunity to build on existing gains while addressing the institutional and labour-related constraints identified in this assessment, thereby ensuring that irrigation investments translate into more and better jobs for rural communities. The planned expansion also provides an opportunity to continue applying the EmplA approach to monitor how irrigation investments influence employment and livelihoods over time. This could be done through further fieldwork, monitoring irrigation effects using satellite data and updating the analysis with forthcoming data from the Integrated Household Survey (2024-2025). This would allow a more comprehensive assessment of longer-term employment and productivity effects associated with the scheme that can feed into the planning of Phase II.

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Annex 1. NDVI and LSWI results

► Figure A.1. NDVI and LSWI results during the wet season



Source: Authors' research.

Annex 2. Case Studies

Case study 1: Emmanuel Kapiye - Rice aggregation and trade

Emmanuel Kapiye is a rice trader from Tidyno 2 Village in Dedza District who operates at the aggregation and trading stage of the rice value chain. Prior to the completion of the Bwanje Valley Dam, his trading activities were constrained by inconsistent production volumes and variable rice quality. Improved water availability under the irrigation scheme has led to higher and more reliable rice production, enabling Emmanuel to expand his trading operations and attract a wider range of buyers. The increased volume and quality of rice have strengthened local market activity and supported income growth, allowing him to invest in housing, livestock and household food security. His experience illustrates how irrigation investments generate indirect employment and income opportunities beyond farming by strengthening agricultural markets and rural trade.



Case study 2: Isaki Paulo - From casual labour to skilled employment

Isaki Paulo, a 28-year-old from Mayiwanza Village, transitioned from casual agricultural labour to formal employment as a rice mill operator within the BVIS. Before 2021, his income depended on irregular piecework in the fields, offering little security or opportunity for advancement. Employment at the Bwanje rice mill provided a stable monthly income, predictable working conditions and skills development in rice processing. His wages have enabled him to support his household and invest in small-scale trading activities, further diversifying his income. This case highlights the role of irrigation-supported value chains in creating more stable and semi-skilled employment opportunities for rural youth.

Case study 3: Memory Chiwayu - Youth employment through rice trade

Memory Chiwayu is a 26-year-old rice trader and mobile money agent from Kapalamula Village who has benefited indirectly from expanded rice production under the BVIS. Increased and more reliable rice output has allowed her to engage regularly in rice trading, purchasing and reselling between 10 and 15 bags every two months. Income from rice trading has strengthened her household welfare, supported her child's education and enabled her to expand both her market stall and mobile money business. Her experience demonstrates how irrigation investments can create employment and entrepreneurship opportunities for young women through downstream value-chain activities, even for those not directly involved in farming.





Case study 4: Moses Liwonde - Irrigated farming as a platform for entrepreneurship

Moses Liwonde, a 28-year-old farmer from Mlongoti Village, joined the Bwanje Rice Cooperative in 2022 and uses irrigated rice farming as the foundation for multiple income-generating activities. Irrigation has enabled more reliable production and year-round income, allowing him to hire casual labour during peak agricultural periods and reinvest profits into off-farm enterprises, including phone charging, barbering and mobile money services. These activities generate additional employment and services within his community, which lacks grid electricity. His case illustrates how irrigation-supported agriculture can act as a catalyst for youth entrepreneurship and local economic diversification beyond the farm.

Case study 5: Rose Lino - Inclusive employment and leadership

Rose Lino is a 50-year-old rice farmer from Madziantsatsi Village and a long-term participant in the Bwanje Irrigation Scheme. Following the construction of the Bwanje Valley Dam, she has been able to cultivate rice twice a year, increasing productivity and income despite living with a physical disability. Through her irrigated plots, she employs at least three casual workers each season and has diversified her income into motorcycle transport and tailoring, creating additional employment opportunities. Rose also holds leadership roles within the cooperative and local development structures, demonstrating how inclusive irrigation schemes can support employment creation, entrepreneurship and social inclusion for women and persons with disabilities.



Source: Authors' research.

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