International Labour Organization

Road map to a green cocoa value chain in Timor-Leste

Business and skills development along with environmental sustainability, amid workplace realities

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Foreword

A more prosperous future for Timor-Leste and its people undoubtedly hinges on economic development and diversification of the economy. Agricultural production is a critical area and is targeted in the IX Constitutional Government Program as a priority.

This report presents an in-depth analysis of an agricultural value chain that is promising and underdeveloped – cocoa. Presented as a road map, the report proposes clear and practical interventions to foster business development (quantity and quality of production, value addition, employment), including interventions directly supporting economic units, those addressing systemic barriers, and those maximizing environmental sustainability.

The report examines the human resource needs associated with environmentally sustainable business development, together with the current skill gaps, and thus offers insights for the design and implementation of adequate education and training policies and programmes that are responsive.

The snapshot of the working conditions in the cocoa value chain is based on a field study jointly conducted with the General Labour Inspectorate (Inspeção Geral do Trabalho). These are presented through the lens of occupational safety and health considerations, contractual arrangements, and working hours. The results include the identification of gaps that need to be filled to ensure not only increases in output and employment, but also the establishment of decent working conditions.

Conducted in mid-2025 using primary and secondary research methods, the study was undertaken as part of the ILO's Country Office for Indonesia and Timor-Leste "Preparing Timor-Leste's Workers and Policymakers for a Just Transition and the Formal Economy" project. The study intended to facilitate continuous, coherent, and informed exchange between stakeholders in the cocoa value chain, including business operators, government agencies, social partners, international development cooperation partners, and civil society. By combining analysis of business development and environmental sustainability, the study will ultimately contribute to a just transition towards an environmentally sustainable Timorese economy and society.

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Director, ILO Country Office for Indonesia and Timor-Leste

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Abbreviations

HS	Harmonized System
ISCO	International Classification of Occupations
FAO	Food and Agriculture Organization of the United Nations
GIS	Geographic Information System
OSH	Occupational Safety and Health
SWOT	Strengths, Weaknesses, Opportunities and Threats
VSS	Voluntary Sustainability Standards

Executive summary

This report provides a detailed and diverse look at the potential for transforming Timor-Leste's cocoa value chain to support the country's economic diversification. After a brief overview of the cocoa value chain and its global market, a summary assessment of the strengths, opportunities, threats and weaknesses of Timor-Leste's local industry is elaborated by means of a phased business development component (Chapter 2) highlighting the necessary support interventions. The pathways to ensure that national industry development is accompanied by environmentally sustainable choices and practices (Chapter 3) and the associated (Chapter 4) quantitative and qualitative human resource needs are presented next, with the latter specifically looking at the potential occupational profiles and competencies. The fifth chapter describes the working conditions observed while conducting the study and highlights gaps to be addressed to ensure future improvements and the associated productivity gains.

Global supply constraints (leading to rising cocoa prices) are creating a timely opportunity for Timor-Leste to strengthen its position as an emerging origin of sustainably produced cocoa. With cocoa production heavily concentrated in West Africa, where ageing trees, labour shortages and disease prevalence are driving down yields, and with prices having surged by up to 169 per cent between June 2023 and June 2025, there is a growing demand for alternative and additional sources. Timor-Leste, where production includes Forastero (used to produce less-valued bulk cocoa) and Trinitario cacao tree varieties (utilized for production of high-quality fine flavoured cocoa since 2015), can possibly find market space, especially if targeting the high-value segment of fine-flavoured cocoa and, within that, the segment of sustainably harvested products. Although still in its early stages, the production is mainly organic-based and benefits from suitable land and climate conditions for (high-end) cocoa growing.

To fully exploit its cocoa potential, Timor-Leste must address sizable structural barriers. Production remains limited, with cocoa typically considered a secondary crop by many smallholding farmers. The average cocoa yields are only a quarter of those in neighbouring Indonesia (at 100 tonnes per hectare), and production is largely constrained by limited access to agricultural inputs, training and technology. These challenges are worsened by the underdeveloped infrastructure and limited private and public investment across most of the value chain activities.

The business development component of the road map outlines three gradual phases to transform Timor-Leste's cocoa sector, which relies on smallholders' production, into a modern, export-oriented industry. Phase one prioritizes improvements in infrastructure and farmers' knowledge and the development of reliable data systems to support monitoring and decision-making among the public and private sector actors. Building on this foundation, phase two shifts the focus to quality control and traceability, supported by the expansion of certified farms, independent nurseries and varietal selection. With consistent production capacity emerging, the sector will be better positioned to meet global standards for sustainable (green) cocoa. In phase three, the road map envisages the development of a domestic cocoa processing industry to increase value addition and competitiveness in international markets.

In terms of environmental sustainability, the report presents options that can be incorporated into the business development strategy. Actions include adopting agroforestry systems through intercropping with high-value timber, using organic fertilizers and implementing soil conservation measures. Integrated pest and disease management, combining chemical, biological and physical controls, is recommended to prevent future disease outbreaks like those that have occurred in West Africa and Indonesia. In the post-harvest stage, the suggested actions entail the use of solar dryers and repurposing cocoa shells and husks as biomass fuel. These practices will strengthen the environmental sustainability of the cocoa sector and better position Timor-Leste to meet emerging international standards, such as the Voluntary Sustainability Standards and those from Rainforest Alliance and Fairtrade. It will also prepare the country for emerging regulatory frameworks, including the European Union Deforestation Regulation, thereby improving market access and creating stronger incentives for farmers and processors.

The skills component of the road map addresses occupational profiles and the associated skills required for transforming the cocoa sector across the different phases. The analysis looks at farmers, traders and processors and their current and future skills profile, consistent with the ISCO-08 framework. In turn, the assessment represents the foundation for capacity-building interventions in four building areas: nursery management, cocoa-based agroforestry, post-harvest treatment and occupational safety and health (OSH) in farm and processing (factory) settings. Strengthening these areas will simultaneously improve workers' capacities, ensure quality standards and support safe and productive employment.

In addition to the road map, this report includes analysis of the working conditions in Timor-Leste's cocoa sector, primarily the OSH conditions, contractual arrangements and working hours. Based on the study's field observations and discussions, farmers are largely concerned about exposure to common biomechanical risks (repetitive motions, heavy lifting, harmful body positions) and biological risks (snakes and other wild animal bites). In contrast, safety hazards appear to be of greater concern in the processing phase, where machinery use and handling practices require stricter controls. Regarding the contractual arrangements, the study findings indicated that, unsurprisingly, cocoa farming remains largely informal, with most labour performed by individual farmers and family members in small and largely unregistered economic units. The small scale of production limits the use of hired labour, and formal employment agreements are rarely observed outside of the processing activities. Working hours in farming are highly flexible, typically ranging from four to eight hours per day, and vary with the agricultural calendar. In the processing stage, labour conditions appear more structured and regulated: Employees in the study areas followed standard working hours, commonly adhering to a 9 a.m.-to-5 p.m. schedule, in line with national labour regulations.

1 Overview of the global and Timor-Leste's cocoa markets

Cocoa, the primary raw material for chocolate, thrives in tropical countries because of their climate conditions: consistently warm temperatures, high humidity and adequate rainfall. These conditions allow cacao trees to thrive and produce cocoa beans, a process that has evolved into a global value chain that was valued at approximately US$9.91 billion in 2023 (OEC 2024). West African countries, mainly Côte d'Ivoire and Ghana, accounted for 50 per cent of world cocoa production in 2023 (FAO 2025). In Asia, Indonesia gradually increased its cocoa bean production as of the 1980s, becoming the region's top producer. To boost their value, cocoa beans are processed into cocoa paste (also known as cocoa liquor), which yields two main derivative products: cocoa butter, used in chocolate and cosmetics, and cocoa powder, used in baking and flavouring.

Despite growing investment in the processing capacity in the cocoa-producing countries, including Côte d'Ivoire's plan to process 50 per cent of its cocoa output (equivalent to 1.1 million tonnes) (USDA 2025) and Indonesia's position as the second-largest processor of cocoa butter, oil and fat (OEC 2024), most value-added processing and final consumption remains concentrated in Global North countries, particularly the Netherlands, Germany, the United Kingdom and the United States (tables 1–2).

▶ **Table 1. Volume of cocoa products exported and imported, 2023**

Product	Top exporters	Top importers
Cocoa beans	Côte d'Ivoire – **$3.68 billion**	Netherlands – **$2.21 billion**
	Ecuador – **$1.14 billion**	Malaysia – **$1.42 billion**
	Ghana – **$1.09 billion**	Germany – **$867 million**
Cocoa paste	Côte d'Ivoire – **$1.32 billion**	United States – **$560 million**
	Netherlands – **$781 million**	Germany – **$452 million**
	Ghana – **$440 million**	Netherlands – **$405 million**
Cocoa butter	Netherlands – **$1.74 billion**	Germany – **$853 million**
	Côte d'Ivoire – **$715 million**	Belgium – **$638 million**
	Indonesia – **$650 million**	United States – **$574 million**
Cocoa powder	Netherlands – **$933 million**	United States – **$388 million**
	Malaysia – **$462 million**	Netherlands – **$197 million**
	Germany – **$360 million**	China – **$175 million**
Chocolate	Germany – **$6.26 billion**	United States – **$4.04 billion**
	Belgium – **$4.09 billion**	United Kingdom – **$3.01 billion**
	Italy – **$2.74 billion**	Germany – **$2.95 billion**

Source: OEC 2024.

▶ **Table 2. Top three chocolate-consuming countries**

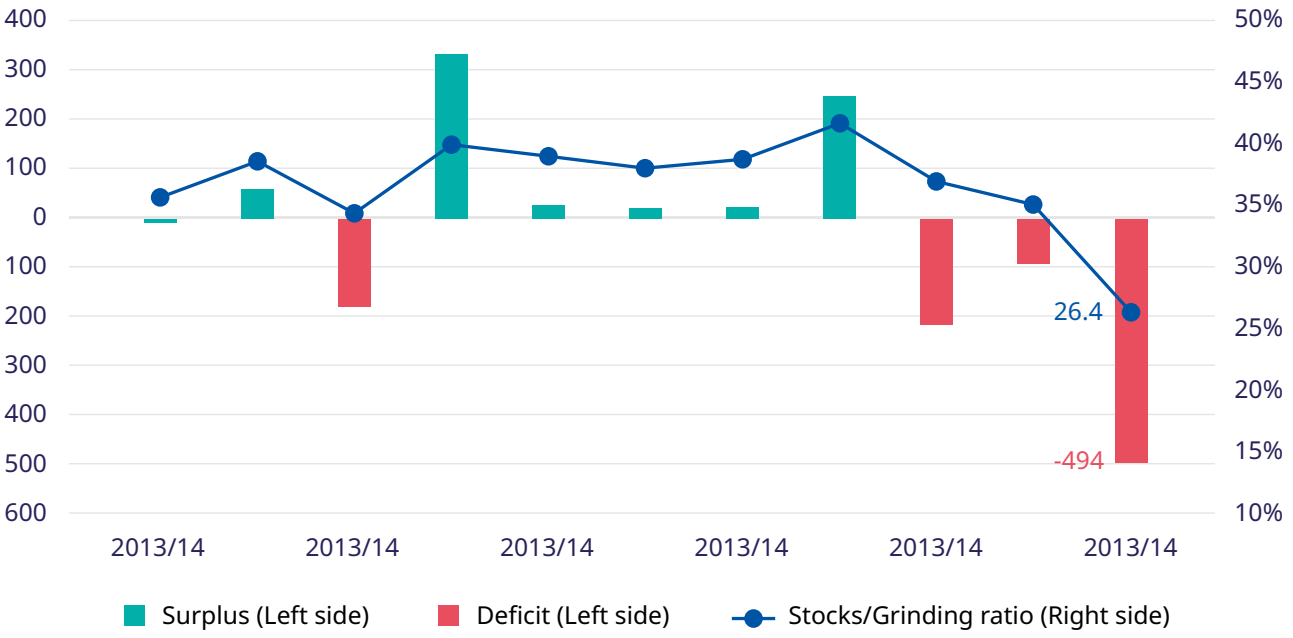
Country	Chocolate consumption (tonnes, 2022)	Chocolate consumption (kg) per capita (2017)
United States	387 216	4.4
United Kingdom	315 228	7.6
France	222 822	4.3

Source: World Population Review 2025

1.1 Market pressures and supply challenges

The global cocoa sector has been under increasing strain due to supply challenges. According to the International Cocoa Organization (2024), the global cocoa supply endured a deficit for three consecutive years (2022 to 2024) due to grinding consistently outpacing production, which indicates a persistent demand–supply imbalance (figure 1). This shortage is further reflected in the sharp rise in cocoa bean price, which surged by 169 per cent between June 2023 and June 2025[1].

▶ **Figure 1. World cocoa market balance and stock ratio, 2013–24**



Source: ICCO 2025a.

Recent dynamics in the global cocoa balance can be summarized as follows.

- For the past three years, climate volatility has persistently produced unfavourable weather (irregular rainfall, rising temperatures), which exacerbated the spread of diseases, such as cacao swollen-shoot virus disease, particularly in the West African countries of Côte d'Ivoire and Ghana (UNCTAD 2024).
- Intensive monoculture, ageing cacao trees and a lack of replanting initiatives have further reduced the productivity of cocoa farms. In addition, emerging economic activities in Côte d'Ivoire and Ghana, such as mining and palm oil cultivation, have diverted labour away from cocoa farming. This shift is particularly evident among younger labourers, who increasingly view wages from cocoa farming as unattractive (Wilson et al. 2016).

1 The price used reflects international cocoa bean average values of US$3,124.22 per tonne in June 2023 and $8,401.95 per tonne in June 2025 (ICCO 2025b).

- The International Cocoa Organization forecasts a potential surplus in the 2024/25 season, but this is primarily a demand-side response to the high cocoa bean prices. However, suboptimal rainfall patterns suggest that the risk of recurring supply deficits remains high (USDA 2025).

1.2 Fine flavour cocoa and bulk cocoa

Cocoa can be categorized into two primary classifications from a worldwide commercial standpoint: bulk, or ordinary, cocoa and fine flavour, or high-quality, cocoa. Fine flavour is appreciated for its complex sensory attributes, which include fruity, flowery, caramel and woody overtones. This high-quality flavour is a result of a mix of genetic, environmental and post-harvest characteristics that improve aroma, flavour and overall bean quality (ICA 2010)

What is the certification in the cocoa sector?

Voluntary Sustainability Standards

- Rainforest Alliance
- Fairtrade
- European Union or United States Department of Agriculture Organic

Mandatory standards

- European United Deforestation Regulation (EUDR)
- Corporate Sustainability Report Directive (CSRD)

Mostly grown in Ecuador, Peru and parts of the Caribbean, Criollo and Trinitario are two high-value cacao varieties often used to produce fine flavour cocoa. They have a distinct flavour and aroma profile that differ by origin, even from the same varieties type. For example, research on Criollo cacao found constant fruity flavour attributes among cocoa beans from the Dominican Republic, Mexico, Peru and Venezuela but with notable regional differences (Putri et al. 2024). Due to these distinct sensory qualities, fine flavour cocoa is typically traded at a premium in the global market. In Latin America, fine flavour cocoa accounted for approximately 14 per cent of the region's total cocoa output in 2020, equivalent to an estimated 730,000 tonnes of the more than 5 million tonnes produced globally each year (Voice Network 2022). In contrast, Ghana's contribution to fine flavour cocoa production is relatively limited and, for reference, in 2012 accounted for an estimated 5–12 per cent of the global production with variation depending on the specific classification criteria and definitions applied (Daniels, Lauderach and Paschall 2012).

Among the fine flavour cocoa varieties, Criollo is widely regarded as the rarest and most expensive due to its agronomic fragility and low productivity (Hamrick, Fernandez-Starke and Gereffi 2017). Native to Central and South America, Criollo trees are highly susceptible to pests and diseases and produce lower yields compared to the more robust cacao varieties, such as Forastero. These challenges have led to a significant decline in Criollo cultivation over the centuries, making it a high-risk option for growers. Nevertheless, Criollo continues to be cultivated on a limited scale (Terza 2023), primarily by smallholder farmers catering to niche markets that value its distinctive sensory qualities.

▶ **Table 3. Cocoa varieties, by type and characteristics**

Variety	Origin	Flavour profile	Category
Criollo	Venezuela	Fruity, nutty	Fine flavour cocoa
	Ecuador	Acidic, harsh, low cocoa	
	Mexico	Strong acidic, low fruitiness	
Forastero	Côte d'Ivoire	Fruity, nutty, low bitterness and acidic	Bulk
	Brazil	Bitter, acid, astringent	
	Ecuador	Floral, low chocolate, earthy notes	Bulk, *some fine flavour*
Trinitario	Trinidad and Tobago	Aromatic, nutty bitterness	Fine flavour cocoa

Source: Based on Kongor et al. 2016 and Afoakwa et al. 2008.

1.3 Sustainable cocoa

Rising concern about the long-term sustainability of the global cocoa value chain is driving international buyers to increasingly prioritize sustainably produced cocoa. To meet this expectation, Voluntary Sustainability Standards (VSS) and mandatory sustainability standards have been integrated into the global cocoa value chain. The VSS is a system developed to promote more sustainable, ethical and transparent cocoa production practices. These standards are adopted by companies or organizations voluntarily, such as Fairtrade, Organic and Rainforest Alliance. Certification is therefore essential in the implementation of sustainability obligations in the cocoa sector because it provides producers with a formal way of demonstrating conformity to the principles of a given VSS. In 2019, at least 47.3 per cent of total cocoa production was compliant with the VSS, reflecting a considerable increase from 27 per cent in 2008 (Voora, Bermúdez and Larrea 2019).

Participation in the VSS schemes enables cocoa farmers to access premium markets, with price advantages reaching up to 30 per cent when compared to non-certified cocoa, thereby improving household income and resilience. These schemes also protect producers from international price volatility through stable trade relationships and contribute to better food and nutrition security due to higher yields and access to sustainable inputs (Perez-Aleman 2012).

VSS participation enhances occupational health by reducing pesticide use, with farmers reporting fewer pesticide-related health issues (Sellare, Meemken and Qaim 2020). Certified farmers tend to adopt improved agricultural practices, such as integrated pest management, agroforestry, soil analysis and biological controls, which contribute to long-term land productivity. Rising demand for certified and organic cocoa, especially in markets like the United States, reflects consumer preference for products with little chemical exposure. At the trade level, certification in 24 cocoa-producing countries has been linked to increased bilateral exports of cocoa beans and paste, although it may have reduced exports of cocoa butter due to segmentation and compliance costs (Grassnick and Brümmer 2021).

Unlike the voluntary standards, mandatory sustainability standards are legally binding regulations that require companies and countries to meet specific environmental, social and governance criteria to produce, trade or sell cocoa products in regulated markets. Failure to comply may result in penalties, legal action and/or exclusion from market access. Two prominent examples in the European Union are the European Union Deforestation Regulation and the Corporate Sustainability Reporting Directive.

The European Union Deforestation Regulation, adopted in 2023 and entered into force in 2025, requires companies that sell cocoa and cocoa-derived products in the European Union to ensure that they do not come from land deforested after 2020. The Corporate Sustainability Reporting Directive, as part of the Green Deal package, is considered a milestone for European sustainability reporting (European Commission 2022). Taking effect in 2024, it strengthens corporate transparency by requiring detailed disclosure of sustainability risks and mitigation strategies across supply chains and requires large companies with operations in the European Union to report their environmental, social and governance impacts, based on the European Sustainability Reporting Standards.

Companies and countries that do not comply with the European Sustainability Reporting Standards may receive penalties, legal sanctions and trade restrictions that threaten their access to the European market, which is one of the biggest global destinations for cocoa products (CBI 2025). But meeting these standards also enhances a company's reputation and credibility with consumers and investors, who increasingly value sustainability and ethical sourcing. Transparent reporting under the Corporate Sustainability Reporting Directive can attract responsible investment, and compliance with the European Union Deforestation Regulation helps manage environmental and social risks, including deforestation and child labour. Additionally, improved traceability and data-driven decision-making contribute to operational efficiency (European Commission 2024). By adhering to these standards, companies will benefit from a level playing field and will demonstrate their alignment with international sustainability obligations.

1.4 Can Timor-Leste help fill the market gap?

1.4.1 Timor-Leste's position in the global cocoa market

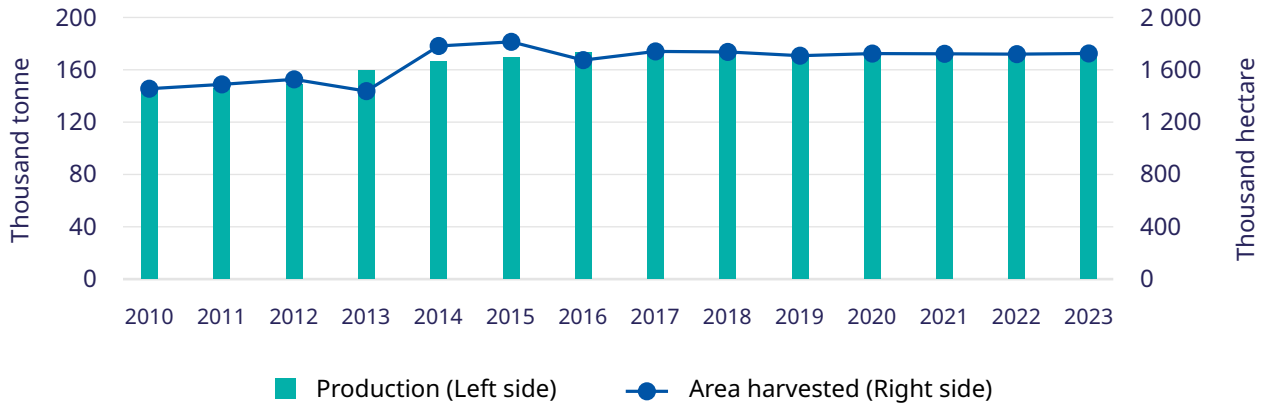
Production

Although cocoa cultivation has a long-standing presence in Timor-Leste, the country's contribution to the global cocoa market remains marginal. Between 2010 and 2023, cocoa bean production experienced a steady rise, from 142 tonnes to a peak of 178 tonnes in 2017. The harvested area reached its highest level, at 1,796 hectares, slightly earlier, in 2015 (figure 2). However, the country's annual production has plateaued since 2018, at approximately

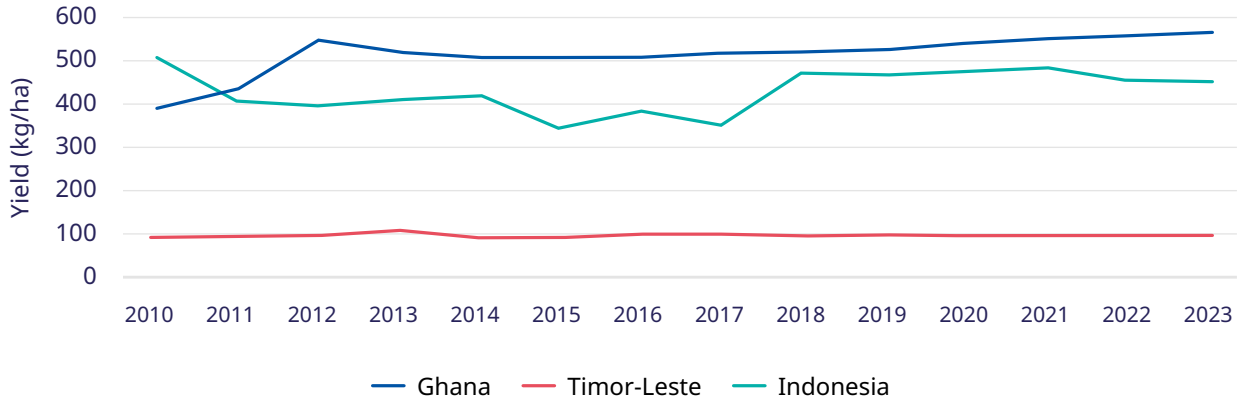
175 tonnes per year, equivalent to less than 1 per cent of the global cocoa production. The estimated size of Timor-Leste's annual harvested cocoa area is around 1,720 hectares (FAO Statistics 2023).

The country's cocoa productivity considerably lags behind Indonesia, the leading cocoa bean-producing country (figure 3). The yield in Timor-Leste began at 98 kilograms per hectare in 2010, gradually rising to a peak of 112 kilograms per hectare by 2013 and remaining relatively stable since, at approximately 100 kilograms per hectare. In comparison, Indonesia's yield, which was 511.4 kilograms per hectare in 2010, dropped sharply in 2012, to 399.6 kilograms per hectare, due to excessive rainfall that severely disrupted the cocoa harvest. It was followed by a modest recovery, at 421.7 kilograms per hectare in 2014, before stabilizing at approximately 470 kilograms per hectare from 2018 to 2023. Between 2010 and 2023, Ghana experienced a remarkable increase in its cocoa production, from 395 kilogram per hectare in 2010 to 550 kilograms per hectare in 2012, due to disease management practices and favourable weather conditions. Ghana reached its production peak of more than 550 kilograms per hectare in the 2020/21 season, with productivity remaining stable in subsequent years (ICCO 2012).

▶ **Figure 2. Timor-Leste's annual cocoa beans production, 2010–23**



▶ **Figure 3. Annual cocoa productivity in Timor-Leste, Indonesia and Ghana, 2010–23**



Source: FAO Statistics 2023

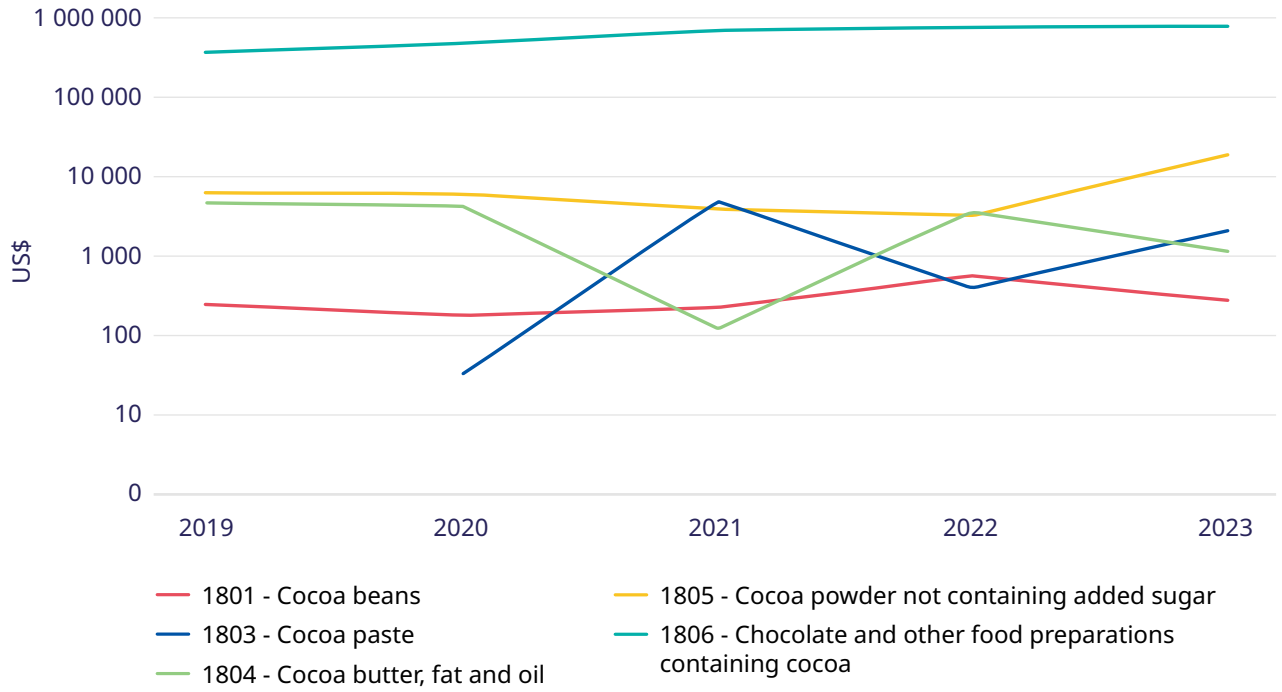
1.4.2 Exports and imports

Timor-Leste's cocoa exports remain negligible, consisting almost exclusively of unprocessed cocoa beans in limited volume. Between 2019 and 2023, the country had minimal export activity, with limited official data available for the previous years. As of 2019, Australia was the main destination for Timor-Leste's cocoa product exports, mainly raw or roasted cocoa beans (HS 1801) and chocolate and other food preparations containing cocoa (HS 1806) (UN Comtrade 2019). According to TradeInvest Timor-Leste,[2] approximately 23 tonnes of cocoa products were exported to Singapore in 2025.

2 In interviews with TradeInvest for this study.

In contrast, Timor-Leste continued to import a range of cocoa-derived products to meet domestic consumption needs as early as 2004, which suggests great opportunity to increase production to meet domestic demand (UN Comtrade 2023). These imports are classified under the Harmonized System (HS) at the four-digit level (figure 4), with chocolate and other food preparations containing cocoa consistently accounting for the highest import value.[3] Timor-Leste sources these imports primarily from regional and historical trade partners, with Indonesia, Australia, Portugal, Singapore and Malaysia as the main sources (in order of import value).

▶ Figure 4. Trends in cocoa and cocoa product imports into Timor-Leste (HS 1801–1806), 2019–23



Source: UN Comtrade 2023.

Based on this study's findings, Timor-Leste's role in the global cocoa market would be more accurately characterized as that of a net importer rather than an exporter. The official trade statistics from 2020 to 2023 indicate that the country exported a total value of nearly US$3 million.[4] This figure was just below the total value of cocoa imports over the same period, which reached approximately US$3.3 million, indicating the country's import-dependent position in the cocoa trade.

1.4.3 Core cocoa value chain in Timor-Leste

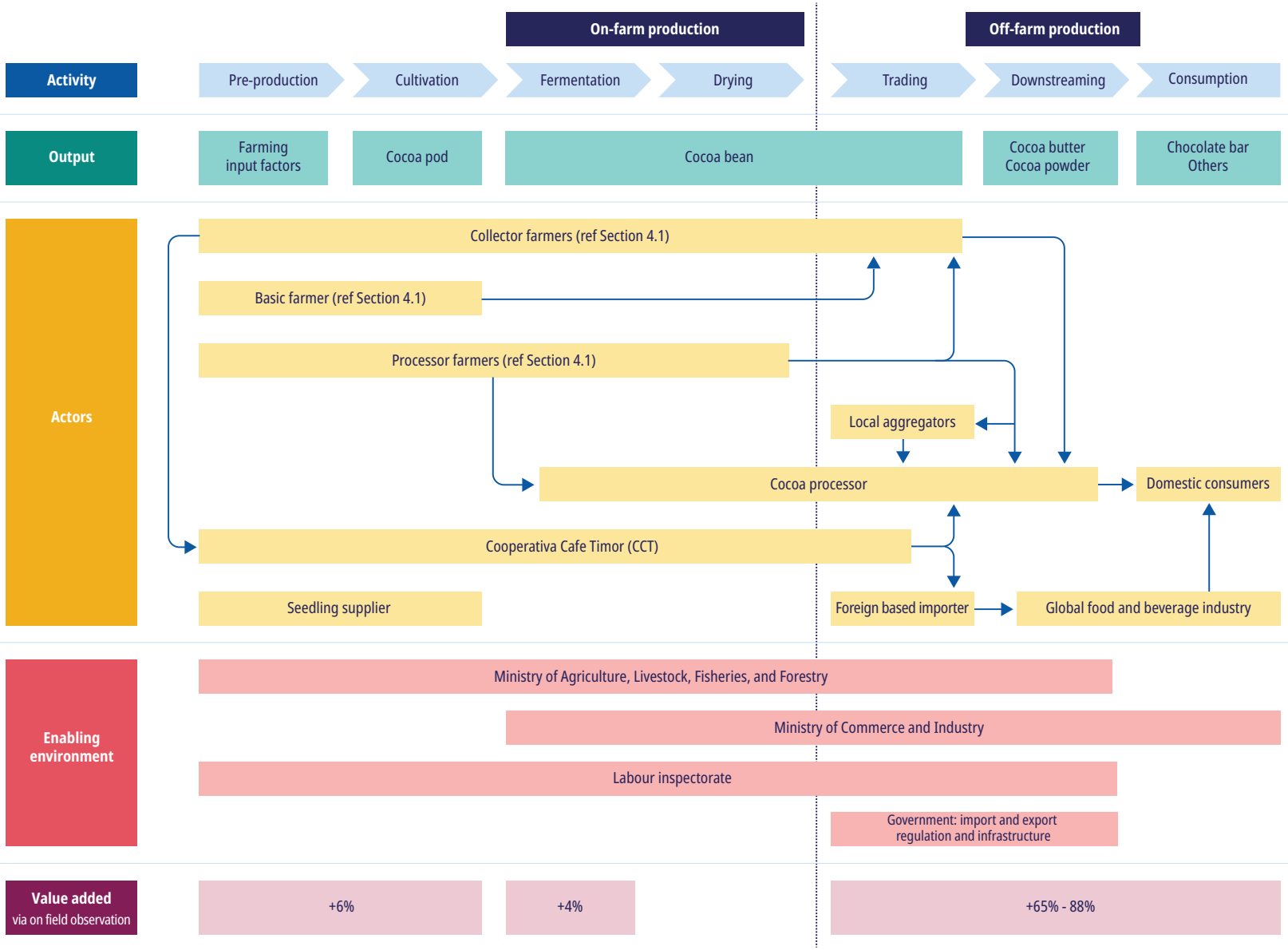
This section examines each stage of the cocoa value chain, from pre-production to final consumption, while also looking at the actors involved, from producers to end consumers (see figure 5 for a visual representation of the production-to-consumption system, and see also Annex 2 for the graphic representation of the conventional cocoa/chocolate value chain and activities). The discussion explores how each stage operates, identifies the supporting or enabling environment and analyses the distribution of value-added across the value chain process.[5] It highlights where economic gains are generated and retained within the system, thus offering insights into which segments have the greatest potential for income enhancement, particularly for smallholder producers.

3 Globally standardized method to classify traded product, developed by the World Customs Organization.

4 According to UN Comtrade data, Australia was the sole recorded export destination for Timor-Leste's cocoa products. However, when interviewed for this study, TradeInvest Timor-Leste officials also cited exports to Singapore from 2020 to 2023 and, more recently, to Indonesia in 2024. These discrepancies may reflect underreporting or misclassification in international trade databases or the use of intermediaries in export transactions were not captured in country-of-origin declarations.

5 Value addition involves producing derivative products beyond raw beans that raise the product's economic value in the supply chain.

▶ Figure 5. Timor-Leste cocoa beans value chain



Source: Authors' field investigation.

As noted, the cocoa value chain largely focuses on domestic production, with minimal export activity. Cultivation areas are generally categorized into older and newer plantation zones, in which the predominant seed sources originated from Indonesia. Trinitario varieties were introduced in 2015, while Forastero, a legacy variety from Indonesia, remains widely used. Overall productivity is low due to widespread reliance on extensive, low-input farming methods, a consequence of cocoa not regarded as an important crop. The Government's Long-Term Strategic Action Plan highlights the sector's underdeveloped status. There are no certified seed breeders, farmers are dispersed and unorganized, and most production is centralized mostly under Cooperativa Café Timor. Processing is still done at a basic level, with traditional methods, such as sun-drying, commonly used and thus further limiting the quality and output potential.

In terms of support systems and enabling conditions, infrastructure for cocoa development remains underprioritized. Farmers lack access points for essential agricultural inputs, such as fertilizers and certified seeds, and/or soil and product testing laboratories. This absence of basic services directly affects the productivity and efficiency of the value chain. The lack of testing labs and technological support also hinders quality improvements in cocoa products, which reinforces reliance on traditional processing and widens the value gap between local farmers and downstream actors in the global cocoa and food and beverage industries.

This study's field investigation found farming practices that are important for the development of Timor-Leste's cocoa sector, particularly for improving productivity, quality and farmer resilience. Table 4 synthesizes global good agricultural practices in cocoa production, drawn from a review of academic and technical literature, including guidance on sustainable cocoa production and post-harvest handling (see Amerino, Apedo and Anang 2024; García et al. 2024; Godinho, Soares and da Costa 2023; Mondelez International 2019). The current farming practices, prevailing conditions and challenges in Timor-Leste were identified through in-depth interviews with cocoa farmers, local agricultural experts and government officials (see Annex 3 for the list of interviews conducted for the study).

▶ **Table 4. Comparative overview of ideal and Timor-Leste cocoa farming practices**

Activity	Good agricultural practice	Farming practice in Timor-Leste
Pre-production	Nurseries are well-maintained with proper site selection for good soil drainage. In many countries, nurseries produce seedlings in polybags filled with excavated fertile soil and provide shade trees for young cocoa plants.	▶ Farmers manage their cocoa seedlings independently. ▶ Commercial cocoa-specific nursery sites are absent.
	Farmers should perform proper varietal identification, notably the disease-resistant ones.	Cocoa seed distribution is primarily driven by government and donor-supported programmes, which have a critical role in expanding cultivation among smallholders, particularly in remote areas. However, the majority of cocoa seeds in use today are sourced from ageing trees originally planted during the era of Indonesian governance; most are Forastero seeds. Locally propagated seeds also have a role, though informally, many farmers establish nurseries using pods from their own or neighbouring trees. Although this practice improves access and reduces costs, it is generally not supported by formal oversight or technical guidance. As a result, most farmers are unable to identify or differentiate between cocoa varieties, which contributes to the widespread use of mixed or unknown genetic material.[1]
	Cocoa varieties should be selected in accordance with environmental suitability.	There is a lack of grading or seedling selection and varietal classification in cocoa nurseries. Most farmers prioritize any variety as long as it produces a high yield. This practice results in the mixed and unclassified seedlings. For example, Cooperativa Café Timor planted cocoa seedlings without clear identification of the varieties, resulting in poor yields in certain areas (such as Los Palos) and higher-performance growth in others (Viqueque Municipality).

Activity	Good agricultural practice	Farming practice in Timor-Leste
Cultivation	▶ Planting seedlings under a shade tree is a beneficial strategy to protect them against intense sun exposure. ▶ Ideal plant spacing is 3–4 metres between cacao trees and 3–6 metres between shade trees.	Farmers in Ermera Municipality tend to maintain the plant spacing of 5 metres between each tree. In other areas, inconsistent spacing practices, which may lead to overcrowding, is a prominent issue.
	Cacao trees respond well to fertilizer applications if soil is unable to provide enough nutrients.	Farmers do not use fertilizers. Some farmers let organic matter, such as branches and leaves decompose on their plants as a "natural fertilizer".
	Farmers should prune their trees every two to three months depending on the growth. Pruning allows more light exposure and increases air flow, which can reduce the risk of disease, such as black pod and witches' broom.	Only a small share of farmers prune their trees. Many farmers lack knowledge on proper pruning techniques.
	Proper knowledge on diseases and the adoption of pest control, either through pesticides or integrated pest management, are common among cocoa farmers.	Cocoa farmers can recognize black pod disease,[2] but they are not fully informed about its cause or ways to prevent or cure it. Moreover, pesticides are generally not used in farming practices, resulting in minimal chemical intervention for disease or pest control.
	A reliable and steady water supply is important to maintain soil moisture.	Cocoa farming relies entirely on rainfall, with no irrigation systems in place. Although drought is not yet a major issue, it could threaten future productivity.
	Agroforestry (mixed planting) implementation can improve soil fertility, water retention and climate regulation.	Traditional mixed planting, locally known as *kuda haur,*[3] is seen in some places but still conducted on a small scale.
Fermentation	Cocoa beans must be fermented in aerated wooden boxes or heaps for five to seven days. The temperature inside the fermentation container should be maintained at 40°–50°C and cocoa beans must be mixed regularly for uniformity.	▶ Fermentation lasts three to four days in plastic buckets or plastic sacks. ▶ Proper fermentation is not performed by all farmers, leading to inconsistent quality.
Drying	▶ Beans should be sun-dried between five and ten days, with regular turning. ▶ Mechanical dryers can be used if deemed necessary. ▶ Moisture level of dried beans must be within 7–7.5%.	▶ The drying process might take three to seven days, depending on weather conditions. ▶ Most farmers dry their cocoa beans on tarps or metal sheets, although the use of drying racks was found in Viqueque Municipality. ▶ Some farmers are not cautious and shorten the drying period to only two or three days, risking the quality of their dried beans.

Source: [1]=Although genetic variation may influence quality, it is not the primary constraint. [2]=Black pod disease has become a prominent issue in areas with old cacao trees, such as Natarbora and Viqueque municipalities. [3]=The traditional practice of agroforestry, a form of climate-smart agriculture that combines trees and crops to improve food security, restore degraded lands and improve soil and water retention.

Down-streaming in the cocoa value chain involves transforming raw beans into semi-processed or finished products, such as liquor, butter, powder and chocolate. It is a key strategy to increase the domestic value capture and employment. In Timor-Leste, downstream activities remain limited to small-scale chocolate manufacturing, with minimal engagement in grinding or intermediate processing. Globally, chocolate manufacturing follows strict

standards, such as ISO 22000 and HACCP,[6] and sustainability certifications like Rainforest Alliance or Fairtrade. These standards ensure food safety, traceability and market access. According to the interviews for this study, small-scale cocoa processors typically lack compliance capacity; only a few of the processors follow good manufacturing practices and set their own hygiene standards[7] or quality protocols to meet a buyer's requirement.

Grinding, the process of transforming cocoa nibs (crushed cocoa beans) into a fine, smooth paste called cocoa liquor, is an essential step in down-streaming. It is increasingly located in origin countries, driven by large enterprises like Cargill, Barry Callebaut, Olam and Ecom (Nielsen et al. 2020). These multinational companies control more than two thirds of the global grinding. In Timor-Leste, such activities are minimal, although a small number of domestic processors have emerged in recent years. Examples include Pattys Serie (chocolate bars and powder), Mehi the Cacao (artisanal bars) and PARCIC (local NGO producer), which produce chocolate bars of quality comparable to Costa Rica's standards. Still, they remain a niche and small in scale; no large-scale grinding exists yet.

In this context, consumption has an important role in shaping the potential for downstream processing. In Timor-Leste, domestic consumption of cocoa-based products remains relatively limited, mostly centred around artisanal chocolate produced by small processors. Cocoa derivatives, such as cocoa butter and powder, both of which carry higher value, are not widely used in the country's food industry. These ingredients are essential not only for chocolate production but also for a range of other food and non-food products, including bakery goods, dairy-based desserts, beverages, confectionery and cosmetics.

In contrast, Indonesia illustrates how more diversified domestic consumption can help sustain grinding operations. Ground cocoa is used for chocolate bars and as an input in dairy, baked goods, confectionery and even cosmetics. Grand Kakao Indonesia and Pipiltin Cocoa, for example, engage in grinding and intermediate processing that supports industrial supply chains and the production of premium chocolate. Additionally, Freyabadi Indotama supplies cocoa ingredients through brands like Tulip and Embassy, catering to both industrial buyers and small-scale users, such as home bakers and food service businesses. This broader and more integrated use of cocoa products as inputs across sectors strengthens domestic demand for semi-processed cocoa and supports the development of grinding capacity closer to the source of production.

6 Hazard Analysis and Critical Control Points, or HACCP, is a systematic, preventive approach to food safety that identifies, evaluates and controls biological, chemical and physical hazards, from raw material production to finished product.

7 According to the study findings, small-scale cocoa processors tend to implement the following hygiene protocols in their processing facility: (i) workers must use mask, gloves and hair nets; (ii) frequent visits from external parties are restricted; and (iii) footwear used outdoors is not allowed in a facility.

2 Timor-Leste's cocoa value chain business development

2.1 SWOT analysis

This study used strengths, weaknesses, opportunities and threats (SWOT) analysis to identify strategic directions for transforming the cocoa value chain in Timor-Leste. SWOT analysis is a widely used strategic planning tool across disciplines, originally developed to support organizational decision-making and future strategy formulation (Helms and Nixon 2010). The study categorized the four dimensions as follows.

- **Strengths:** The internal attributes that provide advantages to the sector.
- **Weaknesses:** The internal limitations or gaps that hinder the development progress of the sector.
- **Opportunities:** The untapped potential or emerging trends that the cocoa sector can leverage.
- **Threats:** The existing or foreseeable risks that could hinder sector development if not anticipated and mitigated.

The distinction between internal and external factors in the SWOT analysis was determined by whether the issue could be influenced or controlled by the actors within the cocoa sector, such as farmers, cooperatives, private companies or government institutions. Based on the SWOT dimensions, the study outlined the following strategic directions to strengthen the sector.

- Building on existing strengths, which provides a foundation for reinforcing what already works well in the cocoa value chain, such as organic farming practices.
- Addressing weaknesses, which highlights priority areas for capacity-building and investment.
- Leveraging emerging opportunities, which helps align the cocoa sector with the trends in the global market and sector policies.
- Mitigating potential threats, which might undermine the development of the cocoa sector.

Table 5 elaborates on the SWOT factors in the cocoa value chain, based on:

- Secondary data analysis on production levels, yield and trade performance, which established a baseline, identified regional performance disparities and complemented the understanding of the underlying trends and constraints.
- National development priorities, as outlined in the Timor-Leste Strategic Development Plan 2011–2030, which focus on transforming agriculture into a sustainable, market-oriented sector. Goals include enhancing food security, reducing rural poverty and boosting exports through improved practices and value-added production.
- The in-depth interviews with stakeholders from the Government, agriculture sector and farming communities to ensure that the proposed interventions respond to field-level conditions.
- Spatial data and land suitability assessments conducted during the study's field observations and consultations with local experts and official institutions to guide the strategic placement of cacao farms and plantations.
- The systemic weaknesses identified through the insights and aspirations expressed during the in-depth interviews and in line with Timor-Leste's national development priorities.

▶ Table 5. SWOT analysis of Timor-Leste's cocoa value chain, 2025

Strengths	Weaknesses
▶ **Organic farming (no fertilizer):** The farming techniques without chemical fertilizers enhances sustainability and environmental health, appealing to eco-conscious consumers. ▶ **Traditional composting:**[1] This practice enriches soil fertility naturally and reduces dependency on chemical inputs, maintaining soil health and biodiversity. ▶ **Soil condition (not saturated):** The soil, which is not yet saturated or exhausted, indicates good potential for cocoa production. ▶ **Land ownership (more than 1 hectare):** Most cocoa farmers manage agroforestry plots larger than 1 hectare, allowing them to maintain diverse tree cover while scaling cocoa production gradually – though smaller plots can also be productive with shared support systems. ▶ **Adaptability to training:** Local cocoa farmers have shown a willingness to adopt good agricultural practices when training is delivered.[2] ▶ **Stable water supply:** A steady rainfall without sign of drought in years ensures steady cacao growth and reduces crop stress. ▶ **Growing interest in cocoa processing:** There›s an increasing trend in scaling up cocoa processing activities locally, adding value beyond raw cocoa production. ▶ **Agricultural education institutions:** Existing agricultural schools and universities, although with limited personnel, offer a foundation to expand curricula with specialized courses in cocoa cultivation, thus enhancing sector knowledge and fostering innovation along the value chain.	▶ **Little disease knowledge:** Farmers have limited understanding of the various cocoa diseases and disease-resistant varieties, which affects effective prevention and control. ▶ **Inadequate mitigation skills:** There is a lack of knowledge on managing and mitigating tree diseases, which risks crop health. ▶ **Ongoing use of traditional methods**: Some farmers use outdated methods (such as fermentation and drying), which may limit quality improvements. ▶ **Poor infrastructure:** Inadequate infrastructure complicates transportation and logistics, affecting timely and profitable market access. ▶ **Ageing cacao trees:** Older trees in production centres are susceptible to disease and reduced yield and quality, posing a sustainability risk. ▶ **Lack of young farmers:** The younger generation is not attracted to cocoa farming, which threatens long-term labour availability. ▶ **Limited trainers and service providers:** The absence of specialized agricultural trainers, such as vocational educators and technically trained facilitators, and the lack of dedicated training centres severely limit farmers' access to structured knowledge and technical support.[3] ▶ **No access to certification:** Cocoa farmers lack access to sustainability certification schemes under voluntary sustainability standards due to the absence of local institutions to support the certification processes. This reduces both the awareness and motivation among farmers to adopt sustainable practices, ultimately limiting their access to premium markets and value-added opportunities. ▶ **Inability to differentiate varieties:** Farmers lack the ability to manage or grow different cocoa varieties, potentially limiting diversification and resilience. ▶ **Limited adoption of modern practices:** Most cocoa farmers have not adopted modern agricultural inputs, such as proper crop spacing and basic mechanization, primarily due to their limited access to capital, lack of exposure to and knowledge of practical demonstrations and a general reliance on traditional methods.
Opportunities	**Threats**
▶ **Proximity to Indonesian market:** Being near a large consumer market, like Indonesia, opens avenues for exports and trade expansion. ▶ **Premium price for organic cocoa:** The growing global demand for organic and certified products can fetch premium prices and better profitability. ▶ **International buyer interest:** Disruptions in other major cocoa-producing regions, such as in Côte d'Ivoire and Ghana, are creating openings for new buyers, enhancing export potential. ▶ **Low import tariffs:** Favourable import tariffs on machinery and inputs facilitate access to technology and modernization tools	▶ **Humidity and temperature challenges:** Climate conditions hinder proper storage, which affects the cocoa quality in end-products. ▶ **Black pod disease:** The spread of black pod disease poses a serious threat to crop health and yield. Although remedies exist, such as proper sanitation, pruning and fungicide application, they are rarely applied due to a lack of knowledge among farmers about the causes and prevention methods.4 ▶ **Emerging major cocoa producers:** Competition from major producers, such as Brazil, could reduce market share if scale and production do not improve.

Source: [1]=Traditional composting refers to the farmers' efforts to manage organic waste as compost feedstock, typically without a deliberate composting technique, such as controlling the carbon-nitrogen composition, using a bio activator or establishment of a composting facility. [2]=In the study's interviews, several farmers expressed a preference for learning through visual media. Local NGO staff and cocoa processors noted that farmers are generally responsive to training and have even started using social media platforms as informal learning tools. [3]=There are no institutions or programmes in Timor-Leste offering targeted cocoa training. Most agricultural knowledge is passed down informally by older farmers. The national agricultural university offers a general agricultural curriculum without specification. [4]=The study's field observations and interviews revealed that this issue is notable in Viqueque Municipality, where older cocoa farms have been heavily affected and farmers are generally unaware of the nature of black pod disease, its transmission or effective treatment.

Timor-Leste now has opportunity to build on its organic cocoa farming practices to access markets that demand organic-produced (sustainably) cocoa. Its geographic proximity to major cocoa processing hubs, such as Indonesia, combined with the presence of organic cultivation, provides a starting point for developing a competitive value chain. However, several weaknesses persist, such as limited cultivation and processing capacity, inadequate infrastructure and logistics and the absence of several supporting functions (nursery and extension services, for starters). Although the sector has not yet encountered major threats, such as large-scale pest or disease outbreaks that other cocoa-producing countries have experienced, its reliance on environmentally sustainable practices should be maintained and scaled up to reduce future risks.

Building on the SWOT analysis, the following sections elaborate on the three strategic components of the proposed road map, business development, environmental sustainability and skill development. The business development component presented below outlines a phased approach to scaling up the sector into a competitive, export-oriented industry. Complementing this, the environmental sustainability component presented in Chapter III identifies on-farm practices that support sustainable growth. Chapter IV then outlines the skills development component, which features the occupational roles and skill levels of actors in the value chain required to support industrial development. It also presents priority areas for capacity-building to promote formal employment, improve workplace safety and strengthen the capabilities of the cocoa workforce.

2.2 Business development

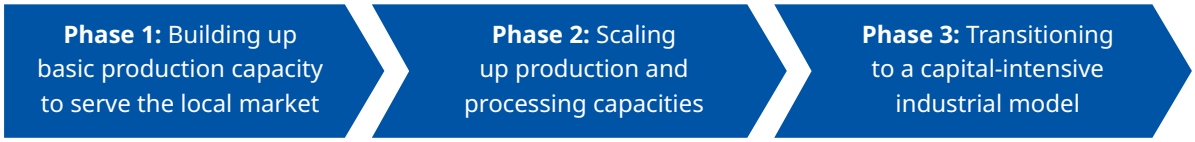
The business development component translates the SWOT findings into a phased approach to the sustainable development of the cocoa sector in Timor-Leste.[8] This phased approach is designed to create a resilient cocoa value chain that supports smallholders and promotes industrial growth. The latter two phases build on the previous phase to enable gradual progress.

- **Phase 1** focuses on improving the enabling environment, such as the infrastructure and information technology necessary for a scalable sector. This phase is expected to begin as early as year 1 and may extend up to year 6.
- **Phase 2** advances this foundation by scaling up both production and processing capacities, with the aim of maximizing utilization rates and enhancing product quality to meet higher market standards. This phase is expected to begin as early as year 3 and may extend up to year 6.
- **Phase 3** for a transition towards a capital-intensive industrial model, prioritizing value addition and local manufacturing through an import-substitution strategy. This phase is projected to commence after year 6, once the enabling environment and production capacities are scalable.

Each phase of the road map is operationalized through interventions that facilitate a clear implementation process:

- **Capital investment:** The resources required to operationalize each intervention.
- **Systemic conditions:** The underlying institutional, technical or structural barriers that currently impede progress, thereby providing the rationale for the proposed intervention.
- **Outcomes:** The expected system change result from the implementation of each intervention.
- **Employment generation:** The type of jobs that are expected to be created as a result of a specific intervention.
- **By-products:** The secondary outcomes that result from the intervention, aside from the primary intended outcome in the cocoa sector.
- **Timeline:** The projected period for implementation, thereby informing the sequencing and coordination of interventions.

These components provide a practical framework that translates the strategic priorities into concrete actions, enabling the progress towards the sustainable development of the cocoa sector (tables 6–8).



8 A similar approach can be found in the Sustainable Farming in Tropical Asian Landscapes Programme, a regional initiative that supports inclusive, landscape-based agricultural development in Timor-Leste (Laksemi et al. 2022).

Phase 1: Building up basic production capacity to serve the local market

▶ Table 6. Building up basic production capacity to serve the local market, Phase 1

Intervention	Required investment	Systemic condition	Outcome	Employment generation	Byproduct	Timeline
Improvement of cocoa data management	▶ IT infrastructure ▶ Software ▶ Data collection tools	Suboptimal effort from policy-makers to construct reliable and accurate cocoa database, possibly due to lack of interest and resources	▶ Better data integration ▶ Timely market insights for private investment	▶ Employment in data collection ▶ Monitoring and management (statisticians and data analytics)	N/A	Years 1–3
Land suitability assessment	▶ Geographic information system (GIS) technology ▶ Survey equipment	Policy-makers have not required this assessment	Better cocoa-related national planning	GIS experts	Improved geographic information for other timber and plants related to cocoa agroforestry	Years 1–3
Cocoa nurseries	▶ Seeds and seedlings ▶ Farm shed for seedlings	Lack of knowledge and skill on cocoa seedling selection and cloning; lack of financial resources; lack of access to cocoa breeders (agricultural scientists and research institutes, that develop new cocoa varieties by selecting and crossing different cocoa trees such as ICCRI Indonesia)	More pest- and disease-resilient cocoa varieties in the country's climate conditions	Nursery farmers	N/A	Years 1–3
Rehabilitation of damaged roads	▶ Heavy machinery ▶ Construction material	Lack of financial resources	Lower logistic costs, up to 65% (Callanta and Moreno 2024)*	Temporary jobs in construction and road maintenance	Lower logistic cost for other commodities	Years 1–6

Note: Logistic costs refer to shorter delivery times, less fuel consumption, reduced spoilage and product loss and reduced unexpected vehicle repairs.

Phase 1 of the business development component is designed to address the challenges within the cocoa value chain by focusing on improving infrastructure, knowledge and data management systems. According to the study findings, cocoa-related data at the national and regional levels are not easily accessible, thus hindering the ability to track sector-based developments and address the challenges. The establishment of a robust data management system is crucial for enhancing industry monitoring and enabling data-driven decision-making. Additionally, the absence of modern agricultural practices and clear varietal classification has led to inconsistent yields across different regions. For example, cocoa production is notably lower in Los Palos than in higher-performing areas, such as Viqueque. The integration of GIS technology for land suitability assessments and varietal classification will be key to optimizing cocoa production. And the development of cocoa nurseries will enable the introduction of more resilient, disease-

resistant varieties, thus contributing to long-term sustainability. Complementing these initiatives, the rehabilitation of critical road infrastructure will facilitate improved distribution networks, reduce the logistics costs and enhance market access for cocoa farmers.

Phase 2: Scaling up and maximizing production, processing capacities and enhancing quality

▶ Table 7. Scaling up and maximizing production, processing capacities and enhancing quality, Phase 2

Intervention	Capital investment	Systemic condition	Employment generation	Outcome	Timeline
Establishment of cocoa lab	▶ Moisture meter, hygrometer and sorting machines ▶ Labs for microbial and mycotoxin tests	No service provider	Laboratory scientists and cocoa experts	Improved quality and safety of cocoa beans	Year 5
Increasing number of farms and/or plantations certified under certain Voluntary Sustainability Standards (VSS)	Socialization of VSS	No headquarter office or certification centre	Assessors	VSS-certified cocoa beans	Years 3–6
Market matchmaking	▶ International trade exhibitions ▶ Public branding campaigns ▶ Market intelligence	Asymmetric information regarding cocoa supply and demand	Trade facilitators	Higher export production	Years 4–6
Refresher module development	▶ Curriculum design ▶ Training materials	Knowledge transfer largely relies on informal learning from older farmers	Cocoa field experts, lecturers and local trainers	Farmers are applying sustainable practices from a seedling nursery to post-harvest handling	Years 3–6

Phase 2 of the business development component covers scaling up and maximizing production and processing capacities to enhance quality. Building on the progress made in Phase 1, in which cocoa production can be consistently tracked through specific varieties and independent nurseries, the focus shifts to quality control. The establishment of a cocoa laboratory will ensure that the processing stages are controlled and measurable, with equipment, such as moisture meters, hygrometers and sorting machines, to test the microbial content and mycotoxins, thus improving the quality and safety of cocoa beans. This intervention will elevate product standards and enhance the industry's reputation in global markets. Despite the importance of performing optimal quality control, the proposed path foresees establishing the cocoa laboratory after the fifth year due to economies of scale considerations. Indeed, the cocoa production volume in the first four years would likely be too small in comparison with the ideal capacity of the proposed laboratory, while increasing the number of farms and/or plantations certified under voluntary sustainability standards will be essential for establishing a consistent supply and demand. Given the limited participation of young farmers in Timor-Leste's cocoa sector, the design of cocoa farmer training programmes should incorporate the specific needs of youths, particularly young women. The Government can exercise this crucial role by facilitating market matchmaking through trade facilitators, thus further strengthening the cocoa sector's market position and fostering export growth.

Phase 3: Transitioning to a capital-intensive industrial model that follows an export-oriented strategy

▶ Table 8. Transitioning to capital-intensive industrial model that follows an export-oriented strategy, Phase 3

Intervention	Capital investment	Systemic condition	Employment generation	Outcome	Timeline
Expanding outputs of chocolate bars from domestic producers	▶ Machinery in roasting, conching and winnowing ▶ Initial outlays and working capital for biodegradable chocolate packaging	Limited scale of domestic cocoa production	Farmers and farm labour	Higher domestic cocoa-derived products	After year 5
Cocoa butter extraction and refining	▶ Pressing machines ▶ Butter melters ▶ Deodorizers ▶ Plate heat-exchangers ▶ Chill water and filter systems	Lack of financial resources	Machine operators and quality control analysts	▶ Initial production of cocoa butter ▶ Diversification of cocoa-derived products for domestic and export markets	After year 5
Cocoa powder production	▶ Hydraulic presses ▶ Pulverisers and tanks	Lack of financial resources	Machine operators and quality control analysts	Greater volume of cocoa powder production	After year 5

Phase 3 of the business development component focuses on transitioning to a capital-intensive industrial model that fulfils the demand in domestic and export markets. An important intervention is the support for local processors to transform raw cocoa beans into finished products. This will involve investing in machinery for roasting, conching and winnowing, along with the working capital for biodegradable packaging. This shift will create more value-added opportunities for local farmers and labourers while reducing waste from cocoa shells and nibs, which can be repurposed for packaging or organic fertilizer. Additionally, the establishment of cocoa extraction and refining facilities will diversify cocoa products for the domestic and export markets, thus contributing to increased output. This will generate new job opportunities for machine operators and quality control analysts, while by-products like cocoa cake discs and sweatings[9] also will be produced. These initiatives, collectively, will drive economic growth, foster job creation and promote product innovation, triggering a significant shift in Timor-Leste's cocoa sector.

9 Liquid waste from pulp fermentation that is used in producing alcohol beverages, vinegar and jams.

3 Environmentally sustainable cocoa value chain in Timor-Leste

3.1 Opportunity for environmentally sustainable cocoa production

The cocoa value chain has environmental impacts across its various activity stages. Some studies have suggested that the cultivation stage has a comparatively greater environmental impact than the processing and manufacturing stage because it is associated with deforestation, biodiversity loss and soil degradation (see for instance Kongor, Owusu and Oduro-Yeboah 2024; Recanati et al. 2018)nevertheless environmental assessments and certifications of cocoa and chocolate are still missing. Given this gap and the increasing global demand for cocoa derivatives, this study aims to evaluate the environmental impacts of an Italian dark chocolate through a holistic cradle-to-grave Life Cycle Assessment (LCA. Expansion of cocoa cultivation is a major deforestation cause in some cocoa regions, leading to biodiversity loss and disruption of the forest ecosystem.

In terms of agriculture practice, the intensive application of agrochemicals for weed control, insect and disease management, as well as soil fertility, may result in soil pollution and degradation. These practices have increased the vulnerability of the cocoa value chain. In West Africa, for instance, the spread of cacao swollen-shoot virus disease has severely impacted cocoa yields. Côte d'Ivoire and Ghana have experienced substantial yield losses (USDA 2025), while early signs of similar outbreaks have been reported in Indonesia (Bryceson et al. 2023), which is the largest cocoa producer in Asia. These patterns suggest that without a transition to more environmentally sustainable practices, emerging cocoa-producing regions risk replicating the same environmental degradation seen in the more established cocoa regions.

As an emerging cocoa producing region, Timor-Leste presents a timely opportunity to establish a more environmentally sustainable (green) cocoa value chain. The country's favourable agroecological conditions, including fertile soil, enable cocoa cultivation with relatively low agrochemical application. The average cocoa farmer does not use agrochemicals for cocoa cultivation yet. In addition, the Government (2011) has expressed preference for promoting agricultural commodities (such as coffee) as organic products in export markets. Given that the sector is still in its early development stages, Timor-Leste is well-positioned to adopt sustainable practices from the outset and avoid the degradation and disease outbreaks that more established cocoa-growing countries are experiencing.

3.2 Environmentally sustainable practices in cocoa cultivation

The study highlighted several pathways for improving the environmental sustainability of cocoa cultivation. These include the adoption of a sustainable intensification model (agroforestry and integrated pest and disease management) that uses a VSS scheme (section 1.3). Agroforestry involves the deliberate integration of trees and other woody plants, such as shrubs, palms or bamboo, with crops or livestock on the same land (FAO 2025). These strategies have been explored in various context across West Africa and South-East Asia (see Kongor, Owusu and Oduro-Yeboah 2024; Niether et al. 2020; Mithöfer et al. 2017)West Africa produces most of the world's cocoa. The crop provides economic support to cocoa-growing countries, smallholder farmers, and the chocolate confectionery industries. Cocoa is also valued for its appealing flavours and the health-promoting properties of the bioactive phytochemicals in the beans, which have received increased global attention in recent years. Main body: The cocoa industry is divided into two sectors: upstream (cocoa bean production and marketing. See table 9 for examples of these practices.

Across the cocoa-producing regions, agroforestry systems have been implemented to mitigate the adverse effects of monoculture farming, particularly on biodiversity and soil health (Kongor, Owusu and Oduro-Yeboah 2024; Niether et al. 2020)West Africa produces most of the world's cocoa. The crop provides economic support to cocoa-growing countries, smallholder farmers, and the chocolate confectionery industries. Cocoa is also valued for its appealing flavours and the health-promoting properties of the bioactive phytochemicals in the beans, which have received increased global attention in recent years. Main body: The cocoa industry is divided into two sectors: upstream (cocoa bean production and marketing. Recent meta-analysis found that cocoa agroforestry systems outperformed monoculture farming across most environmental indicators, thus supporting biodiversity conservation and climate adaptation and impact mitigation (Niether et al. 2020). Although the cocoa yields in those analysed agroforestry systems were, on average, 25 per cent lower than in monoculture systems, the overall productivity of the diversified systems was approximately ten times greater, contributing to food security and income diversification for smallholding farmers.

Agroforestry can be implemented through several practical actions: (i) Farmers can integrate nitrogen-fixing and native shade tree species[10] to enhance soil fertility and reduce the need for synthetic inputs. (ii) Farmers can use composted organic matter and manure (feedstocks) to replace synthetic fertilizers, which are among the highest emission sources in the cocoa value chain (Recanati et al. 2018). (iii) Soil and water conservation practices, including terracing, organic mulching and the installation of biopore infiltration holes, are particularly relevant in Timor-Leste, where 44 per cent of land has slopes exceeding a 40-per cent angle (Godinho, Soares and de Costa 2023; Paudel et al. 2022).

These practices can provide farmers with multiple benefits. In addition to sustaining the cocoa yields in the long term, agroforestry systems diversify income streams through the sale of high-value timber, fruit crops and carbon credits.[11] Additionally, agroforestry reduces the risk of deforestation – farmers can increase production without clearing new land, thus not only meeting sustainability standards but also the forthcoming implementation of the European Union Deforestation Regulation. That implementation will require Timor-Leste to guarantee that the cocoa exported to the European Union is not linked to deforestation or forest degradation that occurred after December 2020.

▶ **Table 9. Making the cocoa value chain environmentally sustainable (green)**

Value chain stage	Green practice	Timeline
Pre-production and cultivation (actors: farmers and cooperatives)	Agroforestry: Use of feedstock and other farm organic material as fertilizer and intercropping on cocoa farming with high-value timber	Years 1–3
	Agroforestry: Conserve the soil by using terraces, organic matter for soil cover and biopore infiltration holes (see Godinho et al. 2023)	Years 1–3
	Integrated pest and disease management: Combination use of chemical, biological and physical controls	Years 1–3
	Participate in voluntary sustainability certification (or carbon projects) to ensure that farmers receive economic return or benefits from stocking carbon through agroforestry methods, and participate in the mandatory sustainability standard schemes to gain access to the European Union market, following the European Union Deforestation Regulation requirements and the Corporate Sustainability Report Directive	Years 4–6
Post-harvest: Fermentation and drying (actors: farmers and traders)	▶ Renewable energy and efficiency ▶ Use of solar dryers ▶ Use of cocoa shells and husks for biomass fuel	Years 4–6

In addition to agroforestry, integrated pest and disease management is essential in sustainable cocoa farming. It is

10 Commonly found in Timor-Leste: Gliricidia sepium, Calliandra calothyrsus or Albizia lebbek (Godinho, Soares and de Costa 2023; Paudel et al. 2022).

11 By increasing on-farm carbon stocks through the selection of shade trees, these systems enable participation in the voluntary carbon markets.

a holistic approach that combines biological and physical controls to improve the productivity and reduce the use of agrochemicals. Strategies include use of natural predators, regular pruning and breeding pest-resistant cocoa varieties, all of which lower the dependence on chemical pesticides and have been associated with improved yields (Rizal et al. 2024; Meilin et al. 2023).[12] As demonstrated in Indonesia, the adoption of integrated pest and disease management can lead to a more resilient environment for cocoa farming (Rizal et al. 2024; Meilin et al. 2023). This strategy, however, might not be feasible in the early stage due to the limited availability of agricultural inputs in Timor-Leste.

In the post-harvest phase, when fermentation and drying occur, more environment-sustaining efforts can focus on renewable energy use and energy efficiency. Traditional wood-fired drying methods can be replaced with solar dryers, which reduce deforestation and energy costs while maintaining bean quality. Alternatively, biomass energy derived from cocoa shells and husks can be used to fuel drying ovens, thus reducing waste and promoting a circular approach. During the processing stage, actors in cocoa processing can further contribute to environmental sustainability by using biodegradable packaging or polymeric materials derived from cocoa husks (Almeida et al. 2021), thus offering both ecological and branding benefits. Moreover, the implementation of closed-loop supply chain models, in which processing waste is reused, such as turning cocoa husks into packaging or organic fertilizer, ensures that resource use is minimized across the production cycle (Fauza et al. 2024).

In the context of Timor-Leste, whereby cocoa production remains limited and economies of scale are difficult to achieve, agroforestry presents a practical and strategic entry point for building an environmentally sustainable cocoa value chain. This approach requires relatively little capital investment because farming households can use locally available resources, such as native tree species, composted organic material and traditional land management practices, to establish their cocoa agroforestry system. The integration of environmentally sustainable practices into the business and skills development components of the road map is essential to ensure that Timor-Leste's cocoa sector does not replicate the environmental degradation that has occurred in other cocoa-producing countries.

12 Integrated pest and disease management does not always rely solely on organic approaches and may at times use a combination of chemical and organic controls but in an integrated way.

4

Skills development in Timor-Leste's cocoa value chain

This chapter presents the proposed path and main elements for enhancing the skills of relevant actors at the various stages of the proposed road map. Critical occupations and skills of the critical different actors are identified while also acknowledging pre-established cocoa-related capacity-building initiatives from development agencies.[13]

4.1 Existing and projected labour needs

Cocoa cultivation in Timor-Leste is predominantly practised under an agroforestry system, in which cacao trees are intercropped with a variety of other crops, such as coffee, vanilla, black pepper and food staples. As a result, cocoa is rarely the sole source of livelihoods. Instead, it functions as part of a broader, multi-crop farming system.

This characteristic has important implications for labour and skills development within the value chain due to the time, expertise and labour allocated specifically to cocoa, which are often influenced by the competing demands of the other crops. If the cocoa sector becomes more prominent in Timor-Leste, it will drive the cocoa bean price up and thus incentivize farmers to increase production. But higher prices of other crops (such as vanilla) might lead to farmers allocating less time and energy for cocoa.

This study identified three main actors in the country's cocoa sector: (i) farmers, (ii) traders and (iii) processors. The farmer category consists of three distinct sub-actors: basic farmers, processor farmers and collector farmers. Basic farmers cultivate cocoa, producing raw cocoa pods or beans. Processor farmers, in addition to growing cocoa, engage in rudimentary fermentation and the drying of their cocoa beans. Collector farmers, in addition to cultivating and processing their own beans, collect beans from other farmers, ferment and dry them and then sell them along with their own beans.

Traders act as intermediaries: They buy processed cocoa beans (fermented and dried) from farmers and sell them to processors (chocolate producers). The largest trader in Timor-Leste's cocoa sector is Cooperative Café Timor.

Mostly located in Dili, processors produce cocoa-based products in many forms, including cocoa butter, cocoa powder and various chocolate specialties. Compared to farmers and traders, processors require more capital and perform more complex production processes.

4.1.1 Basic farmers and processor farmers

Basic farmers occupy an important role (table 10) in Timor-Leste's cocoa value chain because they provide cocoa beans for further processing in the downstream value chain. They grow cacao trees with minimal cultivation, harvest the pods and sell them in the form of pods or beans. Several farmers produce seedlings either for their own use, to

13 Some notable programmes are: (i) the European Union's Agroforestry-Skills for Employment and Resilience Programme that seeks to promote green and sustainable economic diversification and resilience through private sector development and technical and vocational education training for youth integration into the labour market; (ii) the United Nations Development Programme's Youth Employment and Entrepreneurship Skills (YEES) Project to improve economic opportunities by fostering youth-led entrepreneurship and increasing youths' access to employment; and (iii) the Food and Agriculture Organization of the United Nation's Green Jobs for Youth Project to strengthen the capacity of rural and urban young men and women in green agriculture, green energy and waste management.

sell or to give to other farmers.[14] They usually perform basic cultivation procedures, such as weeding and pruning, which are considered replanting procedures, and do not typically engage in disease treatment.

As this study found, knowledge of post-harvest rudimentary fermentation and drying procedures varies across farmers. Equipment used during the fermentation process also varies, notably plastic sacks, wooden boxes and plastic buckets. Fermentation by local farmers does not always follow good practice; for example, the average length of cocoa bean fermentation ranges from three to four days, instead of five days at the least. They perform basic grading through visual inspection.

▶ **Table 10. Basic farmers' and processor farmers' occupation and skill levels**

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
6310	Subsistence crop farmers	2	▶ Preparing the soil and sowing, planting, tending and harvesting field crops ▶ Weeding, pruning, fermenting, drying, weighing and (basic) grading ▶ Selling or bartering some products at local markets
6330	Subsistence mixed-crop and livestock farmers	2	
9211	Crop farm labourers	1	▶ Planting and harvesting field crops ▶ (Basic) grading, sorting, bunching and packing produce into containers ▶ Watering, thinning and weeding crops by hand or hand tools
9213	Mixed-crop and livestock farm labourers	1	

Note: *=See Annex 1 and ILO 2012.

4.1.2 Collector farmers

As this study found, the collector farmers are similar to the other farmer categories in terms of cocoa cultivation (table 11). They obtain seedlings from the Government, the Cooperative Café Timor or other farmers. They perform minimal plant maintenance in terms of weeding and pruning. Post-harvest treatment in the form of fermenting and drying varies without much adherence to good practice. Some farmers ferment their beans for only three or four days, in contrast to the recommended five or six days (Fowler 1999). The drying duration also varies,[15] and farmers do not inspect the moisture level of their beans after drying.

What set the collector farmers apart from the other two categories in this study is their involvement in trading activities. In addition to growing cocoa, they also engage in buying raw or fermented beans from other farmers and selling them to Cooperative Café Timor or other cocoa processors.

Collector farmers tend to be generous with the transfer of knowledge. Because they are typically the most advanced farmers in their locality, other farmers often come to them for advice. Some farmers who grow seedlings from their own plants give them to other farmers to start their own plantation.

14 The distance between trees varied in the study findings: Some farmers planted their trees with a 3-metre gap while others did not follow any pattern, especially if they practised agroforestry.

15 According to the field interviews, most farmers take three to four days to dry their fermented beans, but some dry their beans for only one or two days.

▶ Table 11. Collector farmers' occupation and skill levels

ISCO-08 Code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
6114	Mixed-crop growers	2	▶ Preparing the soil and sowing, planting, tending and harvesting field crops ▶ Weeding, pruning, fermenting, drying, weighing and (basic) grading ▶ Selling or bartering some products at local markets. ▶ Watering, pruning and weeding crops by hand or hand tools
6130	Mixed-crop and animal producers	2	▶ Driving and tending cars, vans or small trucks to deliver mail or good ▶ Navigating or determining most appropriate route
8332	Heavy truck and lorry drivers	2	

Note: *=See Annex 1 and ILO 2012).

4.1.3 Traders

Traders have a large role in the trade of agricultural commodities in Timor-Leste, including cocoa. Some traders, such as Cooperative Café Timor, have their own plantation, but their largest presence is in the trading sector. The Cooperative is by all accounts the biggest buyer of cocoa beans, buying beans from farmers across the country in various forms with various quality. The Cooperative sets prices that also vary by region and dynamic. For example, it buys beans from Natarbora farmers at US$3 per kilogram but for US$5 per kilogram from Viqueque farmers. Cooperative Café Timor uses a moisture measuring kit to grade beans, but its drying process lacks consistent standards. Cocoa processors partnering with the Cooperative reported during the study interviews that they must redry the product to meet the required moisture levels.

▶ Table 12. Traders' occupation and skill levels

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
12**	Administrative and commercial managers	3, 4	▶ Establishing and directing operational and administrative procedures ▶ Determining and directing sales activities ▶ Monitoring and evaluating strategies and policies ▶ Marketing, public relations and advertising campaigns ▶ Controlling expenditure and ensuring the efficient use of resources ▶ Controlling the selection, training and performance of staff ▶ Preparing budgets and overseeing the financial operation
1311	Agricultural and forestry production managers	3, 4	▶ Monitoring agricultural and forestry market activity and planning production ▶ Managing budgets, monitoring production output and costs; recording information, such as farm management practices; and preparing financial and operational reports ▶ Contracting with farmers or independent owners for the production of crops or for the management of production ▶ Planning the type, intensity and sequence of farm operations

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
1324	Supply, distribution and related managers	3, 4	▶ Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans ▶ Preparing and implementing plans to maintain required stock levels at minimum cost ▶ Negotiating contracts with suppliers to meet quality, cost and delivery requirements ▶ Monitoring and reviewing storage and inventory systems ▶ Establishing and managing budgets, controlling expenditure and ensuring the efficient use of resources ▶ Establishing and directing operational and administrative procedures
1420	Retail and wholesale trade managers	3, 4	▶ Determining product mix, stock levels and service standards ▶ Formulating and implementing purchasing and marketing policies and setting prices ▶ Promoting and advertising the establishment's goods and services ▶ Maintaining records of stock levels and financial transactions ▶ Undertaking budgeting for the establishment ▶ Controlling the selection, training and supervision of staff ▶ Ensuring compliance with occupational safety and health regulations
2132	Farming, forestry and fisheries advisers	4	▶ Collecting and analysing data and samples related to produce, feed, soil, water quality and other factors affecting a farm ▶ Advising on techniques for improving the production of crops ▶ Studying the effects of cultivation techniques, soil, insects and diseases
3323	Buyers	3	▶ Determining or negotiating contract terms and conditions ▶ Purchasing general and specialized equipment, materials or business services
3331	Clearing and forwarding agents	3	▶ Carrying out customs-clearing procedures for exports or imports. ▶ Ensuring that insurance is in order ▶ Ensuring that export and import licenses and other formalities are in order ▶ Signing and issuing bills of landing
43**	Numerical and material recording clerks	2	▶ Helping with accounting ▶ Bookkeeping records and computations ▶ Calculating unit production costs ▶ Checking production operation schedules
5153	Building caretakers	2	▶ Supervising the work of cleaning, housekeeping and building maintenance staff and contractors ▶ Participating in cleaning, simple repairs and maintenance of building interiors ▶ Notifying management and owners of buildings of the need for major repairs ▶ Patrolling buildings to ensure security is maintained

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
6111	Field crop and vegetable growers	2	▶ Preparing the soil and sowing, planting, tending and harvesting field crops ▶ Weeding, pruning, fermenting, drying, weighing and (basic) grading ▶ Selling or bartering some products at local markets ▶ Watering, thinning and weeding crops by hand or hand tools
6114	Mixed-crop growers	2	
6130	Mixed-crop and animal producers	2	
8332	Heavy truck and lorry drivers	2	▶ Driving and tending cars, vans or small trucks to deliver mail or goods ▶ Navigating or determining the most appropriate route

Note: *=See Annex 1 and ILO 2012.**=In column 1, when stated at the 2-digit (sub-major group) level, all associated 4-digit (unit group) occupations within that category are included.

4.1.4 Processors

Processors produce the final cocoa-based products that can be consumed directly by consumers. As the study found, Timor-Leste has several cocoa processors producing various cocoa-based products, from more intermediate foodstuffs, such as cocoa butter and cocoa powder, to ready-to-consume chocolate specialties, such as chocolate bars and chocolate candy.

In terms of skills, processors come in various forms, from a small and individually owned business to a business unit within a larger enterprise. In all cases, the business requires administrative and managerial skills to navigate the legal and commercial requirements of producing and selling food products. Additionally, processors require technical skills related to chocolate production. They usually employ workers to operate chocolate-making machines (oven, oil presser, mixer), packing and labelling the product, transporting the products to point-of-sales and marketing. Processors also perform their own sourcing of raw materials, using skills related to grading and inspecting the quality of cocoa beans they get from farmers or the Cooperative Café Timor. Various grading techniques are used, from inspecting visually to using tools to measure bean quality.

All cocoa processors in Timor-Leste typically operate as a formal business entity. They hire full-time employees with monthly salary and contribute to employees' social security scheme.

▶ Table 13. Cocoa processors' occupation and skill levels

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
12**	Administrative and commercial managers	3, 4	▶ Establishing and directing operational and administrative procedures ▶ Determining and directing sales activities ▶ Monitoring and evaluating strategies and policies ▶ Marketing, public relations and advertising campaigns ▶ Controlling expenditures and ensuring the efficient use of resources ▶ Controlling selection, training and performance of staff ▶ Preparing budgets and overseeing the financial operation

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
1321	Manufacturing managers	2, 4	▶ Determining, implementing and monitoring production strategies, policies and plans ▶ Planning details of production activities in terms of output quality and quantity, cost, time available and labour requirements ▶ Controlling the operation of the production plant and quality procedures through planning of maintenance ▶ Coordinating the implementation of occupational safety and health requirements
1324	Supply, distribution and related managers	3, 4	▶ Determining, implementing and monitoring purchasing, storage and distribution strategies, policies and plans ▶ Preparing and implementing plans to maintain required stock levels at minimum cost ▶ Negotiating contracts with suppliers to meet quality, cost and delivery requirements ▶ Monitoring and reviewing storage and inventory systems ▶ Establishing and managing budgets, controlling expenditures and ensuring the efficient use of resources ▶ Establishing and directing operational and administrative procedures
1420	Retail and wholesale trade managers	3, 4	▶ Determining product mix, stock levels and service standards ▶ Formulating and implementing purchasing and marketing policies and setting prices ▶ Promoting and advertising the establishment's goods and services ▶ Maintaining records of stock levels and financial transactions ▶ Undertaking budgeting for the establishment ▶ Controlling the selection, training and supervision of staff ▶ Ensuring compliance with occupational safety and health regulations
3122	Manufacturing supervisors	3	▶ Coordinating and supervising the activities of process control technicians, machine operators, assemblers and other manufacturing labourers ▶ Organizing and planning the daily work with regard to plans, economy, staff and the environment ▶ Preparing cost estimates, records and reports ▶ Identifying shortage of staff or components ▶ Ensuring safety of workers ▶ Instructing and training new staff
3323	Buyers	3	▶ Determining or negotiating contract terms and conditions ▶ Purchasing general and specialized equipment, materials and business services
43*	Numerical and material recording clerks	2	▶ Helping with accounting ▶ Bookkeeping records and computations ▶ Calculating unit production costs ▶ Checking production operation schedules

ISCO-08 code	Occupation	Skill level (1 minimum to 4 maximum)*	General tasks performed
5153	Building caretakers	2	▶ Supervising the work of cleaning, housekeeping and building maintenance staff and contractors ▶ Participating in cleaning, simple repairs and maintenance of building interiors ▶ Notifying management and owners of buildings of the need for major repairs ▶ Patrolling of buildings to ensure security is maintained
5211	Stall and market salespersons	2	▶ Obtaining permission to set up a stand at a particular place in streets, markets or other open spaces ▶ Determining product mix, stock and price levels for goods to be sold ▶ Buying or contracting a regular supply of goods to be sold from wholesale suppliers or directly from producers ▶ Dismantling stalls and stands and transporting, storing, loading and unloading goods for sale ▶ Demonstrating and selling goods and accepting payment
5212	Street food salespersons	2	▶ Obtaining permission or a licence, where required, to sell food and drinks on the street or in a public place ▶ Obtaining food and drinks for sale ▶ Preparing, either beforehand or on the spot ▶ Loading and unloading, pushing, pedalling or carrying handcarts, trucks, trays or baskets to deliver food and drinks to the desired place in the street or to public places, such as stations or cinemas ▶ Displaying and selling food and drinks and accepting payment.
8160	Food and related products machine operators	2	▶ Operating machinery for roasting, pressing, milling, winnowing, conching and moulding ▶ Cleaning and maintaining machines and equipment
9112	Cleaners and helpers in offices, hotels and other establishments	2	▶ Sweeping or vacuum cleaning ▶ Washing and polishing floors, furniture and other fixtures in buildings ▶ Picking up rubbish, emptying garbage containers and taking the contents to waste areas for removal
9321	Hand packers	2	▶ Weighing, wrapping, sealing and packing materials and various products by hand ▶ Filling bottles, cans, boxes, bags and other containers with products by hand ▶ Labelling products, packages and various containers by hand
8322	Car, taxi and van drivers	2	▶ Driving and tending cars, vans or small trucks to deliver mail or goods ▶ Navigating or determining the most appropriate route

Note: *=See Annex 1 and ILO 2012. **= In column 1, when stated at the 2-digit (sub-major group) level, all associated 4-digit (unit group) occupations within that category are included.

4.1.5 Projected labour needs

This section provides an estimate of the number of workers required for each actor in Timor-Leste's cocoa sector per activity stage. These labour-need figures were estimated based on field interviews with ten farmers, two traders and two processors conducted in May 2025.

▶ **Table 14. Projected labour requirement per activity (persons)**

Actor	Activity					
	Cultivation (planting, growing, harvesting)	Post-harvest processing (fermenting, drying)	Collecting, transporting	Buying, inspecting, grading	Chocolate production (roasting, grinding, conching, tempering, moulding)	Chocolate marketing and sale
	Person per hectare of cocoa farm	Person per tonne of cocoa bean			Person per tonne of chocolate product	
Basic farmer	1–2					
Processor farmer	1–2					
Collector farmer	1–2		1–2			
Trader			1–2	1–2		
Cocoa processor			1–2	1–2	3–4	5–30*

Note: *=Contingent on number and type of customers, trade fairs.

4.2 Skills development

This section outlines five interventions aimed at increasing the capacity of actors in Timor-Leste's cocoa sector to support the road map to a green cocoa value chain (section 2.2).[16] These interventions include capacity-building for nursery house management, cocoa-based agroforestry, post-harvest treatment and OSH training in farms and cocoa processing facilities. Improving cocoa cultivation practices is expected to increase productivity due to better seeds, good farming practices and higher-quality beans. For each type of intervention, this section identifies the targeted capital investment, systemic conditions acting as barriers for implementation, targeted beneficiaries of the intervention and the skills and knowledge to be developed.

For nursery and agroforestry training, this component of the road map emphasizes improving farmers' skills in seedling management, grafting, transplanting, soil and water management and pest control. These interventions are expected to improve productivity due to higher yields and better quality of beans. These interventions target farmers and farm labourers. In the post-harvest phase, capacity-building focuses on enhancing knowledge of fermentation and drying processes, managing biochemical changes and mitigating quality risks. The OSH training is implemented at the farm and processing facility levels. The former addresses a critical gap in farmers' awareness and promotes hazard identification, ergonomic practices and the prevention of fatigue and heat-related illnesses, which are serious issues for labourers working under strenuous conditions in cocoa farms. The latter addresses gaps in data collection and the regulatory OSH framework in the cocoa processing industry and seeks to improve the sector's OSH practices.

16 Past efforts to increase skills in Timor-Leste's cocoa sector include the International Labour Organization's 2024 Agroforestry Skills for Employment and Resilience Project.

▶ Table 15. Skills development component for the cocoa value chain in Timor-Leste

Intervention	Required investment	Systemic condition	Targeted beneficiaries (by ISCO code)	Skills and knowledge	Alignment with business development component	Timeline
Capacity-building for nursery house management	▶ Trainers ▶ Training modules ▶ Training programme	▶ High dependency on non-public financing ▶ Limited number of agricultural trainers	Farmers ▶ 6310 ▶ 6330 ▶ 6114 ▶ 6130 Farm labourers ▶ 9211 ▶ 9213	▶ Seed selection and germination ▶ Grafting and budding technique ▶ Transplanting seeding ▶ Shade house construction ▶ Soil, water and nutrient management for optimum seedling growth ▶ Seedling inventory maintenance and variety labelling ▶ Seedling selection and knowledge transfer to farmers	Phase 1	Years 1–3
Capacity-building for cocoa-based agroforestry	▶ Trainers ▶ Training modules ▶ Training programme ▶ Fertilizer ▶ Pest and disease control supplies	▶ High dependency on non-public financing ▶ Limited number of agricultural trainers	Farmers ▶ 6310 ▶ 6330 ▶ 6114 ▶ 6130 Farm labourers ▶ 9211 ▶ 9213	▶ Good agriculture practices** ▶ Good practices on cocoa cultivation ▶ Good practices on planting distance ▶ Good practices on farm rejuvenation ▶ Pest and disease control	Phase 1	Years 1–3
Capacity-building for post-harvest treatment	▶ Fermentation equipment (moisture measurement kit, wooden box, plastic or burlap sacks, drying racks or houses)	▶ Insufficient financial resources to support post-harvest improvements ▶ Tendency among farmers to prioritize short-term gains over long-term investment	Farmers ▶ 6310 ▶ 6330 ▶ 6114 ▶ 6130 Farm labourers ▶ 9211 ▶ 9213	▶ Understanding biochemical changes in the fermentation process ▶ Fermentation control through turning, heaps preparation and temperature monitoring ▶ Controlling the drying rate ▶ Selecting and conducting drying via sun-dry or mechanical method ▶ Assessing the moisture level of dried cocoa beans ▶ Mitigating the risk of contamination in the fermentation, drying and storage processes	Phase 2	Years 1–3

Intervention	Required investment	Systemic condition	Targeted beneficiaries (by ISCO code)	Skills and knowledge	Alignment with business development component	Timeline
Capacity-building for OSH in farms	▶ Trainers ▶ Training modules ▶ Training programme ▶ Boots ▶ Hand gloves	▶ Limited awareness of OSH on farms	Farmers ▶ 6310 ▶ 6330 ▶ 6114 ▶ 6130 Farm labourers ▶ 9211 ▶ 9213	▶ Hazard identification and risk assessment on cocoa farms ▶ Ergonomic and safe work practices for farm labourers ▶ Prevention of heat stress, dehydration and fatigue	Phases 1 and 2	Years 2–5
Capacity-building for OSH in cocoa processing factories	▶ Trainers ▶ Training modules ▶ Training programme ▶ Face masks ▶ Hand gloves	▶ Inadequate data and information regarding OSH in the cocoa sector ▶ Lack of comprehensive OSH regulations	▶ 12* ▶ 1321 ▶ 1324 ▶ 1420 ▶ 3122 ▶ 3323 ▶ 4229 ▶ 43* ▶ 5153 ▶ 5211 ▶ 5212 ▶ 8160 ▶ 9112 ▶ 9321 ▶ 8322	▶ Hazard identification and risk assessment in processing facilities ▶ Safe handling of machinery and equipment ▶ Fire safety and emergency preparedness ▶ Chemical safety ▶ Noise, dust and air quality control measures ▶ Health and hygiene practices for workers in food processing ▶ Incident reporting and occupational injury management ▶ Workplace safety culture	Phase 3	Years 2–5

Note: *=In column 4, when stated at the 2-digit (sub-major group) level, all associated 4-digit (unit group) occupations within that category are included. **=Refer to Asare and David 2010.

Source: Direct observation and field interviews with ten farmers, two traders and two cocoa processors conducted in May 2025.

5 Working conditions in Timor-Leste's cocoa value chain

This chapter describes the working conditions in the country's cocoa sector in terms of OSH, contractual arrangements and working hours.[17]

5.1 Occupational safety and health

The study classified hazards into seven categories: biological, physical, chemical, psycho-social, biomechanical, safety and natural phenomena.[18] The study included a subjective assessment on the probability of hazard occurrence, in which each hazard was assessed as *unlikely, likely, highly likely* or *certain* to occur in a one-year period, based on direct observation and the field interviews conducted in May 2025.[19]

▶ **Table 16. Probability of hazard occurrence**

Hazard	Agent	Probability		
		Farmers	Traders	Processors
Biological	▶ Viruses, bacteria, mould and parasites	Unlikely	Unlikely	Unlikely
	▶ Insect and other animal bites	Certain	Unlikely	Unlikely
	▶ Snake and other animal bites	Highly likely	Unlikely	Unlikely
	▶ Fluids and excrement	Unlikely	Unlikely	Unlikely
Physical	▶ Noise	Unlikely	Likely	Likely
	▶ Vibration	Unlikely	Likely	Unlikely
	▶ Underground work	Unlikely	Unlikely	Unlikely
	▶ Poor lighting	Likely	Likely	Unlikely
Chemical	▶ Fertilizers, pesticides, fungicides, herbicides and other chemical products, such as disinfectants	Unlikely	Unlikely	Likely

17 This section is largely based on information gathered during the field visits conducted in collaboration with the Timor-Leste Labour Inspectorate in May 2025.

18 The hazard classification refers to *Methodology for OSH Hazard Identification and Risk Assessment and Evaluation in the Coffee Sector* (ILO 2020, 14–15).

19 The probability of hazard occurrence refers to *Methodology for OSH Hazard Identification and Risk Assessment and Evaluation in the Coffee Sector* (ILO 2020, 17).

Hazard	Agent	Probability		
		Farmers	Traders	Processors
Psycho-social	▶ Conflicts with co-workers or with the owner of the farm	Unlikely	Likely	Likely
	▶ Long working hours	Unlikely	Likely	Likely
	▶ Perceived physical assault or sexual and psychological harassment by co-workers or farm owners	Unlikely	Likely	Likely
	▶ Overwork	Unlikely	Unlikely	Unlikely
	▶ Monotonous, repetitive work	Highly likely	Highly likely	Highly likely
	▶ Low income	Likely	Likely	Unlikely
Biomechanical	▶ Standing, kneeling or squatting for more than two hours during the working day	Highly likely	Likely	Highly likely
	▶ Above-the-head arm movements	Highly likely	Unlikely	Unlikely
	▶ Repetitive hand and arm movements	Highly likely	Highly Likely	Highly likely
	▶ Heavy lifting (bags or sacks of coffee), carrying loads, pushing or dragging heavy objects	Highly likely	Highly likely	Highly likely
Safety	▶ Use of machinery, vehicles, machetes, sickles, chain saws and other items that can wound, bruise or crush body parts	Certain	Certain	Certain
	▶ Electrical contact or shock	Unlikely	Unlikely	Likely
	▶ Inadequate order and cleanliness	Highly likely	Likely	Unlikely
	▶ Public order (theft, robbery, delinquency, fighting or illegal armed groups)	Unlikely	Unlikely	Unlikely
	▶ Falls (on uneven ground)	Likely	Unlikely	Unlikely
	▶ Work at heights (over 1.5 metres)	Unlikely	Unlikely	Unlikely
Natural phenomena	▶ Landslides, floods, fires and other natural disasters or emergencies	Likely	Likely	Likely

Source: Direct observation and field interviews with ten farmers, two traders and two cocoa processors conducted in May 2025.

5.1.1 Biological hazards

Biological hazards refer to the risk of exposure to harmful biological agents, such as viruses, bacteria, fungi, parasites and animal bites, that may lead to infectious diseases or other health complications. In Timor-Leste's cocoa sector, farmers are particularly exposed to insect and snake bites due to their work location, while traders and processors are less likely to encounter these hazards. Other types of biological hazards, such as viruses, bacteria, parasites and mould, as well as fluids and excrement, are unlikely to occur in Timor-Leste.

5.1.2 Physical hazards

Physical hazards encompass risks associated with the environmental conditions in which the work takes place. These include exposure to excessive noise, vibration, underground work and poor lighting. Cocoa farmers face limited risks from these hazards, particularly concerning noise and vibration, because their work generally takes place in quiet and open environments, and the use of machines is uncommon in Timor-Leste. Traders are particularly exposed to noise and vibration caused by prolonged use of vehicles, while processors are at risk of noise from machine operation. Processors commonly work in a well-lit place, whereas farmers and traders may work in the dark (harvesting under cloudy skies and driving in the night).

5.1.3 Chemical hazards

Chemical hazards are associated with the use of harmful chemical substances, such as fertilizers, pesticides, fungicides, herbicides and other chemical products. The use of synthetic fertilizers, pesticides and other chemical products are rare in cocoa farming in Timor-Leste. Thus, exposure to chemical hazards is unlikely for farmers and traders. Processors may be exposed to chemicals during the chocolate production stages.

5.1.4 Psycho-social hazards

Psycho-social hazards refer to the risks stemming from mental and social stressors, including conflicts with co-workers or employers, long working hours and physical or psychological harassment. These hazards are more prevalent among traders and processors, who may operate in a high-pressure environment or experience overwork and interpersonal conflict in the workplace. In contrast, farmers generally experience fewer psycho-social hazards, although their low income due to the cocoa price can contribute to stress and mental health concerns. Processors are unlikely to experience income-related stress because of their regular fixed income.

5.1.5 Biomechanical hazards

Biomechanical hazards are linked to physical activities that can lead to musculoskeletal injuries. These include repetitive motions, body positions and the lifting of heavy objects. Farmers are at high risk due to their involvement in physically demanding tasks, such as standing or kneeling for long periods when weeding, lifting heavy loads and performing repetitive motions. Similarly, traders and processors, although less exposed to heavy lifting, may still confront biomechanical risks due to repetitive tasks in their daily work routines, such as packaging and sorting products.

5.1.6 Safety hazards

Safety hazards are associated with the use of dangerous machinery, tools and equipment that can cause physical injuries, such as cuts, bruises or fractures. Farmers face great risk of injury due to their frequent use of sharp tools (machetes and sickles) and machinery. Traders and processors may be exposed to safety hazards, although their exposure is generally lower.

5.1.7 Natural phenomena hazards

Natural phenomena hazards include risks posed by natural disasters, such as landslides, floods, fires and other environmental events. These hazards affect all segments of the sector (farming, trading and processing), but farmers are particularly vulnerable due to their direct exposure to natural elements. Some farms are situated on sloped terrain within valleys, rendering them susceptible to landslides. Additionally, flooding poses a risk by potentially impeding access to farmland and inundating chocolate processing facilities.

5.2 Contractual arrangements

Cocoa farming activities in Timor-Leste are predominantly carried out by individual farmers cultivating their own land. According to the study findings, each farmer typically manages around 1–2 hectares of farmland. Daily farm operations are generally performed alone, with additional assistance from family members during the harvesting season, most typically a wife. The engagement of external labour is rare, and most farmers do not hire workers to support routine agricultural tasks.

The employment of external labourers is uncommon largely due to the limited scale and economic capacity of most cocoa farms. Because farm operations are usually manageable by individual farmers or with minimal family support, there is little incentive or need to recruit additional workers. Still, the findings from the interviews and field observations suggest that contribution to an employment-related social security scheme on the part of small farmers is non-existent, either as employers of the occasionally hired labourer or as contributors of the voluntary social security contribution scheme. Compliance tends to be higher in the downstream value chain, among agricultural traders and cocoa processors.

Labour practices in cocoa processing facilities differ significantly. Workers employed in these facilities are typically hired under formal contracts. According to the two small-scale chocolate producers who were interviewed for this study, these contracts are established with clear terms of employment, and the companies contribute to the workers' social security scheme. This suggests a relatively higher degree of labour formalization in the processing segment of the cocoa value chain compared to the farming segment.

The field observations and the interviews with ten cacao farmers that child labour and forced labour are not prevalent in the cocoa value chain, setting it apart from several other cocoa-producing countries where such practices remain a tremendous concern. The smallholder nature of cocoa farming in the country contributes to this condition because most farmers manage modest plots of land and primarily rely on their own labour. Although unpaid family labour is commonly used, it is generally limited to adult family members, most notably spouses, who assist during labour-intensive periods, such as harvesting. The involvement of children in cocoa production is rare and not a systemic practice, again, based on the study's field observations and interviews.

The field observations of farmers, traders and cocoa processors also indicated that women's presence is more prominent in cocoa processing and retail trading than in farming. The cocoa farmers in the study were predominantly men, possibly assisted by their wife during the harvesting period. The observations and interviews also tended to confirm that business decision-making was controlled by men. In both farms and processing facilities, women endured the double burden of juggling their work with household responsibilities (cooking, child care, etc.).

The cocoa sector presents a relatively low-risk environment for labour rights violations, owing to the smaller scale of production in farming and processing. However, continued monitoring and education on labour standards remain important to maintain these positive conditions as the sector evolves.

5.3 Working hours

Working hours on cocoa farms tend to be highly flexible because the farmers independently determine their daily work schedule. On average, according to the study findings, farmers spend around four to eight hours per day tending to their land. Based on the agricultural calendar, the intensity and duration of work vary significantly. Farm-related activities between harvest periods are relatively minimal and primarily consist of routine maintenance tasks, resulting in lower work intensity. Due to the small scale of the existing farms, farmers do not need extra labour during harvest season.

In the cocoa processing facilities, and again based on this study's observations, labour conditions are more structured and regulated. Employees typically follow standard working hours, commonly adhering to a 9 a.m.-to-5 p.m. schedule, in line with the national labour regulations. However, during peak periods when cocoa supply volumes are larger, the needs are covered by hiring ad hoc additional labourers – not necessarily by requesting overtime work for regular staff. This contrast between the flexible, self-directed schedules in farming and the more formalized, regulated hours in processing reflects broader differences in labour organization along the cocoa value chain.

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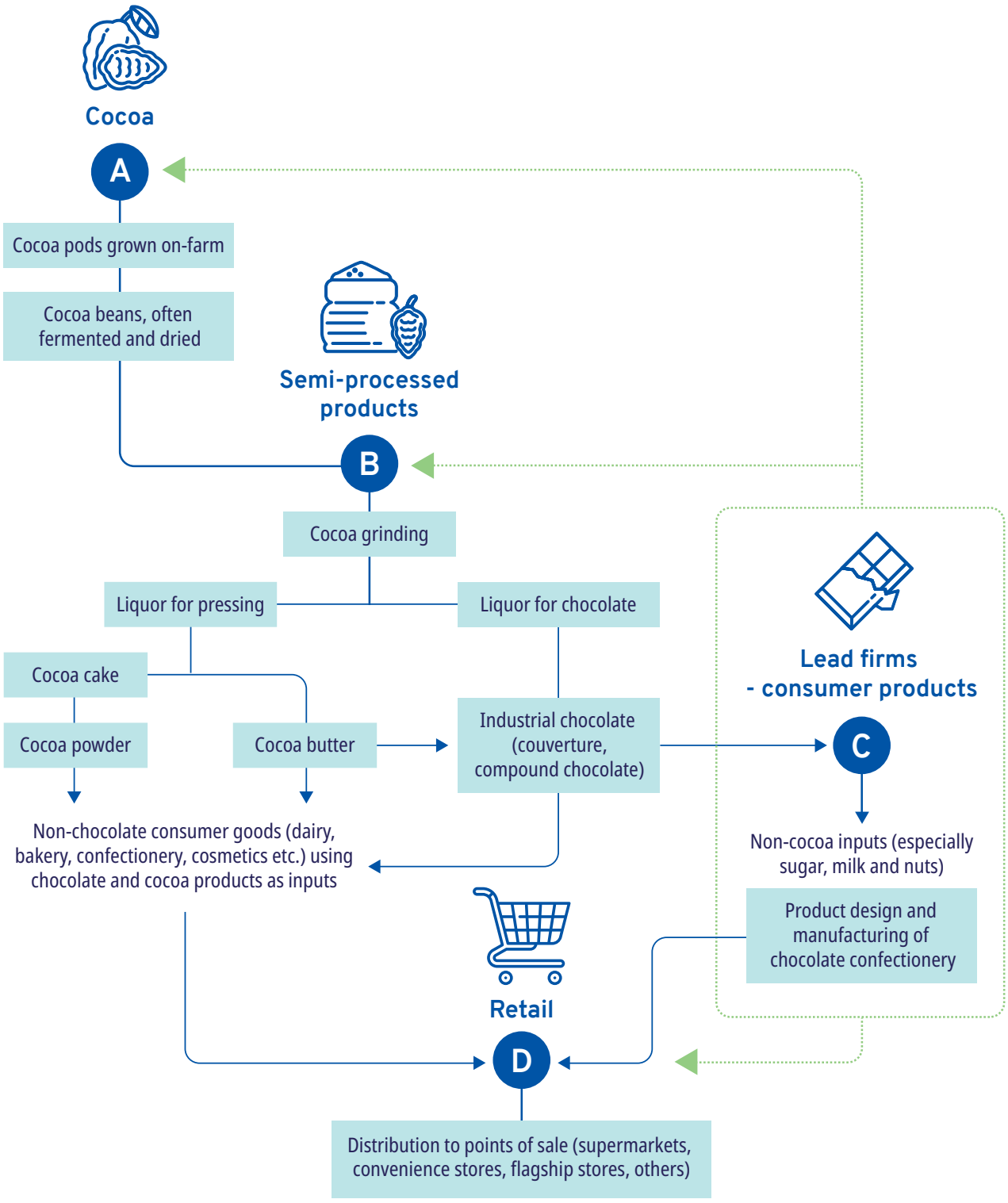
Annexes

Annex 1. Skill level descriptions

Broad skill level	ISCO-08	Description*
Skill levels 3, 4 (highly skilled workers)	▶ Managers ▶ Professionals ▶ Technicians and associate professionals	**Skills level 3:** Typically involves the performance of complex technical and practical tasks that require an extensive body of factual, technical and procedural knowledge in a specialized field. **Skills level 4:** Typically involves the performance of tasks that require complex problem-solving, decision-making and creativity based upon an extensive body of theoretical and factual knowledge in a specialized field.
Skill level 2	▶ Clerical support workers ▶ Service and sales workers ▶ Skilled agricultural, forestry and fishery workers ▶ Craft and related trades workers ▶ Plant and machine operators and assemblers	Typically involves operating machinery and electronic equipment; driving vehicles; maintenance and repair of electrical and mechanical equipment; and manipulation, ordering and storage of information.
Skill level 1	▶ Elementary occupations	Typically involves the performance of simple and routine physical or manual tasks.
Armed forces	▶ Armed forces occupations	
Not elsewhere classified	▶ Not elsewhere classified	

Note: *=For descriptions, see www.ilo.org/resource/glossary-skills-and-labour-migration.

Annex 2. Schematic representation of conventional cocoa/chocolate value chain and activities



Source: Neilson et al. 2020.

Annex 3. Study interviews

Resource persons

- General Labour Inspection
- Ministry of Agriculture, Livestock, Fisheries and Forestry
- Ministry of Commerce and Industry
- Department of Trade and Investment
- TradeInvest Timor-Leste
- Outspan Agro Timor Unipessoal LDA
- PARCIC
- Patty's Serie Chocolate
- Cocoa farmers or traders in Ermera Municipality
- Cocoa farmers or traders in Manatuto Municipality
- Cocoa farmers or traders in Viqueque Municipality

Note: The 18 interviews were conducted between 5 and 10 May 2025.

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