



Ravaged landscapes and climate vulnerability: The challenge in achieving food security and nutrition in post-conflict Timor-Leste

Gianna Bonis-Profumo^{a,*}, Rebecca McLaren^b, Jessica Fanzo^c

^aResearch Institute for the Environment and Livelihoods, Charles Darwin University, Darwin, NT, Australia

^bThe Berman Institute of Bioethics, Johns Hopkins University, Baltimore, MD, United States

^cThe Nitze School of Advanced International Studies, The Bloomberg School of Public Health and The Berman Institute of Bioethics, Johns Hopkins University, Baltimore, MD, United States

*Corresponding author: e-mail address: gianna.bonis-profumo@cdu.edu.au

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1. Introduction

This is the time—the time for Timor-Leste to move toward prosperity for all its citizens after a long history of hardship from conflict and mounting challenges from climate change. Despite its violent history, Timor-Leste now stands strong and dignified. With a new era of peace and stability and a national petroleum fund worth over 16 billion United States Dollars (USD), Timor-Leste has a great opportunity to ensure food security and nutrition for its citizens. However, the remnants of war-torn infrastructure remain and the impacts of climate change are increasing, both with detrimental effects on the country's agricultural sector, impacting food security and nutrition. There is a critical need for Timor-Leste to prioritize a climate-smart, nutrition-sensitive food system and healthy diets and nutrition for all.



2. History of conflict

A long history of conflict has led to significant food insecurity and malnutrition. Timor-Leste is one of the world's youngest democracies, with a history of violent takeovers, colonialism, and occupation. The Portuguese invaded in 1515 and colonized the country until 1975. There was a short-lived declaration of independence by the FRETILIN resistance until Indonesia invaded in 1976 and occupied the country, declaring Timor-Leste its 27th province. The people of Timor-Leste lived under Indonesian occupation for 24 years before the resistance prevailed. During the occupation, over 150,000 people were killed, which is about one fifth of the country's population, and many more were displaced (Kiernan, 2008). In 1999, the

United Nations (UN) passed a referendum and the Indonesian troops were forced to leave the country. For the next 2 years, Timor-Leste was under the United Nations Transitional Administration in East Timor (UNTAET). Despite the presence of the UN, Indonesian security and militia groups remained and continued to kill the Timorese and destroy the country's infrastructure. After decades of violence and destruction, Timor-Leste became an independent democracy in 2002.

After a short period of peace, conflict broke out again in 2006 and 2008. In 2006, conflicts within the military and between the military and police also led to wider civil unrest. The violence was centered in Dili but spread to surrounding areas. There was also an attempted military coup. The UN, Australia, Malaysia, and other countries intervened and the Prime Minister resigned and was replaced by José Ramos-Horta. Over this period of unrest, 38 people were killed and 150,000 were displaced (Crisis Group, 2008). In 2008, there was a series of contested events that the government described as an attempted coup and assassination attempts on President Ramos-Horta and Prime Minister Xanana Gusmão. Ramos-Horta was shot and wounded but both survived. This was followed by over 2 months of state of emergency but then peace returned. The UN had missions on the ground for over 12 years but withdrew at the end of 2012, leaving Timor-Leste to stand on its own.



3. New challenges

3.1 Climate change

While at peace, the country now faces a new set of challenges. Climate change is a significant threat to the country and is only expected to intensify. Climate change is already causing higher temperatures, less consistent precipitation patterns, more frequent and severe floods, and rising sea levels. It is expected that the temperature will increase by 1.5 °C and rain will increase by 10% by 2050 (Molyneux et al., 2012). The sea level has already risen 9 mm per year for the past 25 years and is expected to continue rising. Increased precipitation leads to inland flooding and rising sea levels lead to larger storm surges and coastal flooding. These increases in extreme rain events are also expected to occur alongside longer dry seasons and droughts (Center for Excellence in Disaster Management and Humanitarian Assistance, 2016; PACCSAP, 2015).

Natural disasters and the El Niño-Southern Oscillation phenomenon (ENSO—both El Niño and La Niña), occurring every 2–7 years, also

contribute to agricultural challenges and food shortages. A lack of coping strategies makes the country the seventh most disaster-prone in the world (Center for Excellence in Disaster Management and Humanitarian Assistance, 2016). Its population has very limited capacity to cope with extreme weather events and disasters due to poverty and limited natural resources (World Bank, 2018a). The country also faces frequent floods, landslides, and droughts (Center for Excellence in Disaster Management and Humanitarian Assistance, 2016). During years impacted by El Niño, there is less rainfall and the rainy season is delayed and shortened. Rain can be decreased by up to 34% in some areas of the country such as the east and south. This is especially damaging for agriculture, which relies on not only the amount of rain but also the timing (Barritt, 2016; Belo et al., 2015).

This presents difficult challenges for agriculture and food production, particularly as most farms are rain-fed. When farmers lose crops or have decreased yields, this impacts food availability. Subsistence farmers grow for their own consumptions and thus are directly affected by losses but decreased yields also lead to increased food prices, impacting those who buy food, especially the most vulnerable (Devereux et al., 2015; Mason and Shrimpton, 2010). Variations in precipitation patterns can also lead to the detrimental loss of seed stock when there is less rain than expected after sowing fields, further compromising food availability. The 2015/2016 El Niño drought affected the water security, yields, and incomes of 120,000 people (Fig. 1). Additionally, there was a very long recovery, with 67% of the most affected households still adopting coping strategies, such as reducing meal portions, 1 year after the end of the El Niño (International Federation of Red Cross and Red Crescent Societies, 2017). Water and food scarcity severely disrupt rural livelihoods and are further exacerbated by pre-existing health and nutrition vulnerabilities of affected populations. The most climate-resilient farmers and households were found to be those with sufficient financial capital, high levels of diversification, and those less reliant on climate-sensitive crops such as paddy rice, maize, or cassava (Government of Timor-Leste and World Food Programme, 2016).

3.2 Oil reserves

Timor-Leste depends heavily on fossil fuels. Additionally, the country's oil is on the decline and could run out as soon as 2021. From 2013 to 2015, oil made up over 90% of the country's revenues (World Bank, 2018a). The country puts these revenues in the Petroleum Fund, which provides funding

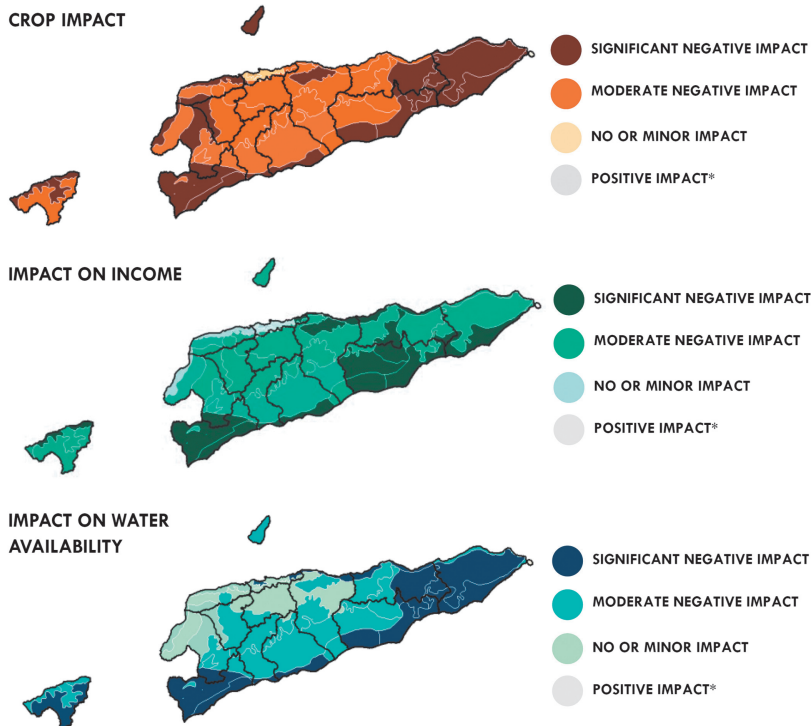


Fig. 1 El Niño 2015/16 reported impacts on crop, income, and water availability. *Note:* *No positive impacts were reported. Most common responses by livelihood group based on a rapid assessment undertaken in February 2016. *Source:* Government of Timor-Leste and World Food Programme, 2016. *Timor-Leste CLEAR report, Consolidated Livelihood Exercise for Analyzing Resilience.* Government of Timor-Leste and United Nations.

for most of the government's budget. In 2017, 84% of the entire national budget was from the Petroleum Fund and other oil money (Ministry of Finance, 2017). The country is in dire need for a post-oil economy diversification strategy (World Bank, 2018a).

Despite the recent resolution of the maritime border dispute with Australia over the Greater Sunrise oil and gas field, future revenues will depend on its successful development and returns, the feasibility of which is contested (La'o Hamutuk, 2019).

3.3 Poverty

Timor-Leste is classified as a middle-income country due to its oil revenue; however, poverty remained as high at 41.8% in 2014. Poverty is

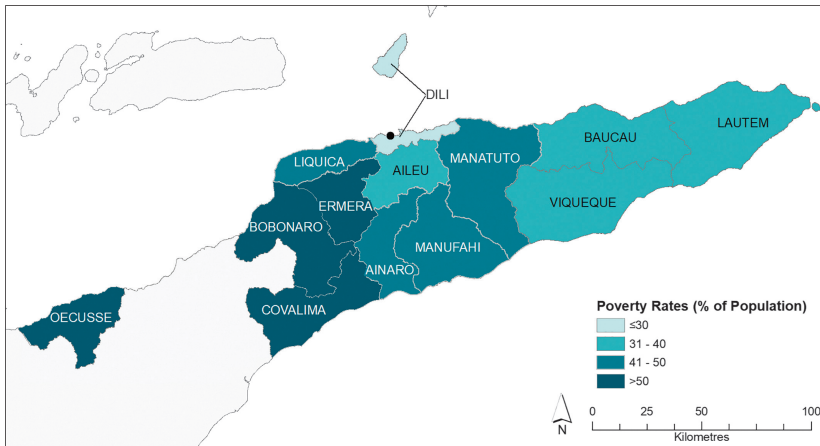


Fig. 2 Poverty map of Timor-Leste. *Source: Data from Ministry of Finance and World Bank, 2016, Poverty in Timor-Leste 2014, Government of Timor-Leste Ministry of Finance and World Bank; map credit Pia Harkness.*

concentrated in the west (Ministry of Finance and World Bank, 2016) (Fig. 2) and is even greater in rural areas, with 47.1% of the population living in poverty at the same time. However, this had decreased from 54.7% in 2007 (Ministry of Finance and World Bank, 2016). Timor-Leste's human development index (HDI) score was 0.625, ranking 132 out of 189 countries in 2018, and having improved very little since 2013 (United Nations Development Program, 2018).

3.4 Population shifts

Timor-Leste has a population of 1.3 million. The population is increasing and is expected to reach two (United Nations Development Program, 2018) to three million by 2050 (Molyneux et al., 2012). The population is also undergoing large transitions. The total fertility rate has fallen rapidly in the last decade, from 7.8 in 2003 to 4.2 in 2016 (General Directorate of Statistics et al., 2018). The country is very young and rapidly urbanizing. Timor-Leste has one of the youngest populations in the world with 62% of its population 25 years old or younger (United Nations Development Program, 2018). Currently, the majority of people live in rural areas but the country is urbanizing. The urban population grew by 3.8% per year between 2010 and 2015 to reach 32.8% in 2015. People, especially the youth, are continuing to move to Dili and other cities and towns (United Nations, 2015).



4. Agricultural production

4.1 Challenges

The history of conflict and the growing impact of climate change have ravaged Timor-Leste's agricultural sector and led to significant food insecurity and malnutrition. During the Indonesian occupation, many people were internally displaced and the Indonesian troops destroyed much of the country's infrastructure. Displacement caused labor shortages that interrupted agricultural production and destruction of roads and agricultural infrastructure, such as irrigation, hindered growing, transporting, and storing food. Climate change impacts farming practices including the crop varieties that can be grown and the amount of crop damage that occurs (Molyneux et al., 2012). Timor-Leste's agriculture suffers from high post-harvest storage losses from pests and contamination (Da Costa et al., 2013; Universidade Nacional Timor Lorosa'e, 2014), while low levels of soil fertility limit crop yields (Williams et al., 2017). Insufficient infrastructure and road inaccessibility during the rainy season can increase transportation costs. Transportation delays can also cause food waste, decreasing availability and increasing cost (Muizarajs et al., 2015) and coincide with the annual hunger season.

4.2 Agricultural GDP and expenditures

The agricultural sector is critical for Timor-Leste's economy and can play a fundamental role in economic growth, employment, and poverty alleviation. While the agricultural sector contributed an average of 19.2% of the non-oil Gross Domestic Product (GDP) since 2010, the Ministry of Agriculture and Fisheries (MAF) received less than 2% of the total budget during this period (World Bank, forthcoming-a) (Fig. 3). Coffee is the major export commodity and cash crop, accounting for 91% of all exports outside of oil in 2017 (Ministry of Finance, 2018a), with its production concentrated in the central uplands. While the agricultural GDP has had an average annual growth rate of 5%, agricultural expenditures decreased in 2019 (Ministry of Finance, 2018b; World Bank, forthcoming-a). Public expenditures are very low and vastly overshadowed by overseas development assistance (ODA), which is more than double public expenditures in the agricultural sector. The agricultural sector is also changing as budgets are being decentralized and transferred to the municipalities. The government has focused on rebuilding infrastructure, with municipalities implementing 49% of all

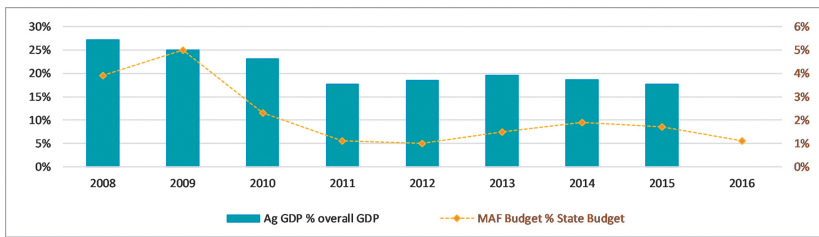


Fig. 3 Agricultural contribution to non-oil GDP vs. public expenditures to the MAF. Source: Data from World Bank, forthcoming-a. Timor-Leste agriculture public expenditure analysis. Manuscript in preparation. World Bank.

public expenditures in agricultural infrastructure (World Bank, forthcoming-a). With larger public investment, stronger agricultural policies, and more reliable data, Timor-Leste's agricultural sector has huge potential to create prosperity, food security, and nutrition for all.

4.3 Food production

The agricultural system in Timor-Leste does not produce enough to feed the country's population (Fischer, 2016; Molyneux et al., 2012). This has been the case for the last three decades. The poor performance of the agricultural sector is due to low yields from highly variable rainfall, steep slopes, poor-yielding crop varieties, unsustainable farming practices, and poor soil fertility (Molyneux et al., 2012). Low availability and knowledge around fertilizer use is an additional barrier. Much of the terrain is steep and most of the land only has a thin layer of productive soil (Da Costa et al., 2013). Due to Timor-Leste's topography, the country has a low percentage of arable land, 155,000 hectares (ha) or 10.4% of the total land (World Development Indicators, 2018). Limited areas suitable for irrigated rice production constrain potential production; however, only 30% of the arable land is used for agriculture (Provo et al., 2017). Additionally, 70% of farmers rely on rain-fed agriculture, which is becoming increasingly difficult in the face of climate change (Barritt, 2016).

The major staple crops in Timor-Leste are maize, rice, cassava, and sweet potatoes by produced amount. In 2015, 35% of farming households cultivated rice (General Directorate of Statistics and United Nations Population Fund, 2016), despite rice being the preferred staple for consumption and a higher status food. Although yields have increased, they are still low with averages increasing from 1.5 metric tons per ha (Mt/ha) for rice and 1.1 Mt/ha for maize in 2008 to 3.0 and 2.2 Mt/ha in 2016 (Food and Agriculture Organization of the United Nations, 2018b; Molyneux

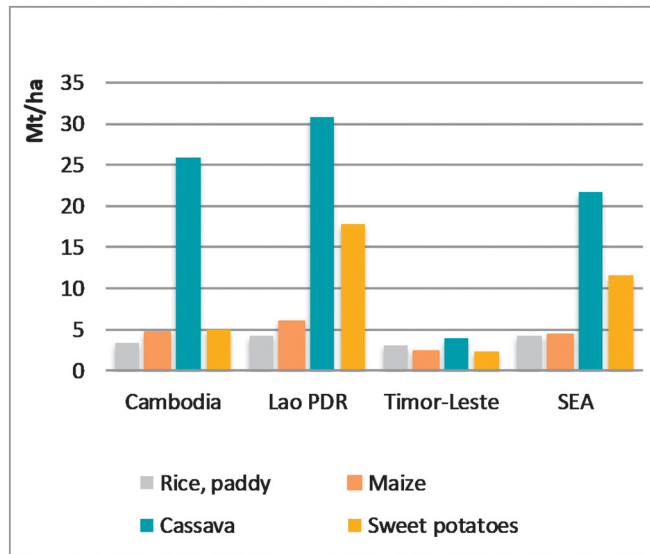


Fig. 4 Productivity (Mt/ha) of staple crops in Cambodia, Lao PDR, Timor-Leste, and South East Asia average 2014–16. Source: Data from Food and Agriculture Organization of the United Nations, 2018b. FAOSTAT. United Nations. Consulted November 2018. <http://www.fao.org/faostat/en/>.

et al., 2012). These yields are much lower than those of Cambodia and Lao PDR, neighboring countries with similar agro-economies, and the South-east Asia (SEA) average (Food and Agriculture Organization of the United Nations, 2018b) (Fig. 4).

Additionally, despite increased yields, total output has decreased due to decreased area harvested (Food and Agriculture Organization of the United Nations, 2018b). In 2017, Timor-Leste produced 130,000 Mt of rice and maize, which was a 20% decline from the previous 5-year average, despite being close to the 2016 level (Food and Agriculture Organization of the United Nations, 2017). The area of rice and maize produced has been decreasing for the past decade. In 2016, the area of paddy rice harvested decreased to 27,000 ha from 46,000 ha in 2008, while for maize, the area went down to 53,000 ha from 79,000 ha over the same period (Food and Agriculture Organization of the United Nations, 2018b) (Fig. 5).

Roots and tubers are also important staples. Between 2014 and 2016, overall production of roots and tubers was 65,000 Mt with cassava making up 28,000 Mt of this and sweet potato making up 5000 Mt. These crops were farmed on almost 20,000 ha; 7000 ha for cassava and 2000 ha for sweet potato (Food and Agriculture Organization of the United Nations, 2018b).

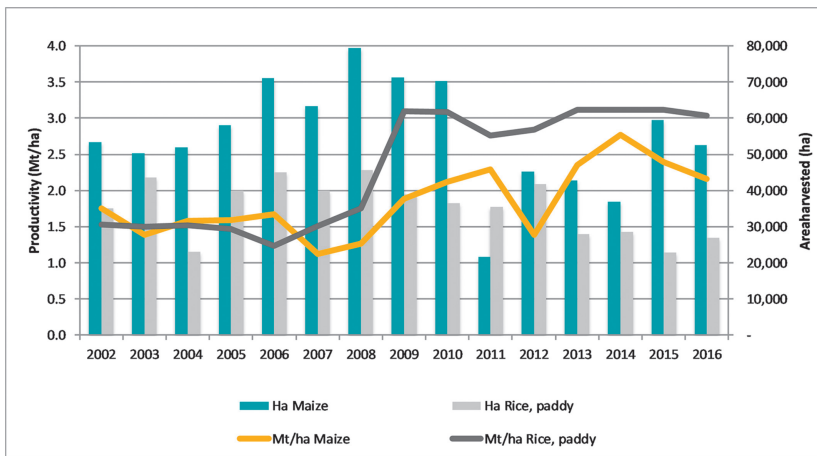


Fig. 5 Productivity (Mt/ha) and area harvested (ha) of key staples in Timor-Leste, 2002–16. *Source: Data from Food and Agriculture Organization of the United Nations, 2018b. FAOSTAT. United Nations. Consulted November 2018. <http://www.fao.org/faostat/en/>.*

These crops allow people to maintain energy intake during the hunger season. This is especially important for food insecure, farming households. However, these numbers do not account for post-harvest loss, estimated as high as one-third of all production (Da Costa et al., 2013; Universidade Nacional Timor Lorosa'e, 2014).

The diverse microclimates and multiple agro-ecological zones of Timor-Leste enable growing a wide range of legumes, vegetables, and fruits. Production of beans, peanuts, and soybeans accounted for over 8000, 4000, and 1000Mt, respectively, harvested across an area of 7000, 3000, and 800 ha each (Food and Agriculture Organization of the United Nations, 2018b). These crops are important as they provide high levels of plant-based protein. Additionally, pulse productivity was 87% of the SEA average (Williams et al., 2017), with higher or equal yields than Cambodia and Lao PDR, indicating a potential competitive advantage to develop the local market for human and livestock needs. From 2014 to 2016, aggregated vegetable production was 29,500Mt grown on 11,500 ha and fruit annual output was close to 17,000Mt cultivated on over 2000 ha (Food and Agriculture Organization of the United Nations, 2018b). As standards of living improve and eating habits change accordingly, there is an increasing demand for fresh produce, especially in cities and towns. Production is increasing to meet this demand. Vegetable production depends on water availability and production is hindered by both a lack of rain or floods. The heavy rain and flooding in the rainy seasons is detrimental to production, leading to lower market supply during this time.

Livestock population is growing, with census data showing increases for all animals. However, there is conflicting data with one source showing a 5% annual reduction in the national cattle herd (Fordyce et al., 2017). Additionally, MAF looked at the impact of the 2015/2016 El Niño drought and found that it was responsible for the death of 70,000 livestock, including over 14,000 cattle and buffaloes and 21,000 pigs and chickens (Ministry of Agriculture and Fisheries, 2016). Livestock production is based on uncontrolled grazing and scavenging on public land, although pigs and poultry receive more low-quality grain and by-product feed. Ruminants graze on degraded land with very low pasture production, weeds in un-cropped paddy land in the dry season, and crop residues (Fordyce et al., 2017). For cattle, this system results in low growth rates and production values of 6.4 kg/head compared to a global average of 32.0 kg/head (Asian Development Bank, 2016). However, this is a reasonable return for labor for herds of 12 animals when using the existing infrastructure for transport, marketing, and processing (Fordyce et al., 2017). In the last decade, the production values of livestock have remained stagnant with pork being the only exception (Food and Agriculture Organization of the United Nations, 2018b), thus showing ample potential for improvements in the livestock sector's productivity.

Fish production is largely undeveloped in Timor-Leste (Asian Development Bank, 2016). The coastal fisheries sector is small and technology use is very limited, with most people fishing in small wooden boats close to shore and around the surrounding reefs as well as gleaning from the shore (World Bank, 2018a). People catch sardines, mackerel, and other species. Fresh-water fishing is characterized by its subsistence nature and by a growing aquaculture sector. Small-scale aquaculture systems have been promoted in rural areas in recent years to provide additional animal protein and supplement food production, often growing tilapia and carp (General Directorate of Statistics and United Nations Population Fund, 2018a). It is an enormous challenge to transport fish from the coast to the interior due to poor road conditions and lack of cold chain storage. These challenges also increase food safety risks.

4.4 Food imports

Timor-Leste has a large food production gap and relies heavily on food imports to meet its needs, with Indonesia, Singapore, and China as major trading partners (World Bank, 2018a). The country must import 30–40% of the cereals it needs (Government of Timor-Leste, 2016; Molyneux et al., 2012). It is estimated that for 2017/18, total cereal imports remained

close to the previous year, which was already high, more than doubling the average amount imported from 2009 to 2013. This reflects reduced cereal production. In 2016/17, the country imported 190,000 Mt of rice and this is forecasted to be similar for 2017/18 (Food and Agriculture Organization of the United Nations, 2018a). The country spent 32 million USD or 28.1% of total food imports in 2017 on cereal imports, primarily rice (Ministry of Finance, 2018a). Imported rice is almost half the price of local production due to low import tariffs, government subsidies, and under-performing large-scale domestic irrigation schemes (World Bank, 2018a).

4.5 Agriculture employment

Of the employed population 15 and over, 64.2% were employed as skilled agricultural workers in 2015, accounting for 76.9% of men and 77.3% of women in rural areas (General Directorate of Statistics and United Nations Population Fund, 2018b). The agricultural industry also includes fishing, forestry, and hunting. While most people continue to work in agriculture, the proportion of those employed in that sector decreased by 20% to reach 64% in 2016, down from 84% in 2004 (General Directorate of Statistics and United Nations Population Fund, 2011, 2016). Additionally, fewer households described themselves as farmers, a decrease of 25% from 2004 to 2010. However, this could partially be explained by increasing off-farm work (Young, 2014).

4.6 Subsistence farming

Agriculture in Timor-Leste is largely subsistence rather than market-oriented, with many farmers growing primarily for their own consumption. Most farmers manage polyculture production systems, with an average of 7.2 crop types in plots under 1 ha (General Directorate of Statistics and United Nations Population Fund, 2018a). Farmers often cultivate multiple plots due to terrain difficulties and land ownership arrangements, which mitigates crop failure and increases food security. Rice is becoming more commonly grown as a subsistence crop, meant to feed farmers and their families but not meant to provide any surplus to sell. The government has been providing assistance and incentives for farmers to grow more rice, such as irrigation infrastructure, free seeds, fertilizer, other inputs, and extension. However, farmers have not increased production as hoped. Additionally, more farmers who use improved seeds may move back to traditional production systems that produce enough for themselves and their families

while requiring less labor (Young, 2016). Farmers also weigh how low domestic rice prices are due to government subsidies for imported rice and benefits they receive, such as the veterans' pensions, in their decision-making.

Animal husbandry is a leading livelihood strategy among Timorese smallholders. Livestock are financial and cultural assets and support protein intake from animal source foods. Farmers often view livestock as savings and sell them when they need cash. Cattle are also seen as a form of social status and play an important role in maintaining social networks as well as being used in ceremonies. These uses dictate cattle numbers and productivity (Bettencourt et al., 2015; Young, 2014). Small flocks of chickens are very common, owned by more than 90% of rural households. There has been a 32% increase in the number of chickens since 2010 (General Directorate of Statistics and United Nations Population Fund, 2016). Chickens are managed in a low-input, low-output, scavenging system. Farmers lack knowledge of improved husbandry practices and most chickens hatched are lost to predators, weather, or disease such as Newcastle's Disease (ND). MAF is working to increase chicken vaccination against ND but these programs need to be scaled up to reach more households as around 15% of chickens are still lost to ND (To'os ba Moris Di'ak, 2017).

4.7 Gender roles and women farmers

Timor-Leste's culture is strongly patriarchal. In farming households, each member has a role in farm operations. Both men and women work in agriculture; however, women do more work in processing, storage, seed selection, sale, and other post-harvest operations. Akter et al. (2016) describe a balanced gender distribution in cropping labor. However, women constitute 75–85% of rural marketplace vendors, who must endure long distances to reach markets on difficult and unsafe roads (To'os ba Moris Di'ak and UN Women, 2018). The prominent role of women in produce marketing is critical to enable a shift from subsistence to commercial farming (Akter et al., 2016). Additionally, women do more work taking care of the household and family, including water and wood collection, resulting in heavier workloads. Women also suffer from the high levels of intimate partner violence seen throughout the country (General Directorate of Statistics et al., 2018).

There is gender inequity in access to the means of production, such as land, government provided inputs, technical information, and credit. One barrier that women face is access to land, the most fundamental agricultural asset. Even when there are laws that protect women's rights, this is only in

theory and actual practices are dictated by the customary justice system, not state laws (Center of Studies for Peace and Development, 2014). Family negotiations determine whether or not women can claim land rights and educated women have a stronger chance in these negotiations (Center of Studies for Peace and Development, 2014). However, women farmers are less likely to be educated with only 48.8% of rural women being literate (General Directorate of Statistics and United Nations Population Fund, 2018b), putting these women at a particular disadvantage. As land is commonly used as collateral for credit, women are at a disadvantage in this area as well. Only 11% of extension officers are women (Gavaluyugova et al., 2018), limiting the enabling environment for women farmers to access inputs and technical information. Additionally, agricultural extension often focuses on reaching those in farmer groups and women are much less represented in these groups (Akter et al., 2016). Gender-responsive technologies and services that generate time and labor gains for women are particularly important, especially when a quarter are undernourished (General Directorate of Statistics et al., 2018).

Young women farmers aged 15–24 constitute 21% of the population and are in a particularly vulnerable position with lower levels of education and access to healthcare and often belonging to poorer rural households (Belun et al., 2018). Their age, gender, and residence intersect, increasing their vulnerability and 36.7% are illiterate compared to 10.5% of non-farmer young women (General Directorate of Statistics and United Nations Population Fund, 2018b). Young women farmers marry younger, have children earlier, and have more children by 24 than non-farmer young women (Belun et al., 2018).



5. Diets and nutrition

5.1 Food insecurity

Timor-Leste is faced with high rates of food insecurity. In 2019, an Integrated Phase Classification (IPC) analysis found moderate chronic food insecurity (CFI) affects 21% of the population and, even more concerning, severe CFI affects 15% (IPC Global Partners, 2019). This indicates that 36% of all Timorese or 430,000 people struggle to ensure sufficient food intake throughout the year. Additionally, this is even higher during hunger seasons. The prevalence of undernourishment was 27.2% between 2015 and 2017. This 3-year average has remained constant since 2001 but decreased drastically from a peak of 44.1% between 1998 and 2000 (Food and Agriculture Organization of the United Nations, 2018b) (Fig. 6). These results

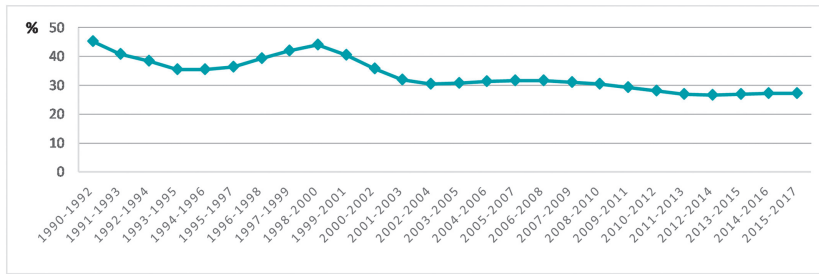


Fig. 6 Prevalence of undernourishment in Timor-Leste, 1990–2017 (3-year average). Source: Data from Food and Agriculture Organization of the United Nations, 2018b. FAOSTAT. United Nations. Consulted November 2018. <http://www.fao.org/faostat/en/>.

correspond with the Food Consumption Score (FCS), in which 11% of households ranked “poor.”

The overall reduced Coping Strategy Index (rCSI), a proxy for household food insecurity measuring households’ resilience to shocks, had a median of three, which was relatively good (General Directorate of Statistics, 2015). However, this index was calculated outside the hunger season, which may explain the difference from the IPC findings. When households are unable to get enough food, they must adopt coping strategies such as relying on others for food (64.5%), eating less (60.3%), or eating fewer meals a day (60.0%) (General Directorate of Statistics, 2015). Similarly, households affected by the El Niño phenomenon used these same strategies (Barritt, 2016; Ministry of Agriculture and Fisheries, 2016).

Populations most vulnerable to food insecurity in Timor-Leste include women, children, and poor households (Belo et al., 2015). Particularly vulnerable households are those who depend on buying food, especially in urban centers. Annual hunger seasons also put more people at risk of food insecurity and undernourishment. These vary by region and may also be exacerbated by ENSO weather patterns and natural disasters (Belo et al., 2015). It is expected that climate shocks will aggravate poverty, food insecurity, and malnutrition (World Bank, 2018a).

The food deficit, which indicates the number of calories needed to provide enough food for everyone, measured 184kcal per capita per day between 2014 and 2016 but is declining (World Development Indicators, 2018). While the food deficit has improved, it is still significant. Between 2015 and 2017, the average dietary energy supply adequacy rate, which measures the calories available in the country’s food supply, was 102% (Food and Agriculture Organization of the United Nations, 2018b). However, a large share of this dietary energy is from staple foods that are dense

in calories but do not provide enough micronutrients or protein (Provo et al., 2017). The average protein supply was 57 g/capita/day for 2011 to 2013 but the average supply of protein from animal source foods was only 17 g/capita/day for the same period (FAO, 2018b).

5.2 Dietary diversity

While rates of food insecurity and undernourishment are high, many more people have nutritionally inadequate diets. The four main staples consumed are rice, maize, cassava, and sweet potato. These staples provide 87% of the caloric needs but only 53% of the protein and 22% of the fat requirements (Molyneux et al., 2012). Infants and young children are especially at risk. For children 6–23 months, 87% did not consume a minimum acceptable diet (MAD) and 66% did not consume the minimum dietary diversity (MDD) (General Directorate of Statistics et al., 2018). Child dietary indicators have not improved since 2013 (General Directorate of Statistics, 2015), except for modest improvements in dietary diversity (Fig. 7). Dietary diversity is also lacking for adults, with most adults mainly consuming rice, maize and/or tubers with some vegetables, and low animal protein intake ranging 30–54% (Belo et al., 2015) with some communities' consumption as low as 6% (Wong et al., 2018).

The 2013 FCS survey found that only 61.3% of households had an “acceptable” FCS. This score is based on food frequency, dietary diversity, and relative nutritional value of different food groups (General Directorate of Statistics, 2015). The remaining 10.9% of households had a “poor” FCS and 27.8% fell into a “borderline” group, vulnerable to fall into the “poor” category when even a mild shock hits the household. There were better FCS in urban

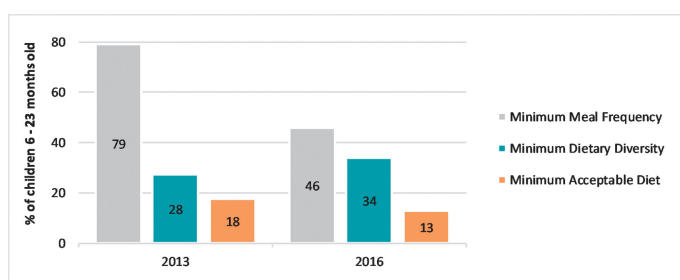


Fig. 7 Indicators of feeding practices for children 6–23 months old in Timor-Leste, 2013–16. Source: Data from General Directorate of Statistics, 2015. Timor-Leste Food and Nutrition Survey 2013. Government of Timor-Leste General Directorate of Statistics and Ministry of Health; General Directorate of Statistics, Ministry of Health and ICF, 2018. Timor-Leste Demographic and Health Survey 2016. Government of Timor-Leste General Directorate of Statistics, Ministry of Health and ICF.

areas, with 76.8% of households in Dili with an “acceptable” FCS. Household members rarely consumed milk, pulses, or fruit because of poor access and affordability (General Directorate of Statistics, 2015). Despite being an island nation, fish consumption is very low. Data show an average annual fish intake of 6.1 kg per capita (AMSAT International, 2011), compared to more than double that in neighboring South Pacific nations (World Bank, 2018a). Fish and seafood from gleaning are a crucial nutritional contribution to the diets of poor coastal communities, with annual intakes of 27.6 kg per capita (AMSAT International, 2011).

5.3 Micronutrient deficiencies

In Timor-Leste, women and children are the most at-risk of being malnourished based on lack of education leading households not to utilize all of their food resources, especially animal source foods that are commonly reserved for ceremonies. Anemia is the most widespread micronutrient deficiency. Anemia was 23% among women of reproductive age (15–49 years old) and 40% in children aged 6–59 months in 2016, a few points higher than in 2009/10 (General Directorate of Statistics et al., 2018). However, an assessment in 2013 reported severe levels of 40% and 63%, respectively (General Directorate of Statistics, 2015). Other vitamin and mineral deficiencies, such as Vitamin A and zinc are also a problem in women and children and iodine deficiency is a problem in women (Provo et al., 2017).

5.4 Undernutrition and overweight/obesity

Despite undernutrition being more prevalent and worrisome in Timor-Leste, the country is undergoing a nutrition transition as reflected in rapidly increasing overnutrition rates. For women age 15–49, 8% were overweight and 2% were obese, and for men of the same age bracket, 5% were overweight and 1% were obese (General Directorate of Statistics et al., 2018), both tripling since 2003 (Ministry of Health et al., 2004). Similarly, child overweight has increased to 6%. This reflects changes in the food environment where cheap, highly processed, unhealthy, calorie-rich foods (high in sugar, salt, and unhealthy fat) are becoming more readily available. However, 27% of women were underweight, and among children under five, 40% were underweight, 24% were affected by wasting, and 46% were stunted in 2016 (General Directorate of Statistics et al., 2018). The burden is incredibly high, particularly in poor households and rural areas (General Directorate of Statistics, 2015), and in comparison, to neighboring countries (Fig. 8).

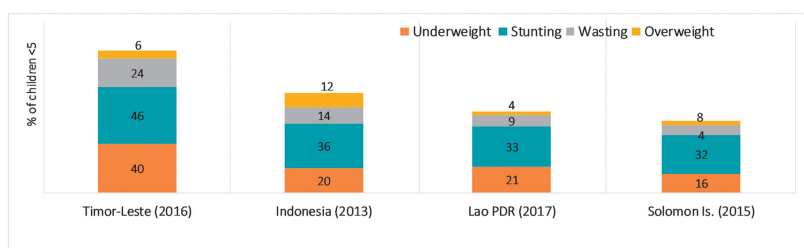


Fig. 8 Prevalence of malnutrition in Timor-Leste, Indonesia, Lao PDR, and Solomon Islands. *Source: Data from General Directorate of Statistics, Ministry of Health and ICF, Timor-Leste Demographic and Health Survey 2016, 2018, Government of Timor-Leste General Directorate of Statistics, Ministry of Health and ICF; United Nations International Children's Emergency Fund, Multiple Indicators Cluster Survey (MICS) Data, 2018. United Nations International Children's Emergency Fund. Consulted 12 November 2018 <http://mics.unicef.org/surveys>; World Bank, World Bank Data, 2018b, Consulted 12 November 2018, <https://data.worldbank.org/indicator/>.*

5.5 Wasting

Wasting, a measure of acute malnutrition in children under five, is alarmingly high at 24% (General Directorate of Statistics et al., 2018).^a Wasting is a significant risk factor of mortality and; therefore, if 10% or more children have global acute malnutrition (GAM), this is considered a serious emergency. When this rises to 15%, the emergency is considered critical. For Timor-Leste, the prevalence has been consistently over 10%. In 2016, the prevalence was over 15% in the majority of municipalities with the highest numbers in the west (General Directorate of Statistics et al., 2018) overlapping with the most poverty-stricken areas, as shown in Fig. 2. Between 2007 and 2014, wasting was reduced, with the bottom two quintiles experiencing the sharpest reductions (World Bank, forthcoming-b).

5.6 Stunting

Of the nation's children under five, 46% remain stunted, measured as height for age (General Directorate of Statistics et al., 2018). However, these children are not only physically shorter but they also have an irreversible disability in development and learning. Children short for their age are worse off and have poor brain growth and development compared to children with good nutrition. Children need good nutrition to grow and develop to their full potential, especially from conception through the first 2 years of life (Victora et al., 2008). In Timor-Leste, almost half of the children are stunted,

^a The 2016 DHS anthropometry data should be looked at with caution and in 2016 there was also an El Niño event which may have additionally increased the prevalence of wasting.

impacting the entire country's development. Additionally, these children are also likely to have children who are stunted themselves, perpetuating the cycle of malnutrition through generations.

Childhood stunting is the best comprehensive indicator of child well-being and development, as well as an accurate indicator of social inequity (De Onis and Branca, 2016). Stunting is a complex measure and it reflects a country's history; depicting wars, persistent poverty, inflictions of infectious disease, and poor healthcare access as well as insufficient, nutritious food. Other countries with comparably high stunting include Yemen, Afghanistan, and Burundi (International Food Policy Research Institute, 2016).

Since 2002, there have only been small reductions in stunting. In 2016, the prevalence was 46% (General Directorate of Statistics et al., 2018), which has not dramatically improved since 2003 when it was 49.4% (Ministry of Health et al., 2004). This reduction is well under the world average annual reduction rate of 2.1% (Scaling Up Nutrition, 2015). Additionally, the reductions at the national level were the result of taking steps forward in urban areas but back in rural ones. In urban areas, stunting decreased by over 20% but in rural areas, it increased by 0.7%. As most people live in rural areas, there was only a small overall reduction (World Bank, forthcoming-b).



6. Overcoming the challenges: Working toward solutions

Despite these challenges, there is hope. A path forward exists. Agricultural sector actions are part of the solution and can make important contributions to poverty reduction, food security, dietary diversity, micronutrient sufficiency, and overall nutrition. Agriculture can be made to be more nutrition- and gender-sensitive with a focus on mixed farming systems, biodiversity, climate-smart practices, and access to inputs, training, and technologies for farmers to enable sustainable and healthy rural livelihoods. Ultimately, productivity levels must improve to support the availability of sufficient and nutritious foods.

6.1 Mixed farming systems, biodiversity, and indigenous species

Globally, food systems are becoming more homogenous as they move toward fewer crops with 200 crops and 5 animal species making up most of the food consumed (Food and Agriculture Organization of the United Nations, 2004). Short-term productivity can be increased by farming in intensified monocultures; however, the loss of biodiversity leads to a loss

of some varieties, potentially permanently (Khoury et al., 2014). These losses can be devastating to longer-term productivity and nutrition as some varieties grow better in different environmental conditions and are more nutritious, providing a larger range of micronutrients.

Biodiversity is a critical component of food system climate change resilience and allows food systems to utilize different crops and varieties to survive and grow in difficult environmental conditions, including higher temperatures, more variable precipitation, and in the face of new pests and diseases (Food and Agriculture Organization of the United Nations, 2016; Khoury et al., 2014). It is especially important to preserve indigenous varieties as these often have unique environmental and nutritional characteristics (Swiderska et al., 2011). Increasing biodiversity minimizes the risk of losing an entire harvest to environmental conditions since different crops and varieties have different vulnerabilities. This makes agricultural systems more resilient and is important for maintaining yields and increasing food security (Food and Agriculture Organization of the United Nations, 2016).

Timor-Leste could focus on increasing production of diverse, nutritious foods including legumes, orange and purple-flesh sweet potatoes, vegetables, and fruits. The country could also increase the availability of animal source foods, which are often lacking in diets. This could be achieved by improving livestock productivity through better animal health, feeding, and herd management as well as by developing fisheries and aquaculture. This would increase the amount of nutritious food for subsistence farmers to eat and sell, improving nutrition and incomes. The country could also promote the value of indigenous and wild foods such as Job's tears, moringa, bitter beans, kumbili, and sago palm (Erskine et al., 2015). These foods also provide an important safety net during seasonal food shortages, though their harvests are not always reliable.

Mixed farming systems and sustainable agroforestry provide a way to increase nutritious food production. These increase yields and farmer incomes (Herrero et al., 2013). Globally, more than half of the world's nutrients come from mixed farming systems (Herrero et al., 2017). Integrating and diversifying crops, livestock, and trees can increase farm efficiency and improve productivity. Agroforestry in Timor-Leste could promote cash crops such as indigenous high-value timber trees and intercrop these with coffee, cacao, and spices, which diversify farmer incomes and also restore ecosystem services and strengthen climate resilience. There needs to be a significant focus on conserving forest biodiversity, as this is vital for many rural households as a source of hunting, wild foods, and medicine. Reforestation efforts can also improve watershed management for small-scale irrigation.

Timor-Leste can continue to expand community-based approaches to distributing seeds, which have outperformed regulated systems (Lopes, 2016). Community production groups could start seed fairs to distribute high-yield cultivars as well as sharing information and training. These would benefit from including indigenous crops alongside improved heat and drought resistance seeds to increase climate change resilience.

6.2 Climate-smart agricultural practices and farmer training

It is critical to develop and promote climate-smart and sustainable practices to increase productivity in the face of climate change. Farming methods such as low- or no-till farming are more productive and sustainable. They do not disturb the soil, increase nutrients in the soil, prevent erosion, prevent water loss, and increase crop yields. Crop rotation involves moving crops seasonally to decrease soil depletion and disease; additionally, cover crops can be planted in a field the following season to increase soil nutrients (Food and Agriculture Organization of the United Nations, 2016). Farmers can also use felled weeds and stones along contoured land to prevent erosion (Da Costa et al., 2013). The country could also benefit from more effective fertilizer use (Williams et al., 2017). Farmers recognize the need to use fertilizer but do not know the most sustainable way to do so to maximize soil quality in a way that is healthy for themselves, their communities, and the environment.

Since 2013, MAF and their partners have been promoting Conservation Agriculture (CA) practices, which integrate the principles of minimal soil disturbance, permanent soil covers, and diversified crop species grown sequentially (Flamarique-Urdín, 2016). Indigenous velvet beans or mucuna are planted in rotation with maize and pigeon peas are intercropped with mature maize. Leguminous plants improve soil fertility through their nitrogen-fixing properties, with velvet beans being a popular choice as a green manure due to their abundant biomass and weed suppressing capabilities (Correia et al., 2014). CA adoption has demonstrated more efficient maize and legume production that is better adapted to precipitation variability and a 50% reduction in labor (Flamarique-Urdín, 2016).

Scaling-up efforts to train smallholder farmers across Timor-Leste in CA methods could substantially increase productivity, contribute to household food security and nutrition, and reduce risks associated with climate change. These programs could be made available nation-wide to reach more farmers, especially women. Building the capacity of the extension workforce appears to be an effective approach to increase the adoption of these practices.

Recruiting more women extension officers will be critical to support women farmers. Extension services can be improved by coordinating with community leaders to reach the most vulnerable farmers and by replicating demonstration plots. The government could also provide insurance to farmers with a safety net when they lose crops in the face of droughts or floods that aggravate food insecurity.

6.3 Agricultural technology and equipment

Alongside providing training and technical support, the government can do more. There is equipment and technology such as walk-behind and larger tractors, seeders, and irrigation that can modernize the country's agriculture to increase yields and decrease labor. Irrigation is an especially important technology for smallholders that can be scaled up. Although precipitation is expected to increase, it is also expected to become more variable and dry seasons and droughts are expected to get longer and more severe (Intergovernmental Panel on Climate Change, 2014). Rain-fed agriculture will continue to be less and less productive. Irrigation is critical to protect against these disruptions in precipitation and maintain agricultural productivity. Globally, despite only making up 10% of the world's agriculture, irrigated agriculture produces 40% of the world's cereals (Food and Agriculture Organization of the United Nations, 2011a).

It is important to make rain-fed and irrigated agriculture more efficient through better water management and training. Water associations and groups can provide training and distribute technology (Food and Agriculture Organization of the United Nations, 2016). Timor-Leste could scale up irrigation focusing on more nutritious horticulture crops in areas where rainfall is the least reliable. Supporting smallholders' access to water is vital, especially for rural farmers that are the most vulnerable to natural disasters and food insecurity. While the government has spent a lot of money on improving irrigation to increase rice production, this has had very poor results (World Bank, 2018a). Such expenditures could be redirected toward alternative strategies such as using tube wells and small pumps (TWSP).

6.4 Home gardens and small animal rearing

Home gardens and small animal rearing are key practices to increase household food production, food security, and nutrition through increasing consumption of nutritious vegetables, fruit, and animal source foods (Carletto et al., 2015; Olney et al., 2015). These can also provide additional income sources, which increase resilience to short-term shocks and long-term

stresses, especially for the most vulnerable households (Olney et al., 2015). Households can forage, consume, and sell wild foods to increase their food security and incomes. These foods are important for increasing resilience and providing micronutrients, especially in the face of crop losses or high food prices (Flyman and Afolayan, 2006; Swiderska et al., 2011).

Promoting small livestock such as chickens, which women are more likely to control, is an important step in improving household nutrition (Wong et al., 2018). Poultry provides meat and eggs and the early introduction of eggs in children's diets significantly improves child growth (Iannotti et al., 2017). Egg promotion is a sound strategy to improve child nutrition in Timor-Leste as eggs are culturally appropriate, the most affordable animal source food, and the majority of poor households own chickens.

6.5 Addressing wasting and stunting

Timor-Leste could make a concerted effort to address the high rates of wasting and stunting in the country. Wasting has a high mortality and stunting has long-lasting impacts on children's health and development and thus it is important to commit attention and resources to addressing these issues. The country could take a four-pronged approach that includes food-based approaches, water, sanitation, and hygiene (WASH) interventions, education and women's empowerment, and Community-Based Management of Acute Malnutrition (CMAM).

First, food-based approaches could include increasing availability, access, and utilization of nutritious foods and increasing dietary diversity, which reliably improves women's (Arimond et al., 2010) and children's nutrition (Arimond and Ruel, 2004; Kennedy et al., 2007; Moursi et al., 2008; Steyn et al., 2006). The food system needs to produce more nutritious and culturally appropriate food. Farmers need to grow more crops and varieties (Tomlins et al., 2007) and increase their market access so that more diverse foods are available. This could be done through globally important agricultural heritage systems (GIAHS); providing sustainable diets using local food systems; protecting indigenous and traditional cultures and crops; empowering small-scale, women, and marginalized farmers; promoting biodiversity conservation and sustainable use; and promoting optimal infant and young child feeding practices.

Second, on top of scaling up water infrastructure, WASH interventions could include eliminating open defecation through community-led total sanitation (CLTS). Access to safe WASH is an important component

of health and dramatically decreases infectious diseases that contribute to malnutrition and stunting. When people suffer from infectious diseases, they have higher nutritional demands, and when they have gastrointestinal illnesses, their bodies cannot absorb nutrients as well (Ngure et al., 2014). CLTS gives communities the power to design and implement actions to improve their own sanitation. Community power ensures that the improved facilities are what people want and are actually used, making them more effective (Kar and Chambers, 2008).

Third, the country could improve women's empowerment by promoting women's education, especially education access for adolescent girls. This could be achieved by providing social protection programs that encourage girls to stay in school as well as providing a safety net for families.

Women's health and nutrition is vital not only for each woman's own well-being, but for her children as well. This is so important because improving nutrition for women and girls causes positive feedback loops that improve health outcomes for everyone, including decreasing pregnancies in young women and girls, improving birth outcomes, and improving child growth (Bhutta et al., 2013; Black et al., 2013).

Fourth, Timor-Leste could scale up its CMAM program to specifically address wasting in the country. While addressing wasting can be difficult, CMAM has been effective in many countries (Qazi, 2012). CMAM aims to improve healthcare infrastructure, increase the supply of healthcare supplies, and improve healthcare staff numbers and training with the end goal of increasing capacity so that the country can treat moderate (MAM) and severe acute malnutrition (SAM) without outside assistance both during an average year and during emergencies (Concern Worldwide, 2016; Hailey and Tewoldeberha, 2010). Timor-Leste already has a CMAM policy that is implemented by the Ministry of Health (MOH) and healthcare workers have been trained in the interventions. However, the country does not yet have the necessary capacity and the program needs to be scaled up to increase coverage. Additionally, many people do not reach health facilities and; therefore, the MOH needs to do more community work to teach people to identify acute malnutrition themselves.

6.6 Nutrition education

Along with increasing the availability of nutritious foods, the country also needs to provide culturally appropriate education so that people will buy and consume more nutritious foods. Education is needed on nutrition for pregnant women, infants, and young children. These periods are critical

as nutrition in a child's first 1000 days, from conception through a child's first 2 years, impacts health during that period as well as for their entire life (Black et al., 2013). Many Timorese pregnant women limit their food consumption to have smaller babies due to fear of complications in childbirth. Changing this requires education about the importance of nutrition in pregnancy and making childbirth safer through increased access and improved healthcare. Many people also do not follow best infant and young child feeding practices instead of exclusively breastfeeding for the recommended first 6 months followed by adding nutrient dense foods, including animal source foods, until 23 months (Dewey, 2013; United Nations International Children's Emergency Fund, 2016). Changing inadequate infant and child feeding requires continuous education and cultural shifts to change these strongly held practices.

It is important that this education reaches everyone, particularly in rural areas, and that it includes men and extended family members, as men tend to be the decision-makers in households and mothers-in-law are often the ones providing information on restricting food during pregnancy and infant and young child feeding. Identifying the influencers of the target audience is essential for effective nutrition education and social behavior change interventions, as in a recent research aimed at improving adolescent nutrition in Timor-Leste (Bonis-Profumo and Meyanathan, 2018). The MOH and other stakeholders are already leading education in prenatal nutrition and infant and young child feeding through healthcare facilities and in mothers' groups, which would benefit from increased coverage. Other approaches could be scaled up such as school gardens and cooking demonstrations. Community trust is essential for people to adopt nutrition education and could be achieved by working with customary authorities, the Church and by engaging the country's leaders.

Another challenge in improving nutrition in the country is the amount of resources used in ceremonies. Households allocate large proportions of available assets, including money and livestock, on these celebrations, even in the poorest areas. Families may use their animals for ceremonies instead of for food for themselves and their children. Culturally sensitive, community-led education about prioritizing resources for nutrition over ceremonies is critical.

6.7 School meal programs

School feeding programs (SFP) work to alleviate child hunger, improve child nutrition and cognitive development, and provide cash for families.

SFP's in low- and middle-income countries have been shown to improve child nutrition, including both energy and micronutrient intake, and increase school enrollment and attendance (Jomaa et al., 2011). Improvements in nutrition are the greatest for SFPs that include meat (Neumann et al., 2007) and eggs (Cao et al., 2013) and for children who are malnourished (Grillenberger et al., 2003; Kruger et al., 1996). However, the evidence on SFP's impact on child growth, cognition, and school performance is less clear (Jomaa et al., 2011).

The country could make changes to the nationally owned School Meals Program, *Programa Merenda Eskolar* (PME), to make it more nutrition-sensitive. The PME has been in operation since 2012 and had a 17 million USD budget in 2017 to cover the entire country (Ministry of Finance, 2017), with an allocation of 0.25 USD per student per day (Provedoria dos Direitos Humanos e Justica, 2016). However, its implementation has been irregular. The PME's main goal is to increase school attendance, with the sub-goals of improving students' nutritional status and providing energy for academic performance. The program also supports the local economy and allows the community to get involved in school management (Provedoria dos Direitos Humanos e Justica, 2016).

Home-grown school feeding (HGSF) programs link school feeding with local agricultural production (Espejo et al., 2009). This is preferable because it avoids the issues of being unsustainable and negatively impacting local markets (Adelman et al., 2008). However, HGSF has two downsides: it requires decentralized food distribution, which does not allow for centralized food fortification, and it makes food supplies less reliable, especially during hunger seasons or droughts (International Food Policy Research Institute, 2016).

To supply the needs of the PME, the National Logistics Centre provides imported rice (Provedoria dos Direitos Humanos e Justica, 2016). However, domestic rice distribution was recently piloted in Dili (Japanese International Cooperation Agency, 2018). If the PME continues to provide rice for children, it could be fortified to address micronutrient deficiencies (International Food Policy Research Institute, 2016). While there are many advantages to HGSF, the country's farmers are not currently able to produce enough food for the PME; therefore, a modified approach is needed. Timor-Leste could use a mixed model where imported foods like rice and eggs are used to ensure an adequate food supply, also allowing for fortification. Imported foods could be supplemented with domestic legumes, vegetables, fruits, and tubers and these could be scaled up to meet a gradually increasing quota as production and availability allow.

6.8 Social protection programs

Timor-Leste could benefit from ensuring that the country's social protection programs such as *Bolsa da Mãe* are more nutrition-sensitive and are provided to the most vulnerable. Social safety nets are a critical tool to address poverty in low- and middle-income countries (World Bank, 2015a). As poverty is a critical cause of malnutrition (Food and Agriculture Organization of the United Nations, 2015), social safety nets can also improve nutrition. However, they do not necessarily translate into nutrition gains unless they are redesigned to be more nutrition-sensitive (International Food Policy Research Institute, 2016).

These programs could be made more nutrition-sensitive by improving the food transfer. The Ministry of Social Solidarity and Inclusion (MSS) and the MOH could make the Food Security Program more nutrition-sensitive by transforming the program from only providing rice to providing more nutritious foods including fortified rice and cooking oil and protein sources such as legumes, tempeh, or tofu. This food transfer could also be provided to *Bolsa de Mãe* recipients.

The government could ensure that the programs are meeting the needs of the most vulnerable by refining the inclusion criteria to ensure that they benefit the most vulnerable populations, which would include women, elderly, orphans, disabled, and poor marginalized communities. The *Bolsa de Mãe*, the only program targeting vulnerable mothers with children, needs to reach more people and provide more benefits to those it does reach (World Bank, 2015b). The MSS could increase the *Bolsa da Mãe's* coverage to reach 95,000 households and increase the benefits to 34 USD per month or greater. Current monthly benefits only cover an average of 3.5% of total household expenditures, which is much lower than other international programs that may cover up to 10–15% (World Bank, 2015c). These modest increases could lead the program to have a more significant impact on reducing poverty (World Bank, 2015b). Additionally, women, who are the recipients of *Bolsa da Mãe*, are more likely to spend money on food and education for children, both globally (World Bank, 2007) and in Timor-Leste (Government of Timor-Leste, 2016), further justifying the need to strengthen this social transfer.

6.9 Women's empowerment

The evidence suggests that if women farmers were able to achieve the same yields as men, the production gains could be 20–30%, while reducing hunger and poverty and promoting economic growth (Food and Agriculture

Organization of the United Nations, 2011b). In Timor-Leste, women farmers produce 15% less per ha than men, with the gap increasing to 31% when adjusting for land plot size (Gavaluyugova et al., 2018). This “gender gap” in agricultural productivity is substantial. Its explanatory factors are lower literacy among women farmers, unequal access to the means of production, such as differences in ability to access farming equipment and hire farm labor, and limited involvement of women in cash crop production as well as in farmers’ groups (Gavaluyugova et al., 2018).

While the challenges faced by women in the agricultural sector and beyond are deeply entrenched and difficult to change, they can get better. Women’s empowerment is a critical part of food security and nutrition. Women farmers need land access and ownership, inputs and technology to save time and labor, business training, improved marketplaces, and legal protection of their rights, including against violence. This would improve agricultural production and women’s empowerment more broadly. The MAF could continue to professionalize extension systems and raise awareness of available services, while increasing the number of women extension workers. Timesaving equipment and technologies with demonstrated reductions in women’s workloads could be scaled up, particularly water systems (BESIK, 2016), water storage devices, shellers, screens, and seed saving groups (Seeds of Life, 2015). Promoting CA, which decreases farmers’ workloads due to time efficiencies in integrated systems (Flamarique-Urdín, 2016), particularly benefits women growers as they not only co-share cropping tasks but also perform many domestic chores and are more time stressed. The MAF could also provide training and business development tailored to the literacy levels of women farmers. Programs need to strengthen women’s and young farmers’ capacity and opportunities to sell their products in emerging markets and join business partnerships as well as farmers’ groups by collaborating with the Secretary of State for Equality and Inclusion (SEII).

In Timor-Leste, broader women’s empowerment is also critical. Women and girls need better access to education and the country needs to strengthen and enforce protections against intimate partner violence and other violence against women. While the country has laws against gender discrimination (Government of Timor-Leste, 2002), these laws need to be strengthened and improved to actually address structural inequalities (International Fund for Agricultural Development, 2016).

When women have more power, including over household decision-making, nutritional outcomes improve for all family members. Education

is one way to improve women's power and influence over decisions and increases in secondary education for women and girls improves child nutrition outcomes, including decreasing stunting (International Food Policy Research Institute, 2016). Targeting women in conditional cash transfer programs also strengthens women's decision-making power and, when women have more control over household incomes, more money is spent on children's food and education (Food and Agriculture Organization of the United Nations, 2011b).



7. Conclusion

The implementation of such recommendations would require a firm commitment from decision-makers. Timor-Leste has the opportunity to capitalize on the demographic force of the young generations by investing in their human capital and ensuring the sustainable development of this proud nation. As oil revenues dwindle in the coming years and the demands for a diversified economy become even stronger, Timor-Leste will depend more on the current and future capacity of its labor force. This capacity is compromised by the impact of undernutrition at a young age. Addressing food insecurity and malnutrition should be of the highest priority and reflected in the yearly budget by re-structuring non cost-effective disbursements. Despite Timor-Leste's solid policy framework to tackle food insecurity and malnutrition, financial allocation and distribution must accompany this in order to translate policy objectives into a tangible reality.

Managing the Petroleum Fund wisely and objectively assessing the potential returns on investment of new oil and gas developments are critical. It is important to consider the number of Timorese who will directly benefit from sectoral investments. The agriculture sector contributes a fifth of the non-oil GDP and employs the majority of the population, providing livelihoods for the most vulnerable. Sound investments to increase agricultural productivity and farmers' incomes are essential to improve food security as well as economic growth. These could generate incentives for the youth in rural areas through economically attractive and sustainable livelihoods. Climate change will continue to intensify and the country needs to prepare now by strengthening its natural capital through better agricultural management, biodiversity conservation, and integrated farming systems. With the new challenges from climate change, agriculture resilience will be key for a peaceful and prosperous Timor-Leste. However, the Timorese are incredibly resilient and have repeatedly adapted in the face of adversity.

References

- Adelman, S., Gilligan, D., Lehrer, K., 2008. How Effective Are Food for Education Programs? A Critical Assessment of the Evidence From Developing Countries. vol. 9. International Food Policy Research Institute.
- Akter, S., Erskine, W., Branco, L., Agostinho, O., Imron, J., Spyckerelle, L., 2016. Gender in crop production in Timor-Leste. In: Nesbitt, H., Erskine, W., da Cruz, C.J., Moorhead, A. (Eds.), *Food Security in Timor-Leste Through Crop Production. Proceedings of TimorAg2016 an International Conference Held in Dili, 13–15 April 2016.* ACIAR Proceedings No. 146. Australian Centre for International Agricultural Research.
- AMSAT International, 2011. Fish and animal protein consumption and availability in Timor-Leste, Regional Fisheries Livelihoods Programme for South and Southeast Asia (GCP/RAS/237/SPA), Field Project Document 2011/TIM/02. Food and Agriculture Organization of the United Nations.
- Arimond, M., Ruel, M.T., 2004. Dietary diversity is associated with child nutritional status: evidence from 11 demographic and health surveys. *J. Nutr.* 134 (10), 2579–2585.
- Arimond, M., Wiesmann, D., Becquey, E., Carriquiry, A., Daniels, M.C., Deitchler, M., Fanou-Fogny, N., Joseph, M.L., Kennedy, G., Martin-Prevel, Y., Torheim, L.E., 2010. Simple food group diversity indicators predict micronutrient adequacy of women's diets in five diverse, resource-poor settings. *J. Nutr.* 140 (11), 2059S–2069S.
- Asian Development Bank, 2016. Country Partnership Strategy Timor-Leste 2016–2020. Asian Development Bank.
- Barritt, P., 2016. Humanitarian Partnership Agreement: Agency Assessment on El Niño Impacts on Timor-Leste as of February 2016. CARE Timor-Leste.
- Belo, E., Snowball, K., Grieve, H., 2015. Roundtable Dialogue on Nutrition and Food Security Mapping the Underlying Drivers of Malnutrition in Timor-Leste. Australian Aid.
- Belun, United Nations Population Fund, UN Women, 2018. Leaving No Youth Behind In Timor-Leste Policy Brief # 1 Young Female Farmers. Belun and United Nations.
- BESIK, 2016. Women's Time Use Mapping: Changes After the Improvement of the Water System in Timor-Leste. BESIK (Australian Aid).
- Bettencourt, E.M.V., Tilman, M., Narciso, V., Carvalho, M.L.D.S., Henriques, P.D.D.S., 2015. The livestock roles in the wellbeing of rural communities of Timor-Leste. *Rev. Econ. Sociol. Rural.* 53, 63–80.
- Bhutta, Z.A., Das, J.K., Rizvi, A., Gaffey, M.F., Walker, N., Horton, S., Webb, P., Lartey, A., Black, R.E., Lancet Nutrition Interventions Review Group, the Maternal and Child Nutrition Study Group, 2013. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? *Lancet* 382 (9890), 452–477.
- Black, R.E., Victora, C.G., Walker, S.P., Bhutta, Z.A., Christian, P., De Onis, M., Ezzati, M., Grantham-McGregor, S., Katz, J., Martorell, R., Uauy, R., 2013. Maternal and child undernutrition and overweight in low-income and middle-income countries. *Lancet* 382 (9890), 427–451.
- Bonis-Profumo, G., Meyanathan, S., 2018. Adolescent Nutrition in Timor-Leste: A Formative Research Study. World Food Programme and TOMAK (Australian Aid). <https://docs.wfp.org/api/documents/WFP-0000102604/download/>.
- Cao, J.Y., Wei, X.P., Tang, X.Q., Jiang, H.P., Fan, Z., Yu, Q., Chen, J., Liu, Y.X., Li, T.Y., 2013. Effects of egg and vitamin A supplementation on hemoglobin, retinol status, and physical growth levels of primary and middle school students in Chongqing, China. *Asia Pac. J. Clin. Nutr.* 22 (2), 214–221.

- Carletto, G., Ruel, M., Winters, P., Zezza, A., 2015. Farm-level pathways to improved nutritional status. *J. Dev. Stud.* 51 (8), 945–957.
- Center for Excellence in Disaster Management and Humanitarian Assistance, 2016. Timor-Leste Disaster Management Reference Handbook. Center for Excellence in Disaster Management and Humanitarian Assistance.
- Center of Studies for Peace and Development, 2014. Women's Access to Land and Property Rights in the Plural Justice System of Timor-Leste. Center of Studies for Peace and Development and UN Women.
- Concern Worldwide, 2016. Global CMAM Surge Approach Operational Guide. Concern Worldwide.
- Correia, M.V., Pereira, L.C., De Almeida, L., Williams, R.L., Freach, J., Nesbitt, H., Erskine, W., 2014. Maize-mucuna (*Mucuna pruriens* (L.) DC) relay intercropping in the lowland tropics of Timor-Leste. *Field Crop Res.* 156, 272–280.
- Crisis Group, 2008. Timor-Leste's Displacement Crisis, Crisis Group Asia Report N° 148, 31 March 2008. International Crisis Group. Consulted 11 February 2019. http://www.observatori.org/paises/pais_78/documentos/148_timor_lesste_displacement_crisis.pdf.
- Da Costa, M.D., Lopes, M., Ximenes, A., Do Rosario Ferreira, A., Spyckerelle, L., Williams, R., Nesbitt, H., Erskine, W., 2013. Household food insecurity in Timor-Leste. *Food Secur.* 5 (1), 83–94.
- De Onis, M., Branca, F., 2016. Childhood stunting: a global perspective. *Matern. Child Nutr.* 12 (Suppl. 1), 12–26.
- Devereux, S., Masset, E., Sabates-Wheeler, R., Samson, M., te Lintelo, D., Rivas, A.M., 2015. Evaluating the Targeting Effectiveness of Social Transfers: A Literature Review. Institute of Development Studies.
- Dewey, K.G., 2013. The challenge of meeting nutrient needs of infants and young children during the period of complementary feeding: an evolutionary perspective. *J. Nutr.* 143 (12), 2050–2054.
- Erskine, W., Ximenes, A., Glazebrook, D., da Costa, M., Lopes, M., Spyckerelle, L., Williams, R., Nesbitt, H., 2015. The role of wild foods in food security: the example of Timor-Leste. *Food Secur.* 7 (1), 55–65.
- Espejo, F., Burbano, C., Galliano, E., 2009. Home-Grown School Feeding: A Framework to Link School Feeding With Local Agricultural Production. World Food Program.
- Fischer, T., 2016. Global food security and Timor-Leste. In: Nesbitt, H., Erskine, W., da Cruz, C.J., Moorhead, A. (Eds.), Food Security in Timor-Leste Through Crop Production. Proceedings of TimorAg2016 an International Conference Held in Dili, 13–15 April 2016. ACIAR Proceedings No. 146. Australian Centre for International Agricultural Research.
- Flamarique-Urdín, R., 2016. Conservation agriculture in Timor-Leste: experiences and opportunities. In: Nesbitt, H., Erskine, W., da Cruz, C.J., Moorhead, A. (Eds.), Food Security in Timor-Leste Through Crop Production. Proceedings of TimorAg2016 an International Conference Held in Dili, 13–15 April 2016. ACIAR Proceedings No. 146. Australian Centre for International Agricultural Research.
- Flyman, M.V., Afolayan, A.J., 2006. The suitability of wild vegetables for alleviating human dietary deficiencies. *S. Afr. J. Bot.* 72 (4), 492–497.
- Food and Agriculture Organization of the United Nations, 2004. What Is Agrobiodiversity? Training Manual “Building on Gender, Agrobiodiversity and Local Knowledge”. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations, 2011a. Energy-Smart Food for People and Climate. Issue Paper. Food and Agriculture Organization of the United Nations.

- Food and Agriculture Organization of the United Nations, 2011b. *The State of Food and Agriculture: Women in Agriculture, Closing the Gender Gap for Development*. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations, 2015. *Nutrition and Social Protection*. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations, 2016. *The State of Food and Agriculture: Climate Change, Agriculture, and Food Security*. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations, 2017. *GIEWS, Global Information and Early Warning System on Food and Agriculture, Country Brief Timor-Leste*. 4 August 2017. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations, 2018a. *GIEWS, Global Information and Early Warning System on Food and Agriculture, Country Brief Timor-Leste*. 6 March 2018. Food and Agriculture Organization of the United Nations.
- Food and Agriculture Organization of the United Nations, 2018b. *FAOSTAT. Food and Agriculture Organization of the United Nations*. Consulted November 2018. <http://www.fao.org/faostat/en/>.
- Fordyce, G., Dagleish, N., Waldron, S., van der Fliert, E., da Costa Varela, C., Coimbra, L., Talo Mali, C.G., Corriea, V.D.P., do Rego, A., de Almeida, A., Amaral, A., 2017. *Enhancing Smallholder Cattle Production in East Timor. Final Report FR2017-04, 2017*. Australian Centre for International Agricultural Research.
- Gavalyugova, D.K., Caminha, S., Verdial, T., Perova, E., 2018. *Women Farmers in Timor-Leste: Bridging the Productivity Gap*. World Bank and UN Women.
- General Directorate of Statistics, 2015. *Timor-Leste Food and Nutrition Survey 2013*. Government of Timor-Leste General Directorate of Statistics and Ministry of Health.
- General Directorate of Statistics and United Nations Population Fund, 2011. *Timor-Leste National Census 2010*. Government of Timor-Leste National Statistics Directorate and United Nations Population Fund.
- General Directorate of Statistics and United Nations Population Fund, 2016. *Timor-Leste National Census 2015*. Government of Timor-Leste National Statistics Directorate and United Nations Population Fund.
- General Directorate of Statistics and United Nations Population Fund, 2018a. *Timor-Leste Population and Housing Census, 2015, Analytical Report on Agriculture*. vol. 12. Government of Timor-Leste National Statistics Directorate and United Nations Population Fund.
- General Directorate of Statistics and United Nations Population Fund, 2018b. *Timor-Leste Population and Housing Census, 2015, Analytical Report on Gender*. vol. 13. Government of Timor-Leste National Statistics Directorate and United Nations Population Fund.
- General Directorate of Statistics, Ministry of Health, ICF, 2018. *Timor-Leste Demographic and Health Survey 2016*. Government of Timor-Leste General Directorate of Statistics, Ministry of Health and ICF.
- Government of Timor-Leste, 2002. *Constitution of Timor-Leste*. Government of Timor-Leste.
- Government of Timor-Leste, 2016. *National Food and Nutrition Security Policy*. Government of Timor-Leste.
- Government of Timor-Leste and World Food Programme, 2016. *Timor-Leste CLEAR Report, Consolidated Livelihood Exercise for Analyzing Resilience*. Government of Timor-Leste and United Nations.
- Grillenberger, M., Neumann, C.G., Murphy, S.P., Bwibo, N.O., Van't Veer, P., Hautvast, J.G., West, C.E., 2003. *Food supplements have a positive impact on weight gain and the addition of animal source foods increases lean body mass of Kenyan schoolchildren*. *J. Nutr.* 133 (11), 3957S–3964S.

- Hailey, P., Tewoldeberha, D., 2010. Suggested New Design Framework for CMAM Programming. Field Exchange. 39.
- Herrero, M., Havlík, P., Valin, H., Notenbaert, A., Rufino, M.C., Thornton, P.K., Blümmel, M., Weiss, F., Grace, D., Obersteiner, M., 2013. Biomass use, production, feed efficiencies, and greenhouse gas emissions from global livestock systems. *Proc. Natl. Acad. Sci. U. S. A* 110 (52), 20888–20893.
- Herrero, M., Thornton, P.K., Power, B., Bogard, J.R., Remans, R., Fritz, S., Gerber, J.S., Nelson, G., See, L., Waha, K., Watson, R.A., 2017. Farming and the geography of nutrient production for human use: a transdisciplinary analysis. *Lancet Planet. Health* 1 (1), e33–e42.
- Iannotti, L.L., Lutter, C.K., Stewart, C.P., Riofrio, C.A.G., Malo, C., Reinhart, G., Palacios, A., Karp, C., Chapnick, M., Cox, K., Waters, W.F., 2017. Eggs in early complementary feeding and child growth: a randomized controlled trial. *Pediatrics* 140 (1), e20163459.
- IPC Global Partners, 2019. The First IPC Analysis Report on the Chronic Food Insecurity Situation in Timor-Leste. National Directorate of Food Security and Cooperation, the Ministry of Agriculture and Fisheries in collaboration with Country IPC Partners. http://www.ipcinfo.org/fileadmin/user_upload/ipcinfo/docs/3_IPC_Timor%20Leste_CFI_20182023_English.pdf.
- Intergovernmental Panel on Climate Change, 2014. *Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group 2 to the 5th Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.
- International Federation of Red Cross and Red Crescent Societies, 2017. *Emergency Plan of Action Final Report (MDRTP004), Timor-Leste: Drought*. International Federation of Red Cross and Red Crescent Societies.
- International Food Policy Research Institute, 2016. *Global Nutrition Report 2016: From Promise to Impact, Ending Malnutrition by 2030*. International Food Policy Research Institute.
- International Fund for Agricultural Development, 2016. *Rural Development Report: Fostering Inclusive Rural Transformation. Spotlight 5: Gender Equality and Women's Empowerment*. International Fund for Agricultural Development.
- Japanese International Cooperation Agency, 2018. The Project and National Logistic Center (NLC) Have Started to Promote Domestic Rice Through the School Feeding Program!. Project news No 32, 3 April 2018, Japanese International Cooperation Agency. Consulted 4 March 2019. https://www.jica.go.jp/project/english/easttimor/006/news/general/180403_en.html.
- Jomaa, L.H., McDonnell, E., Probart, C., 2011. School feeding programs in developing countries: impacts on children's health and educational outcomes. *Nutr. Rev.* 69 (2), 83–98.
- Kar, K., Chambers, R., 2008. *Handbook on Community-Led Total Sanitation*. Institute of Development Studies.
- Kennedy, G.L., Pedro, M.R., Seghieri, C., Nantel, G., Brouwer, I., 2007. Dietary diversity score is a useful indicator of micronutrient intake in non-breast-feeding Filipino children. *J. Nutr.* 137 (2), 472–477.
- Khoury, C.K., Bjorkman, A.D., Dempewolf, H., Ramirez-Villegas, J., Guarino, L., Jarvis, A., Rieseberg, L.H., Struik, P.C., 2014. Increasing homogeneity in global food supplies and the implications for food security. *Proc. Natl. Acad. Sci. U. S. A.* 111 (11), 4001–4006.
- Kiernan, B., 2008. *Genocide and Resistance in Southeast Asia: Documentation, Denial, and Justice in Cambodia and East Timor*. Routledge.
- Kruger, M., Badenhorst, C.J., Mansvelt, E.P., Laubscher, J.A., Benade, A.S., 1996. Effects of iron fortification in a school feeding scheme and anthelmintic therapy on the iron status and growth of six- to eight-year-old schoolchildren. *Food Nutr. Bull.* 17 (1), 1–11.

- La'ο Hamutuk, 2019. Misinformation and Facts About the Greater Sunrise Project. La'ο Hamutuk. 6 March 2019. Consulted March 2019. <http://www.laohamutuk.org/Oil/Sunrise/2019/MisinformationFactsEn.pdf>.
- Lopes, M., 2016. Characterization of farmer groups successfully multiplying and disseminating seed in Timor-Leste. In: Nesbitt, H., Erskine, W., da Cruz, C.J., Moorhead, A. (Eds.), *Food Security in Timor-Leste Through Crop Production*. Proceedings of TimorAg2016 an International Conference Held in Dili, 13–15 April 2016. ACIAR Proceedings No. 146. Australian Centre for International Agricultural Research.
- Mason, J., Shrimpton, R., 2010. *Progress in Nutrition: 6th Report on the World Nutrition Situation*. United Nations Standing Committee on Nutrition.
- Ministry of Agriculture and Fisheries, 2016. *El Niño Report: Rapid Drought Impact Assessment*. Government of Timor-Leste Ministry of Agriculture and Fisheries.
- Ministry of Finance, 2017. *State Budget 2017 Approved, Budget Overview Book 1*. Government of Timor-Leste Ministry of Finance.
- Ministry of Finance, 2018a. *External Trade Monthly Reports 2017*. Government of Timor-Leste Ministry of Finance.
- Ministry of Finance, 2018b. *State Budget 2019 Books 1 and 2*. Government of Timor-Leste Ministry of Finance.
- Ministry of Finance and World Bank, 2016. *Poverty in Timor-Leste 2014*. Government of Timor-Leste Ministry of Finance and World Bank.
- Ministry of Health and National Statistics Office of the Government of Timor-Leste, University of Newcastle, Australian National University, ACIL Australia, 2004. *Timor-Leste 2003 Demographic and Health Survey*. University of Newcastle.
- Molyneux, N., Da Cruz, G.R., Williams, R.L., Andersen, R., Turner, N.C., 2012. Climate change and population growth in Timor Leste: implications for food security. *Ambio* 41 (8), 823–840.
- Moursi, M.M., Arimond, M., Dewey, K.G., Treche, S., Ruel, M.T., Delpeuch, F., 2008. Dietary diversity is a good predictor of the micronutrient density of the diet of 6- to 23-month-old children in Madagascar. *J. Nutr.* 138 (12), 2448–2453.
- Muizarajs, M., Choudhury, P., Steffen, E.M., Kuppers, A.L., Tajima, Y., Beath, A., 2015. *Democratic Republic of Timor-Leste—Programa Nasional Dezenvolvimentu Suku (PNDS) Research and Evaluation Program: Omnibus Baseline Survey and Process Monitoring Report*. June 2015. Report No: ACS13711. World Bank.
- Neumann, C.G., Murphy, S.P., Gewa, C., Grillenberger, M., Bwibo, N.O., 2007. Meat supplementation improves growth, cognitive, and behavioral outcomes in Kenyan children. *J. Nutr.* 137 (4), 1119–1123.
- Ngure, F.M., Reid, B.M., Humphrey, J.H., Mbuya, M.N., Pelto, G., Stoltzfus, R.J., 2014. Water, sanitation, and hygiene (WASH), environmental enteropathy, nutrition, and early child development: making the links. *Ann. N. Y. Acad. Sci.* 1308 (1), 118–128.
- Olney, D.K., Pedehombga, A., Ruel, M.T., Dillon, A., 2015. A 2-year integrated agriculture and nutrition and health behavior change communication program targeted to women in Burkina Faso reduces anemia, wasting, and diarrhea in children 3–12.9 months of age at baseline: a cluster-randomized controlled trial. *J. Nutr.* 145 (6), 1317–1324.
- PACCSAP, 2015. *Current and Future Climate of Timor-Leste*. Pacific-Australia Climate Change Science and Adaptation Planning Program.
- Provedoria dos Direitos Humanos e Justica, 2016. *Relatorio kona-ba monitorizasaun programa merenda eskolar iha Timor-Leste*. Provedoria dos Direitos Humanos e Justica.
- Provo, A., Atwood, S., Sullivan, E., Mbuya, N., 2017. *Malnutrition in Timor-Leste: A Review of the Burden, Drivers, and Potential Response*. World Bank.
- Qazi, S., 2012. *Scaling Up CMAM in the Wake of 2010 Floods in Pakistan*. Emergency Nutrition Network Issue 43.

- Scaling Up Nutrition, 2015. Technical Note on the Statistics Presented in the 2015 Scaling Up Nutrition Movement. Scaling Up Nutrition. Consulted November 2018. https://scalingupnutrition.org/wp-content/uploads/2015/10/technical_note_data2015_EN.pdf.
- Seeds of Life, 2015. Gender Impact of Labor Saving Devices' Use in Maize Seed Groups. Government of Timor-Leste Ministry of Agriculture and Fisheries and Seeds of Life.
- Steyn, N.P., Nel, J.H., Nantel, G., Kennedy, G., Labadarios, D., 2006. Food variety and dietary diversity scores in children: are they good indicators of dietary adequacy? *Public Health Nutr.* 9 (5), 644–650.
- Swiderska, K., Reid, H., Song, Y., Li, J., Mutta, D., Ongogu, P., Mohamed, P., Oros, R., Barriga, S., 2011. The role of traditional knowledge and crop varieties in adaptation to climate change and food security in SW China, Bolivian Andes and coastal Kenya. In: McLean, K.G., Ramos-Castillo, A., Rubis, J. (Eds.), *Proceedings of UNU-IAS Workshop on Indigenous Peoples, Marginalized Populations, and Climate Change: Vulnerability, Adaptation, and Traditional Knowledge*. United Nations University and Institute of Advanced Studies.
- Tomlins, K., Ndunguru, G., Stambul, K., Joshua, N., Ngendello, T., Rwiza, E., Amour, R., Ramadhani, B., Kapande, A., Westby, A., 2007. Sensory evaluation and consumer acceptability of pale-fleshed and orange-fleshed sweet potato by school children and mothers with preschool children. *J. Sci. Food Agric.* 87 (13), 2436–2446.
- To'os ba Moris Di'ak, 2017. Village Chicken Development, Technical Report 15. To'os ba Moris Di'ak (Australian Aid).
- To'os ba Moris Di'ak and UN Women, 2018. Gendered Marketplace Assessment, Women Vendors' Voices and Aspirations for Change. To'os ba Moris Di'ak (Australian Aid) and UN Women.
- United Nations, 2015. Timor-Leste Country Profile. United Nations.
- United Nations Development Program, 2018. Timor-Leste National Human Development Report 2018, Planning the Opportunities for a Youthful Population. United Nations Development Program.
- United Nations International Children's Emergency Fund, 2016. From the First Hour of Life: Making the Case for Improved Infant and Young Child Feeding Everywhere. United Nations, International Children's Emergency Fund.
- Universidade Nacional Timor Lorosa'e, 2014. Post Harvest Losses Under Traditional System of Storing Maize Research. Universidade Nacional Timor Lorosa'e.
- Victora, C.G., Adair, L., Fall, C., Hallal, P.C., Martorell, R., Richter, L., Sachdev, H.S., The Maternal and Child Undernutrition Study Group, 2008. Maternal and child undernutrition: consequences for adult health and human capital. *Lancet* 371 (9609), 340–357.
- Williams, W., de Almerida, L., Nabais, C., Erskine, W., 2017. Why is agricultural productivity so low in Timor-Leste? In: Poster Presented at TropAg2017—International Tropical Agricultural Conference, 20–22 November 2017, Brisbane. <https://ai-com.tl/research-reports-and-publications>.
- Wong, J.T., Bagnol, B., Grieve, H., da Costa Jong, J.B., Li, M., Alders, R.G., 2018. Factors influencing animal-source food consumption in Timor-Leste. *Food Secur.* 10 (3), 741–762.
- World Bank, 2007. From Agriculture to Nutrition: Pathways, Synergies and Outcomes. World Bank.
- World Bank, 2015a. Policy Brief #1: Social Assistance: Conceptual Foundations and Policy Options. World Bank.
- World Bank, 2015b. Policy Note: Assessing the Bolsa da Mãe Benefit Structure. World Bank.
- World Bank, 2015c. Policy Brief #2: Performance of Timor-Leste Social Assistance Programs. World Bank.

- World Bank, 2018a. Timor-Leste Systematic Country Diagnostic: Pathways for a New Economy and Sustainable Livelihoods. World Bank.
- World Bank, forthcoming-a. Timor-Leste Agriculture Public Expenditure Analysis, Manuscript in preparation. World Bank.
- World Bank, forthcoming-b. Food Consumption and Nutrition in Timor-Leste, Manuscript in preparation, World Bank.
- World Development Indicators, 2018. World Development Indicators data. World Development Indicators. Consulted 12 November 2018. <http://datatopics.worldbank.org/world-development-indicators/>.
- Young, P., 2014. Situational Analysis of the Agriculture Sector in Timor-Leste: Draft for Development Partners. Development Partners MAF Engagement Platform.
- Young, P., 2016. Timor-Leste: Financial and Economic Analyses of the Seeds of Life Program. Seeds of Life.