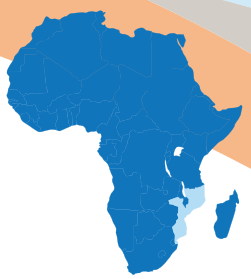
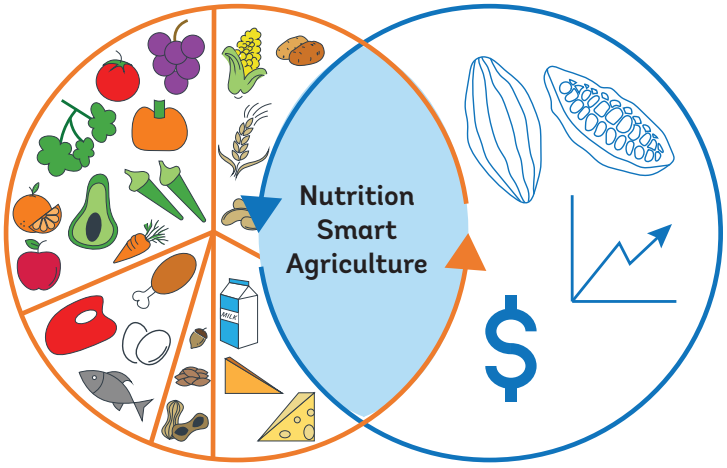


Nutrition Smart Agriculture in Mozambique

Nutrition Smart Agriculture (NSmartAg) aims to simultaneously improve agriculture incomes and nutrition outcomes through agriculture interventions. NSmartAg practices and technologies contribute to address local nutrition issues and increase farm and/ or agribusiness productivity and income (Figure 1). It is a building block of food systems that promote healthy people, a healthy planet, and healthy economies.

Figure 1: Nutrition Smart Agriculture has two aims



Actions taken in the agricultural sector impact people's nutrition—it's where decisions are made on what and how much to produce, as well as the techniques that can be used to boost a food's nutritional content. Not leveraging the agriculture sector to contribute to nutrition outcomes is a missed opportunity. Agriculture and food production have been shown to be key drivers of nutrition outcomes. Failing to act on nutrition has staggeringly high economic and social costs for countries and the negative effects of poor nutrition can span entire lives and generations. Human capital – the sum total of a population's health, nutrition, skills, knowledge and experience – is estimated to account for over two-thirds of total global wealth [1], and 10-30% of the cross-country differences in gross domestic product (GDP) per capita can be linked to variations in human capital [2]. Malnutrition is intrinsically connected to human capital as undernutrition contributes to 45% of child mortality, and stunting is known to be associated with lost productivity and earnings in adulthood. Adding all these up, the

- Chronic malnutrition affects 43% of children under five years old in Mozambique.
- In Mozambique, more than 70% of poor households live in rural areas and mostly depend on agriculture for food and income. The sector employs 80% of the workforce.
- 54% of households in Mozambique cannot afford a nutritious diet that meets minimum nutrient needs. There is a strong correlation between nutritious diet non-affordability and stunting prevalence by province.
- Iron, vitamin A and zinc are commonly referred to as problem key micronutrients to be addressed as part of national efforts.
- An analysis of available data allows for the identification of major food sources that contribute to the production and consumption of these key nutrients in Mozambique. An illustration of the contribution of the main food groups produced in Mozambique in providing the optimal nutrient intake to contribute to a healthy diet (as defined by the EAT-Lancet Commission) reveals that the production levels of most food groups fall below the recommended threshold. By contrast, production of starchy vegetables and grains exceeds the planetary health boundary levels.
- There is a host of NSmartAg practices that were identified, for agro-ecological zones in North, Center and South of Mozambique and for the primary production and post-harvest/ processing levels, that represent an opportunity for local agricultural production to step up and fill these gaps.

Financial support for this work was provided by the Government of Japan through the Japan Trust Fund for Scaling Up Nutrition.

global economic cost of undernutrition is estimated to be US$ 3 trillion [3]. The prevalence and costs of overweight/obesity are also rising even in low- and middle-income countries where over 70% of the 2 billion overweight/obese people live today [4]. The total economic impact of obesity is estimated to be US$ 2 trillion a year, or 2.8% of world GDP [5].

NSmartAg technologies and practices are those focused on primary production, and/or agri-food processing and distribution, i.e. where farmers and agri-businesses make decisions on what and how to produce. NSmartAg supports the overall Nutrition Sensitive Agriculture agenda across the food system (Figure 2).

Existing NSmartAg technologies and practices are available to farmers and agribusinesses in Mozambique, but their adoption has been incipient. There is thus an opportunity for these NSmartAg technologies and/or practices to be supported by agriculture public policies and programs, expanding their adoption.

This country profile provides a snapshot of NSmartAg technologies and practices across the country and identifies entry points for their adoption for improved outcomes for farmers and agri-entrepreneurs.

NATIONAL CONTEXT

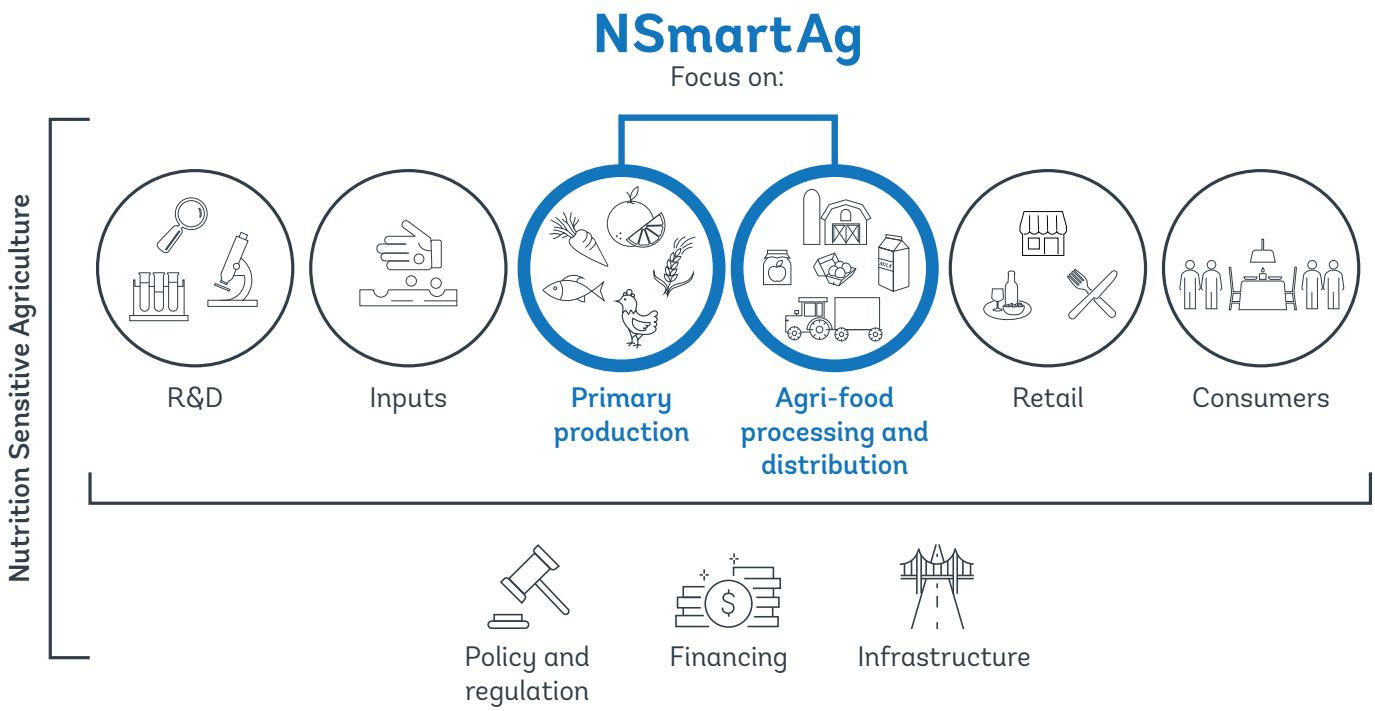
KEY FACTS ON MALNUTRITION

Chronic malnutrition, also known as **stunting**, is one of Mozambique's biggest development challenges. This condition affects 43% of children under the age of five [6]. In 2015, there were 2.1 million (out of 4.8 million) [7] stunted children. This situation is especially critical in children between one and five years old, 47% of which had low height for their age (**stunted**, i.e. chronically malnourished) and 6.1% suffered **wasting** (acutely malnourished). Also, more than half of the women (51%) in reproductive age have anemia.

In Mozambique, malnutrition rates become progressively higher from south to north. Stunting is over 50% in the northern provinces of Nampula and Cabo Delgado, while it is lower than 30% in the provinces of Maputo and Gaza.

Meanwhile 7.8% of children under five years old are **overweight**. The prevalence of **overweight/obesity** among reproductive-aged women (BMI>25kg/m^2) is 16.4%. This situation is especially worrisome in the urban areas, where the prevalence is 27%, while it is 10.5% in the rural ones. **Obesity** (BMI>30kg/m^2) affects 4.2% of women in

Figure 2: Nutrition Sensitive Agriculture and NSmartAg



reproductive age (15-49 years old) while it is higher in the urban households, affecting 8.9% of those, and lower in the rural ones, with a prevalence of 1.6% [8].

The 2016 Cost of Hunger in Africa study reveals that in 2015 **malnutrition cost Mozambique almost 11% of its Gross Domestic Product (GDP) – equivalent to US$ 1.7 billion**. The loss of potential productivity as a result of malnutrition-related mortality, morbidity and reduced cognitive development accounts for the largest share of that. Just between 2011 and 2015, it is estimated that 211,611 child deaths were directly associated with malnutrition, translating to 25.6% of overall infant mortality rate [9].

In addition, Mozambique is a country prone to weather-related shocks that further jeopardize food security and nutrition in certain areas. Mozambique ranks third among African countries most exposed to multiple weather-related hazards and suffers from periodic cyclones, droughts, floods and related epidemics [10]. For instance, due to Cyclone Idai that hit the country in March 2019, hundreds of rural communities experienced food shortages and were plunged into a nutrition crisis [11]. Six weeks later, Cyclone Kenneth made landfall in northern Mozambique.

Map 1 presents key Indicators on malnutrition.

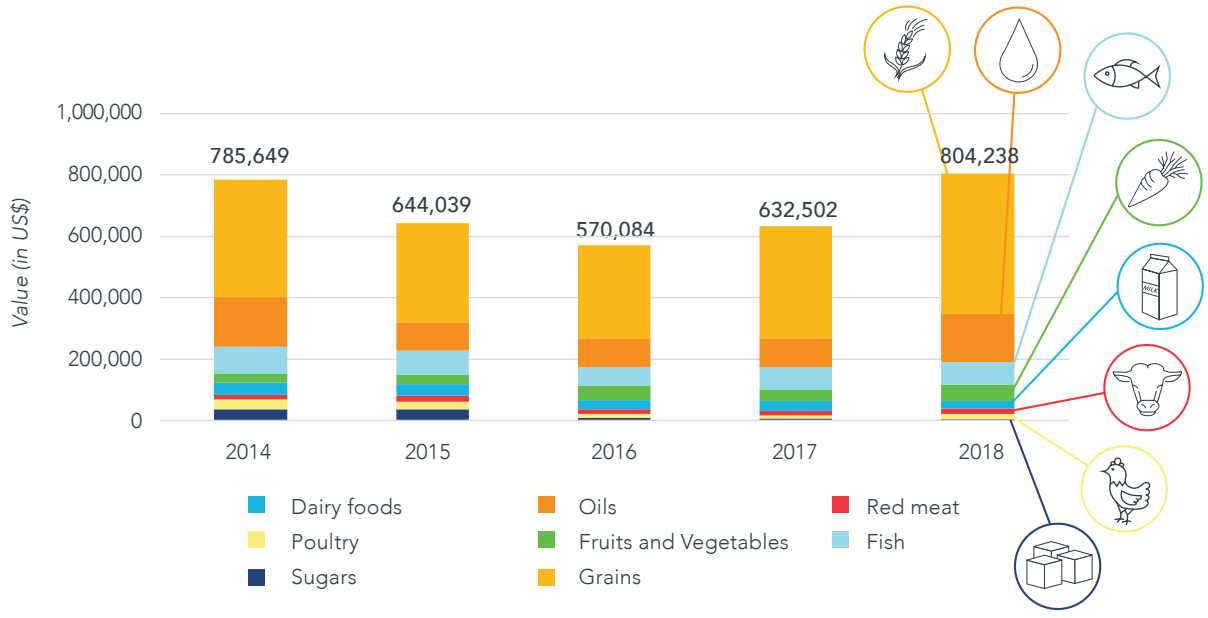
KEY FACTS ON FOOD PRODUCTION

Mozambique has around 36 million hectares of fertile and arable land, but only 16% of land suitable for farming is currently cultivated [12]. In Mozambique, more than 70% of poor households live in rural areas and mostly depend on agriculture for food and income. The sector employs 80% of the workforce [13], and is the main source of income for more than 70% of the population. In general, agricultural productivity is low in the country [14]. The lack of appropriate technologies, use of traditional agricultural methods, low yield seed varieties and low levels of mechanization undermine agricultural productivity.

Mozambique exports mainly mineral resources (like graphite, iron and titanium). In 2018 these represented almost half of total exports [15]. Food product exports were valued at US$ 208.5 million, which amounts to 4.2% of total exports (154.8% higher than the previous year). Agricultural products accounted for 4.1% of total exports (decreasing by 6.4%).

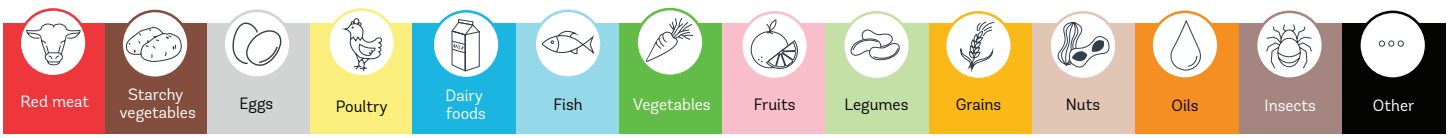
Mozambique is a net food importer. In 2018 alone, the country had a food and agriculture trade deficit of US$ 665 million, and 15.5% of total imports were food products [16]. In comparison with the previous year, 2017, these imports increased by 27%. There is a significant dependency of

Table 1: Main food products imported by Mozambique

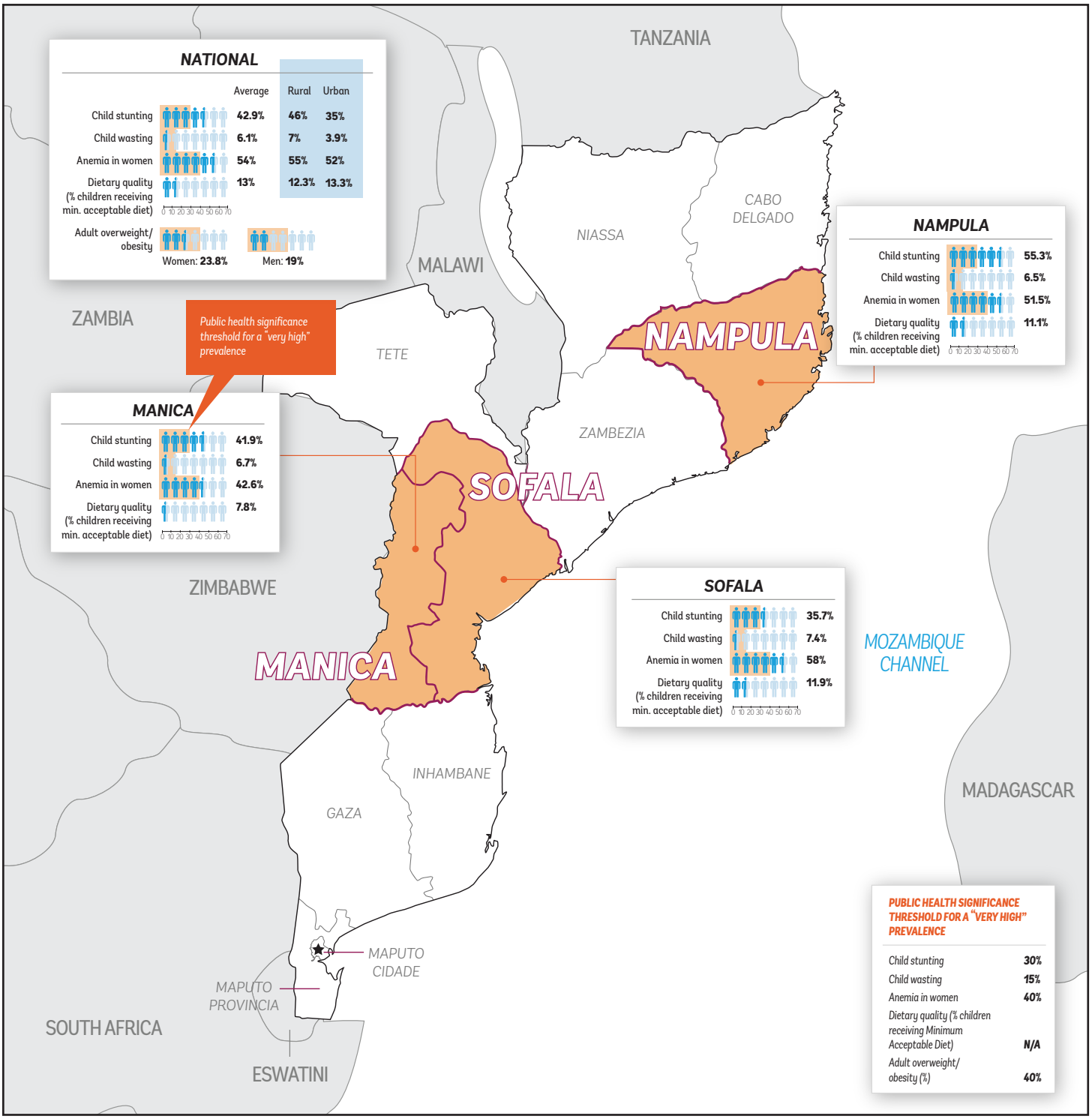


Source: UN Comtrade and INE

Key



Map 1: Key malnutrition indicators

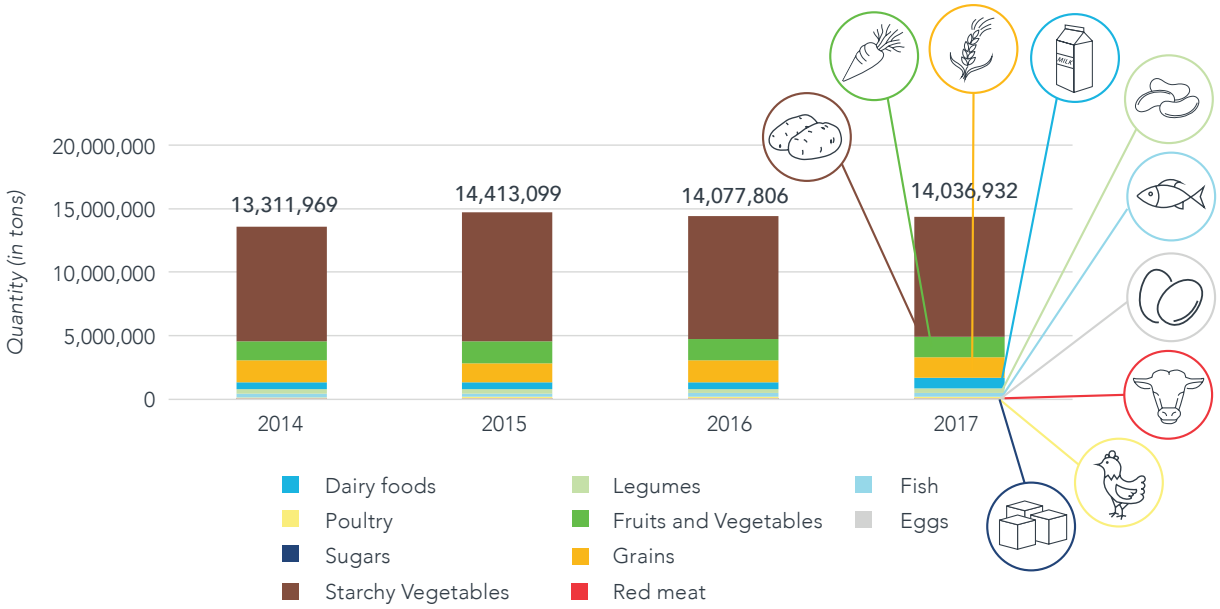


agriculture and food imports from a few countries, especially South Africa. In 2018, around 30% of overall imports came from South Africa, followed by Thailand with 12% [17]. Over the last years, cereals have been the most imported product, accounting for more than 7% of total imports in 2018, followed by vegetable and animal oil with 2%.

Agriculture and livestock activities are concentrated in the provinces of Nampula, Zambezia, Sofala, Manica and Tete, contributing 75% of national production.

Over the last few years, the amount of food production has been relatively stable (Table 2). On average between 2014

Table 2: Food production by categories and year



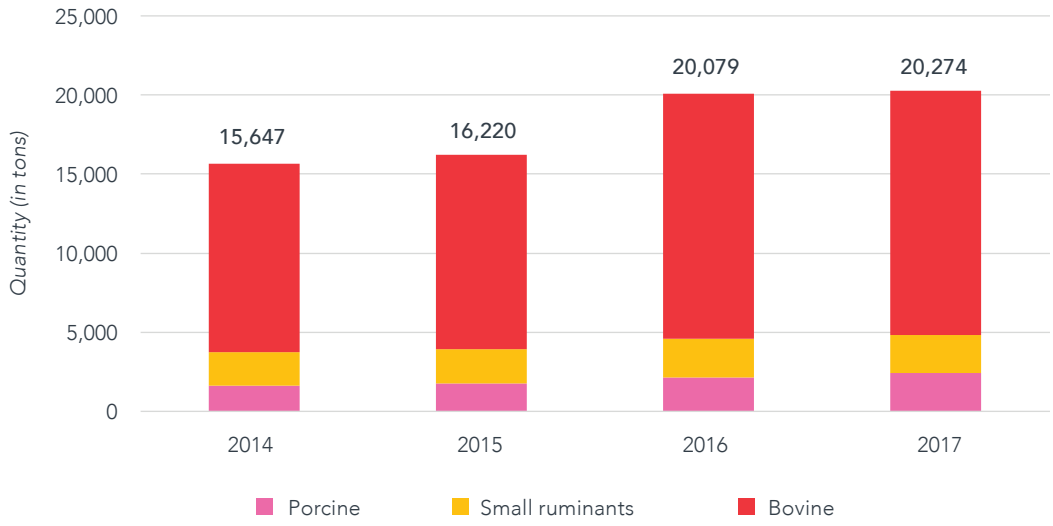
Source: INE (Statistical Yearbook 2017 – Mozambique), FAO Stat, FAO FishStat, Koema.com

and 2018, there was modest growth (2%) in agricultural output.[1] Production of corn, onion, tomatoes, beef cattle, potatoes and sweet potatoes has been growing significantly – even if the country has registered a significant drop (year-to-year) in the production of rice, millet, sorghum, cowpeas and oranges. Wheat production, meanwhile, has remained stable.

Legumes are one of the most important food products in Mozambique, and a major source of dietary protein (in fresh or dried form). They include chickpea, mung beans, cowpea and pigeon pea which sometimes substitute beans. Tete and Beira are the main producers of legumes, where 90% of the output comes from smallholders.

Between 2014 and 2017, red meat production increased almost by 30% (Table 3). Bovine meat, the production of which is concentrated in the provinces of Maputo, Nampula and Manica, has been leading that trend, followed by porcine meat that comes from Nampula, Inhambane and Zambezia.

Table 3: Red meat production [18]



Source: Ministry for Agriculture and Rural Development

1 Between 2014-2018, fish constituted 80% of white meat produced; goat meat, 61% of red meat; corn, 86% of grains; cassava, 90.4% of starchy vegetables; bananas, 35.9% of fruits and vegetables; tomatoes, 21.3% of fruits and vegetables; and cowpeas, 26% of legumes). Source: FAOSTAT.

Poultry is most commonly type of livestock held by households, followed by caprine and/or ovine meat. Manica, Maputo and Nampula lead the production of poultry and eggs.

Dairy is still an emerging industry, but there are several smallholder dairy farms around the Beira Corridor and at least eight (8) milk-processing companies located in Manica, Sofala and Maputo provinces, producing long-life milk, and yogurt.

The contribution of the main food groups to an optimal nutrient intake in a "planetary health diet", as defined by the EAT-Lancet Commission [19], reveals that the production levels of most food groups fall below the recommended thresholds (Figure 3). By contrast, production of starchy vegetables and grains exceeds the planetary health boundary levels.[2]

KEY FACTS ON FOOD CONSUMPTION

At the national level, according to the 2013 Baseline Report on Food and Nutritional Security elaborated by the Technical Secretariat for Food Security and Nutrition (SETSAN),[3] 23% of households experience moderate food insecurity [20], i.e. inability to regularly eat healthy, balanced diet [21]; and 2% suffer severe food insecurity, i.e. feeling hungry but not eating, or not eating for an entire day, due to lack of money or other resources [22].

Overall, 10% of households have a poor-quality diet,[4] 23% have a moderate quality diet and 67% of households have an adequate diet, as defined by the World Food Programme's Food Consumption Score [23]. Compared to the Baseline Report on Food and Nutritional Security from 2006, the results show a significant improvement in the proportion of households with an adequate diet going from 50% in 2006 to 67% in 2013. For further information on food environment, please see Box 1.

Figures 3 and 4 show food production and consumption by food group in grams per day per adult equivalent in Mozambique. At the national level, the consumption levels of all major food groups are below the recommended EAT-Lancet Commission planetary health thresholds with the exception of grains and starchy vegetables (Figure 4). The same applies to the production (Figure 3) of most food groups that do not contribute to the optimal nutrient intake for a healthy diet as defined by the EAT-Lancet Commission. Instead, grains and starchy vegetables exceed the planetary health boundary levels, as set by the EAT-Lancet Commission.[5]

In Mozambique, the review of national policies/strategies and other literature[6] reveals that iron, vitamin A and zinc are commonly referred to as problem key micronutrients to be addressed as part of national efforts (Box 2). Overweight and obesity are an emerging nutritional problem in Mozambique and many other countries, yet evidence related to the impact of specific agriculture interventions on overweight/obesity is still limited. Malnutrition issues related to undernutrition and micronutrient deficiencies are still more prevalent and receive policy and program attention. Specific interventions that directly try to address overweight and obesity issues therefore were not analyzed while an 'obesity lens' was applied in selecting the recommended menu of options. Analysis of available data allows for the identification of major food sources that contribute to the production and consumption of key nutrients for human nutrition in Mozambique. At a national level, consumption of foods constituting main sources for three of the key nutrients – iron, zinc and vitamin A – does not reach the internationally recommended human requirements. Similarly, production of food sources for the same three key nutrients (vitamin A, iron and zinc) does not meet recommended levels (Figure 5). Grains constitute major food sources for zinc and iron, followed mostly by other plant-based sources which do not have as much bioavailable forms of the nutrients as those in animal sources.

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2 The dotted line represents the production level of the entire country if all that is produced by the households is consumed locally (no exports or imports). This gives an idea of how far away the production of some key food products is from the "self-sufficiency" link representing the average healthy eating plate of that given population. This does not mean that self-sufficiency is being promoted, but it is an indication of an opportunity to increase production of certain foods that clearly show a deficit in terms of nutrient deficiencies of the local population.

3 Food insecurity level is determined by the FSI (Food Security Index). This is based on the household score on the following five sub-indicators: Food Consumption Score (FCS), composite score based on dietary diversity, food frequency, and relative nutritional importance of different food groups; level of severity of livelihood coping strategies (CSI); and grain stocks and the main sources of income. FSI and FCS are calculated according to WFP's Consolidated Approach for Reporting Indicators of Food Security (CARI).

4 Food consumption was measured using the FCS, which is a score calculated using the frequency of consumption of different food groups consumed by a household during the seven days before the survey. Households are then further classified as having "poor," "borderline," or "acceptable" food consumption by applying the recommended cut-offs by the World Food Programme to the food consumption score.

5 The dotted line represents the production level of the entire country if all that is produced by the households is consumed locally (no exports or imports). This gives an idea of how far away the production of some key food products is from the "self-sufficiency" link representing the average healthy eating plate of that given population. This does not mean that self-sufficiency is being promoted, but it is an indication of an opportunity to increase production of certain foods that clearly show a deficit in terms of nutrient deficiencies of the local population.

6 These documents include: Multisectoral Action Plan for the Reduction of Chronic Undernutrition 2011-2015 (2020); DHS 2011; Trend analysis: Key food security & nutrition indicators in Mozambique, WFP, Jan 2016; Korkalo L, Freese R, Alfthan G, Fidalgo L, Mutanen M. Poor micronutrient intake and status is a public health problem among adolescent Mozambican girls. Nutr Res. 2015; 35:664-73.

Figure 3: Main food groups produced and contributing to optimal nutrient intake

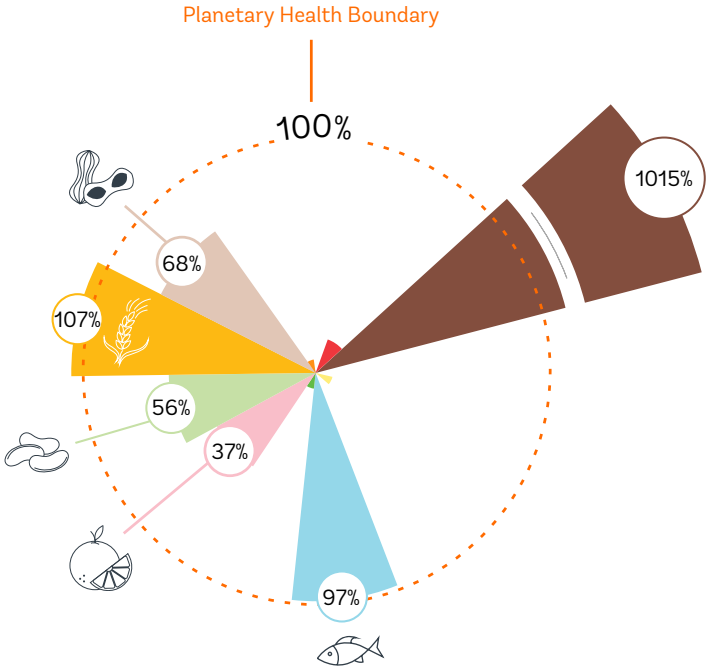
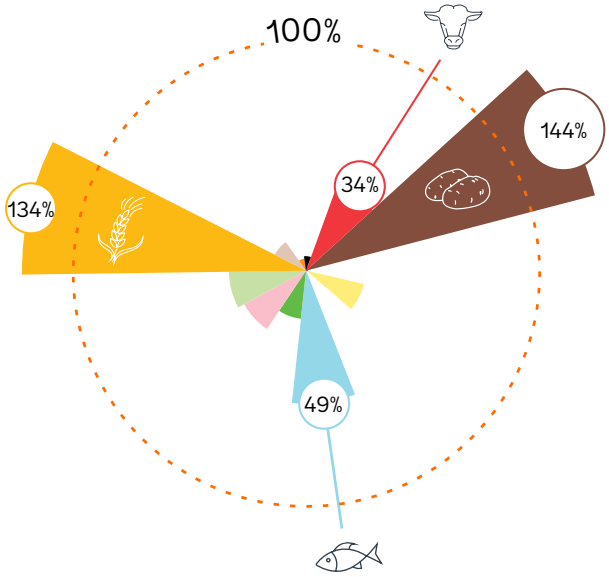


Figure 4: Main food groups consumed and contributing to optimal nutrient intake



Box 1: Food Environment: Diverse and nutritious diets are not affordable

The food environment in Mozambique is low in nutrient-dense foods and more than half of the people do not have economic access to a nutritious diet of available foods. The Fill the Nutrient Gap report led by WFP and finalized in 2017, used the Cost of Diet (CoD) (*) software to calculate the daily and monthly cost of different diets throughout the country.

The study revealed that 54% of households in Mozambique are not able to purchase a nutritious diet that meets minimum nutrient needs. It also estimated that the daily cost of a nutritious diet was more than four times the cost of an energy-only diet. For most of Mozambique there was little variation in the cost of the energy-only diet. Most families in Mozambique could afford an energy-only diet, with only 7% of households unable to do so. Non-affordability of the energy-only diet was highest in Zambezia (13%) and Gaza (13%).

A nutritious diet was most expensive in Cabo Delgado, Niassa and Tete, likely due to lower availability of nutritious foods. The households that cannot afford a nutritious diet seem to be concentrated in the same provinces where stunting prevalence is the highest, and specifically in the northern half of the country in the provinces of Cabo Delgado and Nampula. Gaza and Manica are outliers: Gaza has high non-affordability and lower stunting than the national average, while Manica has low non-affordability and high stunting. Even so, as evidenced in provinces like Manica, affordable nutritious foods is only part of the solution to multi-sectoral problems such as stunting.

(*) CoD is an assessment tool that uses software to estimate the amount and combination of local foods needed to provide a typical family with a diet that meets their averaged needs for energy and recommended intakes of protein, fat and micronutrients.

Box 2: What are the consequences of deficiencies in iron, zinc and vitamin A?

Iron deficiency often causes anemia, which is a condition where the capacity of the blood to carry oxygen to the body's tissues is reduced, resulting in symptoms such as fatigue, weakness, dizziness and shortness of breath, among others. These physiological conditions also affect the overall health status, cognitive development in children and productivity in later life. Iron is found in both plant and animal sources, yet the bioavailability (i.e. the absorption rates in the body) of plant-sourced iron is much lower than the animal-sourced one.

Zinc deficiency limits childhood growth and decreases resistance to infections, as zinc is an important essential nutrient for cellular growth, cellular differentiation and metabolism. Zinc is more commonly found in animal-sourced food items, while some plant sources, such as nuts, contain zinc, which has lower bioavailability.

Vitamin A deficiency diminishes our body's ability to fight infections, and thus increases the risk, especially among young children, of dying from common, preventable diseases such as measles, diarrhea and acute respiratory infections. It is also the leading cause of childhood blindness and maternal night blindness.

The estimated protein consumption level per adult female per day appears to be close to the recommended level, albeit mostly from grains, especially through consumption of corn-related products. While production of specific plant-based products – such as nuts and legumes that contain several of those nutrients simultaneously – can be further promoted, it may be desirable to diversify the sources of those key nutrients as much as possible, including animal sources. Current consumption of fish as a potentially more affordable product is encouraging, although fish production has room for improvement. These gap analyses represent opportunities for local agricultural production and processing to step up and increase nutritionally smart investments.

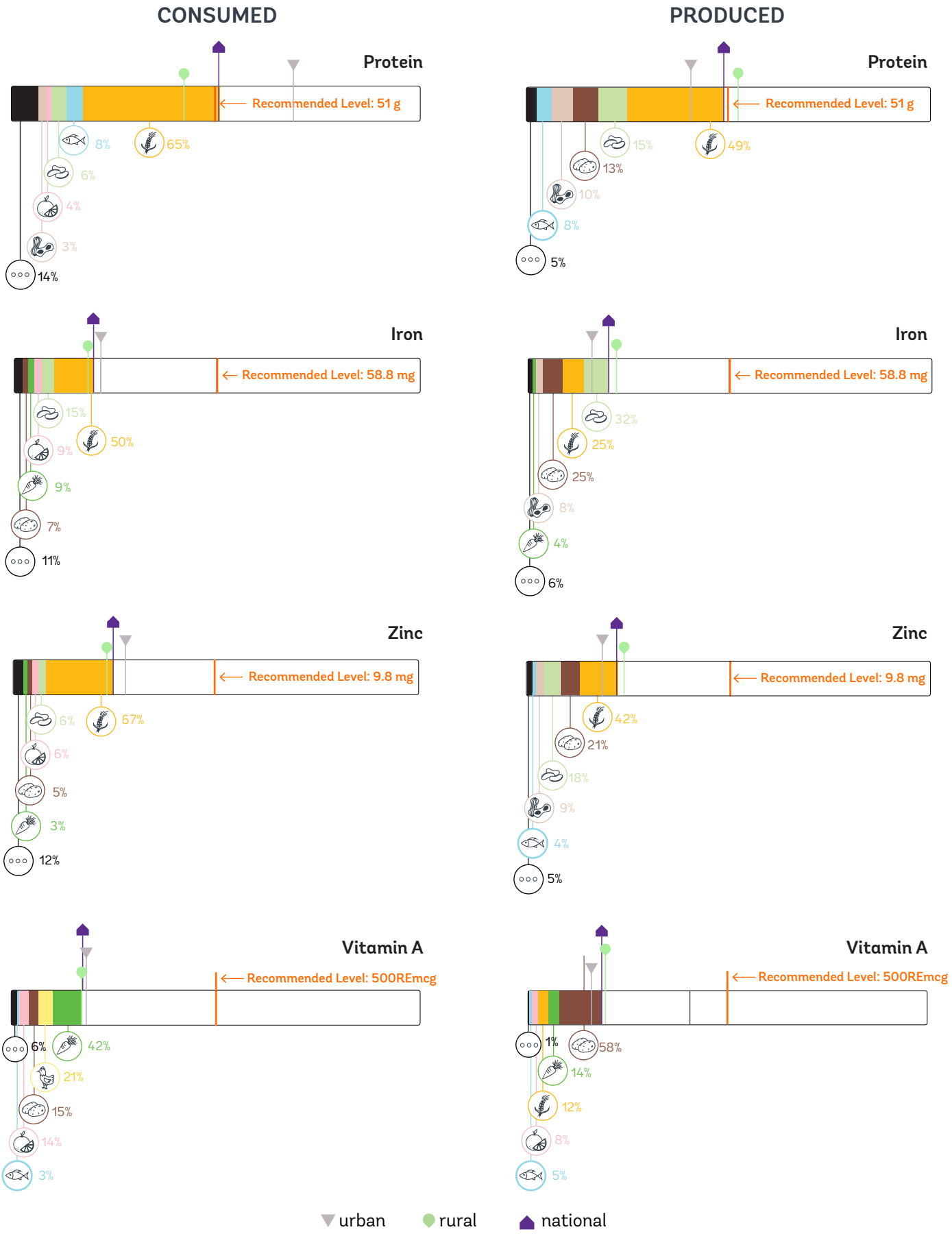
Figure 5 shows the estimated average nutrient production and consumption levels,[7] per day, per adult female equivalent.[8] For each graph, the estimated production or consumption level of each nutrient of interest is compared to the corresponding recommended intake level[9] for the adult female category. The top five (5) food groups that contribute to the intake are displayed as colored segments, sized accordingly to their contribution.

7 Bio-available and after-losses average nutrients intake.

8 Special statistical measures were applied to compute an adult female equivalent instead of per capita (see more detailed methodologies in the supplementary materials), as physiological nutrient requirements and individual dietary patters are different by age/sex, and women tend to be more vulnerable to nutrient deficiencies. A child equivalent was not used due to lack of reliable information about intra-household food allocations in the Mozambican context.

9 The 'recommended intake level' for each nutrient of interest refers to the "Recommended Nutrient Intakes (RNIs)," which is a set of internationally recognized and used reference values developed by the Institute of Medicine.

Figure 5. Food group sources for key nutrients (produced and consumed) at the national level



NUTRITION SMART AGRICULTURE TECHNOLOGIES AND PRACTICES

NSmartAg technologies and practices present opportunities for contributing to achieving a double objective: contributing to improving nutrition while achieving increasing farm- and/or agribusiness-level productivity or revenue – the drivers for agribusiness investment. For this profile, practices are considered NSmartAg if they contribute or have the potential to contribute to both these objectives and are based on observation/evidence of what farmers and agribusinesses can produce.

Table 4 showcases NSmartAg practices that were identified for prioritized production systems/agro-ecological zones in North, Center and South of Mozambique, and by targeted food groups for the primary production and post-harvest/processing levels.[10] The same analysis presented in Figures 3 and 4 was done at the provincial level (results shown in the Supplementary Materials), comparing the consumption and production levels by food group against the planetary health thresholds. Based on the provincial-level results, the food groups that are neither consumed nor produced optimally were selected for further analysis. The food groups that are only produced at negligible levels were excluded as they may not represent immediately exploitable business opportunities.

Based on the selected food groups for each province, a list of food items to be promoted for primary production was formulated. Once specific food groups are identified as being produced locally, and if overall production and productivity trends have been positive (in other words, if the product is not disappearing from the local production systems), then the food product appears in the NSmartAg menu of options. Additionally, at post-harvest food transformation/processing and handling level, field visits are undertaken to agri-entrepreneurs that handle such food groups in order to assess whether they engage in NSmartAg practices and/or technologies. The field survey intends to assess the degree to which the activity increases productivity or revenue and the extent in which the key nutrients are maintained/preserved without adding unhealthy ingredients (sugars, trans fats etc.), or at least doing so only in acceptable quantities. The food groups identified for each province were: grains, legumes and fish in Nampula; nuts, fruits, legumes and fish in Sofala; and oils, nuts, legumes and fruits in Manica. See Box 4 for more information on fruit processing in this province. The identification of food products/groups to promote does not imply a call to self-sufficiency. It constitutes simply an indication of an economically viable opportunity to increase production of certain foods that clearly show a deficit in terms of key nutrient deficiencies of the local population.

Table 4: Nutrition Smart Agriculture practices in Mozambique

		NSmartAg		
Value Chain Segment	**Practices and Technologies**	**Contribution to nutrition**	**Market potential**	**Where**
PRODUCTION	Production of pulses	Addresses micronutrient deficiencies (mainly iron) and may contribute to increased protein intake if consumed in larger quantities	Big market size; expectation for market growth	 Nampula Manica Sofala
	Production of nuts (peanuts and cashew nuts)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Big market size; expectation for market growth	
	Production of fruits	Addresses micronutrient deficiencies (mainly vitamin A)	Big market size; stable market growth	
	Fresh fish	Addresses micronutrient deficiencies (mainly iron, zinc and vitamin A) and provides an additional source of protein consumption	Big market size; existing demand, expectation for market growth	
	Production of Corn Soy Blend (CSB) (corn and soybeans milled, dried and cooked)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	

10 Annex III in the Supplementary Material presents an indicative list of case studies on nutrition smart agriculture technologies and practices.

		NSmartAg		
Value Chain Segment	Practices and Technologies	Contribution to nutrition	Market potential	Where
POST-HARVEST/PROCESSING	Production of Corn Soy Blend (CSB) (corn and soybeans milled, dried and cooked)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Production of CSB plus (with toasted peanuts)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Drying pigeon peas	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Dried sorghum (drying and milling)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Milling and sieving millet	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Shell cutting, peeling and grading of cashew nuts	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; shrinking market due to competitive landscape	
	Dried beans (sorting and drying)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	 
	Production of baobab pulp flour (baobab pulp is crushed to fine powdery form and sieved)	Addresses micronutrient deficiencies (mainly iron and zinc)	Positive outlook for commercial viability of the product; existing demand; niche size; expectation for market growth	
	Dried fruit (no added sugar) (mango)	Addresses micronutrient deficiencies (mainly vitamin A)	Small market size; expectation for market growth	
	Production of fruit juices (no added sugar)	Addresses micronutrient deficiencies (mainly vitamin A)	Small market size; expectation for market growth	
	Production of soy milk and soy yogurts (no added sugar)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; no price changes due to low-cost techniques; big market size; expectation for market growth	
	Production of banana chips (sun dried, no added sugar)	Addresses micronutrient deficiencies (mainly vitamin A) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Drying peas	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; stable market growth	

		NSmartAg		
Value Chain Segment	Practices and Technologies	Contribution to nutrition	Market potential	Where
POST-HARVEST/PROCESSING	Dried peanuts (drying)	Addresses micronutrient deficiencies (mainly iron and zinc) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; stable market growth	
	Fish cutting and storing in cold chain facility	Addresses micronutrient deficiencies (mainly iron and some zinc; and vitamin A) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	
	Fish, shrimp and squid sorted, cleaned, packaged and stored in cold chain facility	Addresses micronutrient deficiencies (mainly iron and some zinc; and vitamin A) and provides an additional source of protein consumption	Positive outlook for commercial viability of the product; existing demand; big market size; expectation for market growth	

Unless otherwise indicated, the practice or service is relevant for all provinces. Lastly, before integrating into a program/ operation/ project, this indicative (and not exhaustive) menu of options needs to be analyzed for cost/ benefits to ensure that investment yields positive returns.

The NSmartAg practices found in Mozambique cover some of the most important food groups (fruits, grains, legumes and fish) but are not very diverse. The most common practice identified is drying, followed by milling. Some of the field survey respondents were already implementing aflatoxin

Box 3: Aflatoxin in Mozambique

Aflatoxins are naturally occurring toxins produced by certain fungi. In high doses, aflatoxins can lead to serious illness and even death in both humans and animals. Aflatoxins mainly accumulate on crops and grains in tropical regions and contaminate a wide variety of food crops/products, such as maize, sorghum, cassava, macadamia nuts, paprika, melon seed, sesame, rice, yam chips, chili, among others. Also, aflatoxin-contaminated feed (e.g. maize meal) in dairy rations can result in aflatoxin contaminated livestock products.

Conclusive evidence of the negative health impacts of aflatoxin is well-established and known for decades, specifically in relation to liver cancer (hepatocellular carcinoma (HCC). Some reports estimate that aflatoxins cause between 5% and 30% of all liver cancer in the world, with the highest incidence of 40% occurring in Africa. In the aflatoxin hotspots of Mozambique, the rate of liver cancer is reported to be up to 60 times higher than that found in the United States of America.[1] Furthermore, studies have shown the effects of aflatoxin contamination on increasing the severity of other opportunistic infections in HIV-positive individuals, principally tuberculosis. It has also been postulated that a synergy exists between HIV and AFB1 (Aflatoxin B1) in AIDS development. Children can be affected by aflatoxin consumed through breast milk or direct consumption of weaning foods. Child stunting and weakened immunity resulting in more illness have also been associated with aflatoxin. The nutritional and health impacts of aflatoxin contamination depend on the contribution that the susceptible commodity makes to a household's or country's consumption. Staple crops (highly susceptible to aflatoxin contamination) are the basis for the diets of millions of poor people in developing countries.

Aflatoxin contamination in maize and groundnut is widespread in Mozambique. Sound agronomic practices and post-harvest practices must be adhered to in order to reduce or prevent contamination or buildup once the crop is harvested and stored. Moreover, in February 2019 Mozambique's Ministry of Agriculture and Food Security approved the registration of two Aflasafe products, which after field testing proved to be an innovative but simple way to control aflatoxin in groundnuts and maize.[2][3]

(1) Partnership for Aflatoxin Control in Africa (PACA), 2020. https://www.aflatoxinpartnership.org/about/about-aflatoxin
(2) Edgar Cambaza, Shigenobu Koseki and Shuso Kawamura. A Glance at Aflatoxin Research in Mozambique, 2018. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6121502/
(3) The maize and groundnut harvested from Aflasafe-treated fields met the stringent European Union safety levels of 4 ppb maximum total aflatoxins for food destined for human consumption, this compared with only 49% in non-treated fields. International Institute of Tropical Agriculture (IITA), 2019. http://bulletin.iita.org/index.php/2019/03/02/aflasafe-registration-gets-approval-in-mozambique/

control measures, while others were looking for support in doing so (Box 3). The analysis conducted shows that the majority of the owners of agri-businesses active in NSmartAg activities were men. In most of the examples, the agri-businesses are micro-, small- or medium-sized owned by agri-entrepreneurs. Usually their production is sold to wholesalers, but in many cases is also sold directly to consumers and retailers located mostly in nearby cities and local markets. Most of the agri-entrepreneurs interviewed were very optimistic about the future of their sector and the commercial viability of their enterprise.

Box 4: The future of fruit and vegetable processing in Manica

The Manica province is one of richest agricultural areas in Mozambique and one of the largest producers of fruits and vegetables in the country. Apart from a few packhouses, such as Companhia de Vanduzi and Westfalia, which are active in packaging mangoes, avocadoes and lychees, mostly aimed for the fresh food export markets of South Africa and Europe, very little value addition is happening in the province.

Since 2018 mangoes from Mozambique have been restricted for export due to the country's status regarding the presence of Bactrocera invadens (a type of fruit fly)[1]. The domestic market would be able to absorb some of this production, that would otherwise end in the landfill, if there was processing infrastructure following food safety practices to transform those rejected mangoes into mango juice, dried mango, canned mango, mango chutney etc. This is what a local company, Frutas de Revue, has already embarked on, investing in a processing plant to produce and sell mango pulp in bulk (for juice making).

Bananas are another such product that goes to waste every year due to limited processing capacity which could be transformed into sun-dried bananas or banana flour, thus contributing to the nutrition of local communities, especially during the dry season. Likewise, in Southern Manica and in Muxungué (Sofala province), at least 8,000 tonnes of pineapple are produced every year which are mostly left to rot due to lack of processing facilities. They also could be processed into concentrated pineapple juice. Potatoes and sweet potatoes could be made into potato flour and sweet potato flour, and surplus tomatoes could become tomato paste or sun-dried tomatoes.

(1) Standards and Trade Development Facility – Establishing Priorities for Sanitary and Phytosanitary Capacity-Building in Mozambique Using a Multi-Criteria Decision-Making Framework (2012), https://www.standardsfacility.org/sites/default/files/Findings%20MCDA%20Mozambique%202012.pdf

Highlight 1: Soy milk and yogurt (with no added sugar) in Manica

Name of agribusiness: SÓ SOJA

Só Soja is a unique and innovative start-up located in Chimoio City (Manica Province). The company produces simultaneously milk and yogurt from soybeans with no added sugar. Só Soja is a vertically integrated business, producing its own soybeans, and manufacturing and distributing the final products to end consumers through a mix of channels for different market segments.

Key considerations for further support:

Soy milk can contribute to the consumption of the key nutrients under the consideration for NSmartAg menu of options, providing high-quality protein as well as modest amounts of iron and zinc, which can be enhanced when it is fermented to make yogurt. Both soy milk and yogurt are also good food vehicles for fortification with vitamins and minerals, such as vitamins A, D, B12, and iron and calcium. Só Soja expressed a desire to fortify its products with those vitamins and minerals. The product will offer a healthful nutritional profile, including essential omega-3 fatty acids and flavonoids that exert antioxidant, anti-inflammatory and cardioprotective properties.

A key challenge for Só Soja is to secure product certification for food safety. The company has not obtained HACCP certification mainly due to lack of funding for upgrading the current manufacturing facilities and processes.

Furthermore, market awareness of key benefits of soy milk and yogurt, as well as their availability at prices equivalent to cow milk products, is still low. Hence, the company would like to invest more in educational marketing and promotion, keeping the important fact in mind that these products are not meant for infants aged 0-6 months, who should be exclusively breastfed. The other key constraint cited by the entrepreneur is access to inputs, particularly regarding packaging.

Highlight 2: Fish processor in Sofala

Name of agribusiness: Casa do Peixe

Casa do Peixe, Lda. is an integrated fish processing company, located in Alto-da-Manga – a peri-urban area in the city of Beiran (Sofala Province). The company is involved in the procurement, processing and distribution of fresh and frozen fish, fish products and seafood.

The company buys directly from the fishermen and is responsible for the inbound transportation of the catch. Fishes are then cut into portion-sized pieces and packed into 1kg, 2kg or 5kg branded bags. The processed fish is then made available at front store and also distributed to other retailers and restaurants.

Casa do Peixe processes and distributes about 60 tonnes of branded fish products per month. Fish can be a potential affordable source of animal protein and other key nutrients, such as iron, and can expand the reach of fish products outside of urban markets with appropriate facilities/technologies, thus contributing to the objectives of NSmartAg.

Key considerations for further support:

The key constraint faced by the company is access to working capital to procure fish, but also funding to support upgrades on the operational side, namely:

- Branding design and labeling system and an automated packaging system
- HACCP certification
- Inventory management and accounting system
- Refrigerated vehicle for delivery, with 2-tonnes capacity

INSTITUTIONS AND POLICIES THAT SUPPORT AGRICULTURE SOLUTIONS FOR NUTRITION

Mozambique went through fifteen years of internal armed conflict that concluded with peace agreements signed in 1992. Even though the country has made progress since the end of the conflict, significant development challenges remain. In 2019, Mozambique ranked 180 out of 189 in the UNDP Human Development Index [24]. Due to the agriculture sector's potential and the country's critical nutritional situation, food security and nutrition have become two policy priorities for the Government.

Since 1998, Mozambique has been developing a more comprehensive policy and investment framework to reduce food insecurity and stunting in the country. In 1998, the country approved the first Food Security Strategy. The goal was to reduce by half the number of people suffering from hunger by 2015. In its Five-Year Plan, Plano Económico e Social (PES) (2015-2019), the Government of Mozambique recognized food and nutrition security as key priorities, emphasizing the importance of improved access to food, living conditions and the development of human capital [25].

Since 2010 the country is implementing the Multi-Sectoral Action Plan for the Reduction of Chronic Undernutrition (PAMRDC, 2010-2020) coordinated with a multi-sectoral approach by the Technical Secretariat for Food and Nutrition Security (SETSAN). The PAMRDC is now decentralized to all 11 provinces, but it has proved challenging ensuring participation of all sectors at the district level [26]. The Nutrition Partners Forum is another initiative established in order to ensure that implementing partners in the field of nutrition share their data with government entities and others [27].

Since 2010, SETSAN is a nationwide institution under the supervision of the Ministry of Agriculture and Rural Development (Ministério da Agricultura e Desenvolvimento Rural, MADER),[11] through which the Government guarantees and coordinates the promotion of food and nutrition security. SETSAN acts as a multi-sectoral coordination secretariat to facilitate and coordinate the various sectors' contributions to the PAMRDC plans at the national and provincial levels, as well as to ensure their successful implementation. At provincial level, food and nutrition activities are coordinated by provincial units of SETSAN under MADER in coordination/support with the Ministry of Health (MISAU) [28]. Mozambique's Institute of Agricultural Research (IIAM) is part of the Ministry for Agriculture of Mozambique. It is mainly involved in disaster management activities through the provision of baseline data sets.

SETSAN was also responsible for monitoring and implementing the Food Security and Nutrition Strategy (ESAN II, 2007-2015). In addition to tackling malnutrition and food insecurity, ESAN II focused on strengthening governance structures and coordination mechanisms for nutrition and food security across the country [29]. Currently, ESAN III is being developed.

In 2011, Mozambique joined Scaling Up Nutrition (SUN), a global movement that unites national leaders, civil society, bilateral and multilateral organizations, donors, businesses and researchers in a collective effort to improve nutrition. SETSAN is also the national focal point for the SUN movement. Since 2015 the Global Alliance for Improved Nutrition (GAIN), along with the World Food Programme (WFP) has begun to build the SUN Business Network (SBN) [30]. SBN Mozambique is a fully functioning business network, with organizations ranging from food packaging and flour fortification to consumer and salt producer associations. SUN Movement's Multi-Partner Trust Fund (MPTF) recently funded the Civil Society Platform in Mozambique, which will work with relevant government sectors to ensure that necessary resources are mobilized and allocated for cross-sector implementation of the PAMRDC and other nutrition interventions. The platform will also work to mobilize and engage nongovernmental organizations and relevant stakeholders at the national and provincial levels to incorporate nutrition-related interventions in their plans and projects [31].

In the agriculture sector, there are two main policy frameworks. The Strategic Plan for Agricultural Development (PEDSA, 2011-2020) presents the vision for Mozambique's agriculture sector. PEDSA follows a value chain approach to foster technology transfer and adoption, provision of agricultural inputs, processing and marketing activities that add value to agricultural, livestock, forestry and wildlife products, and sustainable natural resource management [32]. The Agricultural Investment Plan (PNISA, 2014-2018) [33] aims to transform the agricultural sector into a "prosperous, competitive, equitable and sustainable agriculture sector" able to contribute to food security and raise the incomes of rural households [34]. Regarding food fortification, there is a Mandatory Food Fortification Decree (Box 5).

In 2011, Mozambique signed the Comprehensive Africa Agriculture Development Programme (CAADP), an African-led program bringing together governments and diverse

11 Before the elections of October 2015, this Ministry was named Ministério da Agricultura e Segurança Alimentar (MASA)

Box 5: Mandatory Food Fortification Decree

Numerous studies have shown very high cost-benefit ratios of food fortification efforts. On March 16, 2016, the Council of Ministers in Mozambique approved the Mandatory Food Fortification Decree. The approval of this Decree was a huge accomplishment for the National Food Fortification Program, a government-led program focused on the fortification of staple foods with key micronutrients[1]. The food items and micronutrients to be added that are covered by the Decree are:

- Wheat flour (for bread) – with iron, folic acid, complex B vitamins and zinc;
- Vegetable oil – with vitamin A;
- Sugar – with vitamins A and D;
- Maize flour – with iron, folic acid, complex B vitamins and zinc;
- Salt Iodization has been included under this law, although it was already mandatory.

Even with a mandatory program in place, fortification is hard to enforce among small producers that require a range of upfront and ongoing costs that include acquiring and installing the dosifier, obtaining certification, accessing the premix, re-training staff for use of the dosifier, re-labeling the package, all of which need to be borne by the entrepreneur. Hence, the 2016 decree only covers maize flour produced by medium- to large-scale entities and excludes hammer-mill level producers scattered largely in rural areas where an improved access to fortified products would have a huge impact on mitigating the nutrition vulnerability of the Mozambican population[2].

On the other hand, some are trying to heed the decree. For instance, Ms. Fatima, the owner of Moageira Fatima, a small-scale milling operation in Nampula, has identified fortification as a "product positioning" opportunity. Although she has procured the dosifier, she does not have the know-how to operate it or to secure certification. Small millers like Ms. Fatima require a strong business case to make investments in fortification and support in terms of business development and capacity building to use the technology.

(1) Policy - Decree No. 9/2016 approving the Regulation for Food Fortification with Industrially Processed Micronutrients https://extranet.who.int/nutrition/gina/en/node/23876
(2) República de Moçambique – Ministério da Indústria e Comércio and Programa Nacional De Fortificação dos Alimentos. 2019. The National Food Fortification Program in Mozambique (2011-2018): Achievements, Challenges and Opportunities.

stakeholders to reduce hunger and poverty and to promote economic growth through agricultural development. The CAADP is implemented through the Strategic Plan for Agricultural Development, which falls under Mozambique's Vision 2025, with the mission of "contributing to food security and income of agriculture producers in a sustainable and competitive manner, ensuring social and gender equity." In 2013, Mozambique joined the New Alliance for Food Security and Nutrition, a partnership between African heads of state, corporate leaders and G8 members to accelerate implementation of CAADP strategies [35].

The food safety system in Mozambique comprises several agencies that have documented roles and responsibilities. However, in practice, the system is fragmented, and agencies need stronger technical capacities to fulfill their roles. The main competent authority is the Ministry of Health (Ministério da Saúde, MISAU) which establishes the regulatory framework for food and food products to be consumed at national level (Box 6).

Box 6: Food safety – current status

The food safety regulatory framework in Mozambique involve the work of four (4) Ministries and four (4) additional Institutions that are housed in them:

1. Ministry of Health (Ministério da Saúde, MISAU);
2. Ministry of Agriculture and Rural Development (Ministério da Agricultura e Desenvolvimiento Rural, MADER), including its National Directorate of Agriculture (Direcção Nacional de Agricultura, DINA);
3. Ministry of Sea, Inland Waters and Fisheries (Ministério do Mar, Águas Interiores e Pescas, MIMAIP), through its National Institute of Fish Inspection (Instituto Nacional de Inspecção do Pescado INIP);
4. Ministry of Trade and Commerce (Ministério da Indústria e Comércio, MIC) through the National Institute for Standardization and Quality (Instituto Nacional de Normalização e Qualidade, INNOQ) and the National Inspectorate of Economic Activities (Inspeção Nacional das Atividades Económicas INAE).

These ministries and agencies have established roles and responsibilities, but in practice they lack coordination, resulting in fragmentation and challenging enforcement of food safety regulations.

MISAU establishes the regulatory framework for all food and food products that are processed and destined for consumption in the national territory. This entails the oversight of both domestically produced and imported products and establishing their quality and sanitary requirements. The Ministry also sets the hygienic requirements for establishments that handle and sell ready-to-eat (RTE) food and issue their operation permits. Specific food safety regulatory issues under the purview of MISAU include: Maximum Residue Limits (MRLs) for pesticides, veterinary drugs, food additives and contaminants, and their methods of analysis and sampling; prescriptions on food hygiene; food labelling standards; and fortification of food.

MADER regulates food safety aspects of primary products up until the processing stage. MADER, through DINA, is also the competent authority over pesticides authorization and registration.

The National Institute of Fish Inspection, housed in MIMAIP, oversees inspection and certification of fish and fisheries products (FFP). The Ministry issues and updates regulations on inspection and quality assurance of fish and fisheries products, and issues sanitary permits for fishing vessels. The Institute, in turn, issues licenses and health certificates for FFPs, performs surveillance, and conducts research and extension programs based on the information stemming from surveillance.

MIC oversees products that will be exported, which in the case of Mozambique include mainly primary agricultural products. INNOQ is the main body responsible for defining and implementing quality policy and coordinating all standardization at national level. INNOQ should coordinate closely with the other food safety agencies, especially MISAU, to establish the food safety technical regulations and conformity assessment procedures. Finally, the INAE is the sole entity in charge of enforcing food safety regulatory framework and to ensure compliance.

The food safety system in Mozambique faces three major constraints: (i) the lack of coordination and communication among agencies within the food safety regulatory framework; (ii) insufficient technical skills at the surveillance and enforcement levels; and (iii) poor analytical infrastructure.

Lack of communication becomes particularly critical at monitoring, surveillance and enforcement level, where it is compounded by INAE's conducting surveillance activities with limited capacity. INEA's creation presented a practical solution for the excessive burden stemming from multiple audits from different regulators that were inspecting food establishments in a siloed approach, and it was successful at tackling that particular problem and fostering an integrative approach. However, its creation was not paired with capacity building for agents to conduct audits of high technical level and in a risk-based manner.

Table 5 lists key actions led by the government in Mozambique, recognizing the role of agriculture sector interventions in addressing malnutrition and calling for such investments.

Table 5: Key actions

National Agriculture Investment Plan (PNISA) 2014-2018[12]	• Seeks to identify and prioritize key investment and policy interventions that are critical to enhancing the agricultural productivity growth in Mozambique in order to achieve integrated goals of poverty reduction, national food security and broad-based economic growth.
Strategic Plan for the Development of the Agrarian Sector (PEDSA) 2011-2020[13]	• PEDSA's vision is a prosperous, competitive, equitable and sustainable agricultural sector, as an answer to the challenges linked to food and nutrition security as well as agricultural markets at the national and global levels. • To guide the implementation of PEDSA, a range of strategies and plans have been developed to define sub-sectoral priorities.
Multi-sectoral Action Plan for the Reduction of Chronic Undernutrition (PAMRDC) 2010-2020	• National framework of policies aiming to accelerate the reduction of chronic undernutrition in children under five. • Coordinated by SETSAN.
Food Security and Nutrition Strategy (ESAN II) 2007-2015[14]	• Focuses on food insecurity and malnutrition reduction at national level. It's anchored in the four pillars of food security and nutrition (availability, accessibility, stability and utilization). • Implemented and monitored by SETSAN.

ONGOING AND PLANNED INTERVENTIONS IN AGRICULTURE AND NUTRITION

The purpose of this section is to present, in a succinct fashion (Table 6), what NSmartAg practices and technologies are supported, where and by who, so that synergies, opportunities and gaps can be easily identified. Information is not exhaustive.

Table 6: Main programs

NSmartAg activity	Program name	Development partner	Target areas	Brief description as related to NSmartAg
Food fortification	Large-scale Food Fortification Program	GAIN, UNICEF and WFP [36]	Countrywide.	Support the Government of Mozambique in consolidating the food fortification policy and improve the conditions for mandatory food fortification; oil and wheat flour fortification.
Greenhouses	SMART	iDE Global and Swedish Embassy [37]	Provinces of Maputo, Tete, Manica and Sofala.	Tropical greenhouses have the potential to change agricultural productivity in Mozambique, which has lagged behind other countries in the region and the world in production per meter cultivated. Focus on a wide variety of products (fruits and vegetables).
Seeds fortification	ProSAVANA	MADER, the Japan International Cooperation Agency (JICA) and the Brazilian Cooperation Agency (ABC) [38]	Provinces of Cabo Delgado, Nampula, Zambézia, Niassa and Tete.	Improve the livelihood of inhabitants of the Nacala Corridor through inclusive and sustainable agricultural and regional development. Focus on different products such as sorghum, corn, coconut, sunflower, soy and peanuts.

12 The Government is working on a new phase of the plan, 2020-2024.

13 The Government is working on a new phase of the plan, 2020-2030.

14 The Government is working on a new phase of the strategy.

Box 7: Food safety – recommendations

The Mozambican national food control system would benefit from closer coordination within the food safety regulatory framework, establishing communications channels, making better use of resources, fostering capacity building and promoting quality control mechanisms. This would benefit INNOQ and INAE the most, as they are in need of improving coordination and communication mechanisms both within and between themselves and the other food safety regulatory agencies (MISAU, MADER, MIMAIP and MASER) on food safety and quality technical regulations, and conformity assessment procedures.

INAE and INNOQ also need investments in technology uptake, noting that such investments must be paired with capacity building to enable INAE and INNOQ staff to make proper use of new equipment and infrastructure. For INAE, this would likely entail an upgrade of the governing regulations to establish divisions of competence within the institute, and investments to help inspectors work under clear protocols when conducting audits. INNOQ has weak analytical capacity, its laboratories lack accreditation, and is in need of updates in methods of analysis and sampling to improve food safety and quality assurance at national level. Such investments would improve Mozambique's credibility and trust in the region and at global level.

There is a strong need for awareness on food safety at high-decision making level, as well as at consumer level. Consumer awareness can act as a catalyst for demand for food that is safe and of high quality. A leading example for such an initiative could be efforts led by the Food Safety and Standards Authority of India (FSSAI)[1] that aim at empowering consumers to recognize and look for proper certifications on the food packaging to assure themselves that what they are eating is safe.

(1) Ishwar, S., Dudeja, P., Shankar, P., Swain, S., & Mukherji, S. (2018). 'Jago Grahak Jago': a cross-sectional study to assess awareness about food adulteration in an urban slum. Medical Journal Armed Forces India, 74, 57-60. doi: http://dx.doi.org/10.1016/j.mjafi.2016.11.007

OUTLOOK FOR NUTRITION SMART AGRICULTURE IN MOZAMBIQUE

Mozambique has the potential to be a major agricultural producer. NSmartAg can help realize this potential, while also contributing to improved nutritional outcomes of the country's population.

The field work undertaken provides some insight on what that would take. Indicatively, agri-entrepreneurs in the Manica province singled out the opportunities for investing in processing facilities and equipment for fruit and vegetables, as well as for proper storage facilities. In Sofala province, where fish production is both a currently profitable and a promising entrepreneurial activity, locals point out to the potential for improving storage and processing through cold chain investments. In Nampula province, both grain and legumes currently present a potential for improvement. Options include the introduction of vitamin A-biofortified maize (VAM) and cassava (VAC) which are drought resistant varieties, and productivity raising via the use of modern farming practices and pest control methods.

Mainstreaming NSmartAg into programs will require the prioritization of NSmartAg solutions in agricultural R&D investments, such as for instance biofortification; integration of NSmartAg principles into farmer agriculture input and technology adoption programs; training of agricultural advisory and extension services in NSmartAg solutions, such as post-harvest technology and product handling, including for aflatoxin prevention and control; and adapting financial instruments embedded in development operations for agri-micro, small and medium enterprises (MSMEs) (such as matching grants) to include NSmartAg technologies and practices, as in, for example, appropriate and affordable packaging material for processed fruits and vegetables or production of fortified foods. Actions to improve the Mozambican food safety system need to begin by creating awareness, both at high-level policy maker and at consumer levels, of the imperative for food safety. The former will enable the establishment of an effective coordination mechanism and investment in capacity and modernization of the system. The latter will foster demand for safer food products and act as a "pull" mechanism for improved food safety (Box 7). A complementary public investment to be continued is the close cooperation with the Ministry of Health and other stakeholders in increasing consumer awareness of the benefits of a nutritious diet.

Efforts and opportunities to disseminate this Country Profile in agri-business fora and to financial institutions could be pursued to promote the adoption of NSmartAg by agribusinesses.

The Covid-19 crisis

The Covid-19 crisis is disrupting livelihoods and communities around the world. The pandemic poses a serious threat to food security and nutrition in developing countries. A majority of households are net food buyers and the poor spend most of their income on food. Experience from past pandemics and the 2007/08 food price crisis highlight food security and nutrition as a major concern. Among the limited studies done in the past, the ones from Bangladesh, Cambodia and Mauritania in 2008 suggested increases to the order of 50% in levels of acute malnutrition in poor children, with plausible links to rising food prices [39].

At the time of publication, the rainy season extending from November 2019 to April 2020 was reasonable in the central and northern parts of the country, which is expected to lead to a good harvest. Food shortages may be severe in areas with low rainfall, especially drought prone areas such as for example Mabalane, Chigubo and Chicualaculaa, where lack of good roads and possible water scarcity may pose additional challenges. The food-corridor through the border with South Africa remains operational, protecting Maputo from food shortages. In general, major cities should suffer less if the corridors continue functioning.

Increases in the price of food, coupled with a decrease in purchasing power from households due to several economic activities closing due to the pandemic, reduce the consumption of food, in particular higher cost micronutrient-dense foods, such as vegetables, fruits and animal-sourced protein, etc., compromising the quality of diets and lead to malnutrition.

In turn, malnutrition weakens the immune system, increasing the susceptibility to infections such as Covid-19. There are several specific micronutrients contained in foods produced in Mozambique and part of the NSmartAg opportunities presented in this country profile that help strengthen the immune system and maintain health, such as vitamin A, zinc and iron that are already causing problems of deficiencies in many low- and middle-income countries. Protein, one of the main macronutrients and represented in the food groups selected by this profile, plays a vital role in building and repairing body tissues and supports physiological utilization of other important nutrients, such as iron. An optimal consumption of protein in diet helps maintain the immune system. Promoting NSmartAg technologies and practices, as well as broader nutrition-sensitive support are of great importance in Covid-19 response to contribute to the resilience of the most vulnerable populations.

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