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ANALYSIS TO GUIDE USAID/MOZAMBIQUE PROGRAMMATIC INVESTMENTS IN AGRICULTURE AND FOOD NUTRITION SECURITY

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List of Acronyms

ADSP	Agriculture Development Support Programme (Zambia)
ADVZ	Agencia de Desenvolvimento de Vale do Zambeze
AFAP	African Fertilizer and Agribusiness Partnership
AMDSP	Agricultural Marketing System Development Project (Tanzania)
AMOFERT	Associação Moçambicano de Promoção de Fertilizantes
APROSE	Associação para a Promoção do Sector de Sementes
ASCAs	Accumulated Savings and Credit Associations
ASSP	Agricultural Sector Support Programme (Zambia)
ASWAp SP	Agriculture Sector Wide Approach Support Project (ASWAp SP)
BAGC	Beira Agricultural Growth Corridor
BDA	Business Development Advisor
BDS	Business Development Services
BNI	Banco Nacional de Investimento
CAT	Commodity Aggregator Traders
CDM	Cervejas de Moçambique
CIDA	Canadian International Development Agency
CIP	International Potato Center
CLUSA	Cooperative League of the USA
COMACO	Community Markets for Conservation (Zambia)
COPAZA	Cooperativa dos Produtores da Alta Zambézia
ETG	Export Trading Group
FCSP	Food Crop and Seed Project (Zambia)
FIDP	Farm Income Diversification Programme
FINAGRO	FinAgro Agribusiness Fund
FSD Moç	Financial Sector Deepening Moçambique
FSRP	Food Security and Research Project (Zambia)
FTF	Feed the Future
GDP	Gross Domestic Product
IAI	Inquérito Agrário Integrado
IAOM	Instituto de Algodão e Oleaginosas de Mocambique
IAPRI	Indaba Agricultural Policy Research Institute
IDRC	International Development Research Centre, Canada
IESE	Instituto de Estudos Sociais e Económicos
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IIAM	Instituto de Investigação Agrária de Moçambique
INCAJU	Instituto de Cajú (Cashew Institute) (now Instituto de Amêndoas)
IRLAD	Irrigation, Rural Livelihoods and Agricultural Development (Tanzania)
MACO	Ministry of Agriculture, Food and Fisheries (Zambia, now MoA)
MADER	Ministério de Agricultura e Desenvolvimento Rural
MMS	Mobile money services
MoA	Ministry of Agriculture (Zambia)
MSME	Micro, Small, and Medium Enterprises

MSU	Michigan State University
NCBA	National Cooperative Business Association
NGO	Non-Governmental Organization
OFSP	Orange-fleshed Sweet Potato
OMR	Observatório do Meio Rural
PEDSA	Plano Estratégico para o Desenvolvimento do Sector Agrário
PROFIT+	Production, Finance, and Improved Technology Plus (Zambia)
PROMER	Programma de Promoção de Mercados Rurais
QDS	Quality Declared Seeds (SGM in Portuguese)
RAIN	Realigning Agriculture to Improve Nutrition (Zambia)
RAMA-NC	Resilient Agricultural Markets Activity - Nacala Corridor
RAMA-BC	Resilient Agricultural Markets Activity - Beira Corridor
REFP	Rural Enterprise Finance Project
SAARNET	SADC animal agriculture network
SADC	Southern African Development Community
SBS	Sociedade de Beneficiamento de Sementes
SCCI	Seed Control and Certification Institute (Zambia)
SCF	Small Commercial Farmer
SECF	Small Emerging Commercial Farmer (also used as SCF)
SEMEAR	Feed the Future Improved Seeds For Better Agriculture
SGM	Semente de Qualidade Garantida
SHF	Smallholder farmer
SIDA	Swedish International Development Cooperation
SMART	Strengthening the Missing Middle in Agribusiness for Rapid Transformation
SME	Small and Medium Scale Enterprise
TIA	Trabalho de Inquerito Agrícola
TNS	Technoserve
TSNI	Towards Sustainable Nutrition Improvement
VBAA	Village Based Agricultural Advisors
VC	Value Chain
VSLA	Village Savings and Loans Association
ZARI	Zambia Agricultural Research Institute

Executive Summary

Introduction: This report was produced by Michigan State University for USAID/Mozambique as an input into the mission’s decision making regarding agricultural programming in Nampula and Zambézia provinces. We collaborated closely with ELIM Serviços Ltda (Tatiana Mata) and Dr. Antony Chapoto of the Indaba Agricultural Policy Research Institute in Zambia.

Our approach is rooted in the concept of the structural and rural transformation of economies, in which rising specialization and productivity in farming is paired with the movement of labor off the farm into better-paying activities in self-employment or wage labor. Because such a transformation is a *sine qua non* for broad poverty reduction, our empirical analysis focuses on evidence of this happening in Mozambique, and the program options we lay out are designed to foster it.

Data, methods, and literature used: In Mozambique, we used an online survey of key informants (58 solicited, 18 responses) and follow-up interviews. Dr. Chapoto generated a review of projects in Zambia, Malawi, and Tanzania, and we drew from that together with our survey and interviews to synthesize lessons from previous programs. We consulted a wide array of project documents and applied academic research. Beyond citations in the references, we include all consulted documents in an annex. Data came primarily from the 2012 and 2017 *Inquérito Agrícola Integrado (IAI)*, though selected data from the World Bank and others (all cited in the document) were also used.

We used existing agroecological zones and livelihood zones and our own knowledge to develop a four-zone classification for the two provinces. The zones differ primarily in agroecology and thus in the crops that USAID might support. One zone (Lowland Southern Zambézia) stands out for better access to improved roads, relatively uncommercialized farming and higher engagement in the nonfarm economy. The other three zones differ little in these three aspects and all zones differ remarkably little in their agricultural practices. Mean and median incomes are also very similar. Food security is a persistent problem across all zones.

Using data from the 2012 IAI (2017 data did not quantify nonfarm income), we developed a typology of rural households based on the concept of the rural transformation and following Hazell (2017). Households are arrayed in a “transformation space” defined by 1) the share of their farm production that they sell, and (2) the share of their total household income (farm plus nonfarm) that comes from nonfarm activities: higher farm sales out of total farm production and higher nonfarm income out of total income reflect greater transformation, along different axes.

Findings from IAI analysis: Empirical application of the typology shows that the smallholder farming sector, commonly seen in Mozambique as an undifferentiated set of “subsistence farmers”, instead shows quite a lot of diversity, ranging from true subsistence farmers who engage little if at all with farm- or nonfarm markets through households that sell most of their farm production even as they earn most of their income off the farm and with much variation in between.

Three additional points are important. First, households generating the highest incomes are doing so through nonfarm income, not through farming. Second, and despite this, farming is still claimed as the most important economic activity for most adults across every farm type. In other words, nearly all households consider farming a central part of what they do. Third, food insecurity is common across all household types, implying need for broad attention to this issue.

Challenges and opportunities for growth and transformation: We review challenges at global, continental, national, and sub-regional levels. Globally, the key challenge is narrowing options for transformation growth due to the decline of export-oriented labor-intensive manufacturing. This puts countries such as Mozambique, which to date have seen little industrialization, in an extremely difficult situation as they struggle to ensure sustained, broad-based growth for their populations.

Continentially, Africa's economic situation is much more precarious now than even five years ago, based on a general bust in African GDP growth since 2013 or 2014 and the economic fallout from the COVID-19 pandemic. The faltering of African growth has a major effect on Africa's rural and agricultural sectors because a large share of increased income is spent on food, making domestic demand for food linked to rising incomes and urbanization a major motor of growth in rural areas. When that growth falters, rural areas suffer. Projections by the IMF in the midst of the pandemic per capita incomes on the continent would be back to where they were 10 years ago by the end of 2021, *"assuming that the pandemic abates, and lockdowns ease further in the second half of 2020"*. If the pandemic instead worsens (as it appears now to be doing) and economic life is further disrupted, the regression will be even greater.

Nationally, Mozambique faces an array of challenges including entrenched poverty, faltering economic growth, poor governance that has worsened over the past 10 years, and a high share of population in rural areas, which makes the rural development challenge more difficult. Of particular concern for rural development are indications of a return to state-led approaches that may undermine the development of sustainable, broad-based markets for agricultural inputs and output.

Zambézia and Nampula face two additional challenges. First, they feature extensive lowlands that are subject to destructive cyclones that appear to be increasing in frequency and intensity. These have generated large loss of life and sometimes catastrophic destruction of physical infrastructure and are a major reason that conditions of road access have improved little in Mozambique over the past decade despite substantial investment. Second, the conflict in Cabo Delgado raises the cost of supplying markets related to the gas field development in and around Pemba and threatens major direct effects on Nampula if it expands. Very recent events in Cabo Delgado are deeply concerning.

Despite profound challenges, Mozambique has many strengths that if harnessed could facilitate sustained rural growth and inclusive transformation. Zambézia and Nampula provinces have a varied agroecology that supports the growing of a wide variety of crops. Yet this same agroecology, given Mozambique's geography, road infrastructure, and rudimentary organizational capacity within value chains, has resulted in quite low average yields for many crops important to the country.

Mozambique's long coastline and major ports in the south (Maputo), center (Beira), and north (Nacala and Pemba) could once again make it an important player in maritime transport, but major managerial reforms (in addition to investment) would be needed to do this.

Rapid urban population growth especially in Nampula is feeding even more rapid growth of domestic food markets, making these a strong basis for transformative growth in rural areas. The rapid urban growth in Nampula emphasizes the importance of road links from the hinterland of northern Zambézia and all of Nampula to the Nacala corridor road, to take advantage of the robustly growing markets for maize, soya, vegetables, and other crops.

We draw on previous research to assess prospects for the speed and size of growth in domestic demand for key value chains. It suggests that growth will be the most rapid for perishable goods of animal origin: dairy, poultry and eggs, other meat, and fish; that the contribution of maize to total growth will be by far the largest of any other food item, at 36%, even without considering derived demand for maize used in animal feed; and that import substitution opportunities exist for most of the products considered due to Mozambique's heavy reliance on imports.

USAID's challenge: USAID/Mozambique's challenge is to promote a structural rural transformation in its intervention area. Doing so requires simultaneously increasing productivity in farming and facilitating progressively more engagement in nonfarm activity. As it does this, it needs to address the food insecurity that pervades all zones and types of rural households. USAID must promote this transformation while dealing with the constraints, and taking advantage of the opportunities, outlined above. Most fundamental among the constraints is the decline of export-oriented labor-intensive manufacturing, driven by automation and globalization.

Four areas of broad agreement exist on how to proceed. First, Mozambique must invest aggressively in its "fundamental capabilities" - human and institutional capacity (including transparent policies and effective regulations) and the hard infrastructure of a modern economy including roads, electricity, and internet connectivity. Micro-grids and mini-grids should be a key part of at least the medium-term energy strategy.

Second, government and private sector need to emphasize a pragmatic, development-oriented relationship between the two and avoid some of the policy mistakes that are mentioned above.

Third, growth in domestic demand for food provides a huge and relatively stable opportunity for growth in rural economies in these countries. Policies, programs, and public investments must be oriented to facilitating private sector investment in these kinds of activities, especially among small- and medium enterprise.

Fourth, these countries need to expand their "domestic" markets through more efficient regional trade. Food manufacturing needs to be central to this strategy *but must be based on fostering competitive food processing*, not hindering trade in raw products. This means a commitment to the new African Continental Free Trade Agreement (AfCFTA) that goes well beyond the tepid support and routine violation of previous regional agreements that has characterized policy in so many African countries.

Mozambique's rural areas: Analysis of IAI 2012 and 2017 data shows very slow progress on the farm but some promising opportunities. Area planted and total value of agricultural production per AE increased substantially and across all zones, though the reasons for this change are not yet clear.

Soybean production in Alta Zambézia increased sharply yet the share of farmers growing sesame, pigeon pea, and cotton dropped. Overall, we see no increase in farmers' cash crop orientation.

Use of variable inputs and tractorization increased broadly but remains extremely low. The only large changes were a large *decrease* in the share of households using pesticides driven by a decrease in cotton planting, and a meaningful increase in the percent using improved seed, potentially due to the emerging expansion of the rural agrodealer network.

Nonfarm activities became more important in all zones over the five years, primarily through own business activities, which increased by nearly 10 percentage points.

Finally, food security remains an important problem throughout the provinces and likely across every type of household. Notably, no single zone appears persistently to be the most food insecure, as the zonal patterns changed between the two periods.

Emerging success stories: The changes identified in the IAI data do not approach the depth and speed needed to drive transformation that rapidly reduces poverty. Yet various pieces of information suggest that real and potentially sustainable change has been happening “under the radar” and that, with good policy and well-designed programmatic support, it could soon begin to make a much broader positive impact among rural households. Here we review two broad areas of positive change.

First, emerging dynamism in input markets due in part to investment by USAID, the EU, and FAO in seed and other input companies and a rural agrodealer network. Concern about donor dependence is reasonable, sustainability cannot be taken for granted. The key imperative is that government programs to promote input access contribute to the further development of this system rather than bypassing and thus undermining it.

Second, Mozambique has seen the emergence, despite periodic busts, of several important cash crops. Chief among these – and potentially the most sustainable – is soya. However, productivity needs to be increased on the farm and in the post-farm to compete with imported soy meal. Maize also provides a strong basis for sustained growth in demand from direct human for beer production, and for animal feed. With the advent of mobile processing units, cassava offers opportunities for value added in starch, animal feeds, and flours, including the potential to substitute fortified high quality cassava flour (HQCF) for a portion of imported wheat in bread.

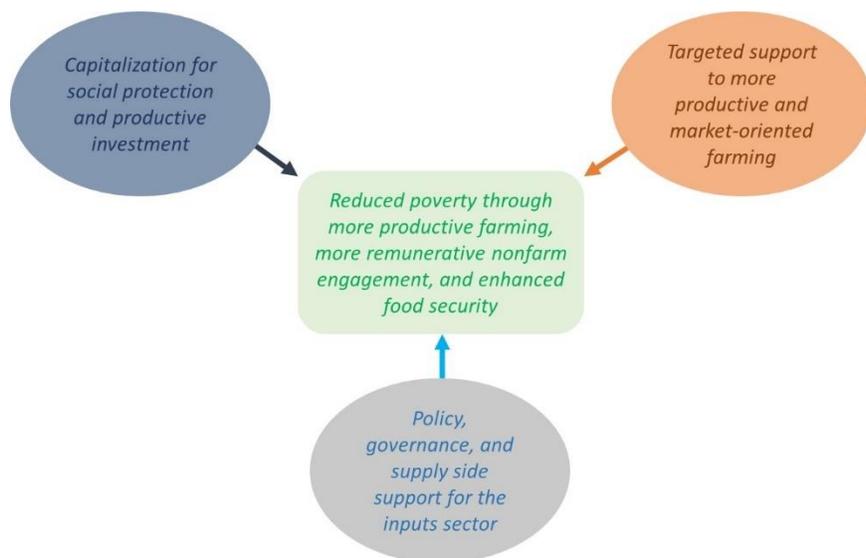
Vegetable production for the market grew rapidly in western Nampula with the improvement in the Nacala corridor road. Road investments connecting areas of Alta Zambézia to the Nacala Corridor road should greatly expand the production areas that have access to this market, including urban populations in Namialo in Nampula. The conflict in Cabo Delgado, however, will increase the cost and risk of supplying Pemba and the oilfields.

Export crops are often more difficult due to quality and other requirements, and they are also potentially more unstable, but do provide opportunities, including for sesame and pigeon pea. Policy must improve and become less dominated by public sector provision if cashew is to prosper.

Programmatic approach: Our theory of change (see figure) contends that (1) support to farming that is targeted geographically and by household and informed by output market possibilities will efficiently improve productivity among those households able to engage with markets; (2) savings mobilization and cash transfers across all households (combined with business development services) will foster expansion by some households into nonfarm activities and allow increased farm investment; and (3) improved policy and governance in the inputs sector, together with supply side support building on past investments will foster increased supply of more affordable and better quality inputs that facilitates more productive farming. This approach falls within the emerging tendency to combine social assistance with agricultural programs, based in part on evidence that the

former nearly always enables recipients “to manage risks, build assets, and undertake activities that are more remunerative”. The innovation in the approach here is that it conceives the social protection portion as part of the productive investment and uses it to ease entry into nonfarm activities rather than focusing only on farming.

Investment options: The broad categories are (1) support to policy, governance, and the supply side of seed and other input markets; direct support to rural households under (2) a Farm



Production Program that is targeted and differentiated; and (3) a Household Capitalization Program for social protection and productive investment based on cash grants and savings mechanisms. We also review possibilities for a program of support to nascent agricultural processing sectors.

The Farm Production Program is organized under two components. The Food Security Component works with households with few assets and little or no

Theory of change for USAID investments in rural Zambézia and Nampula

agricultural market engagement to improve their production of food security crops without relying on multiple expensive cash inputs. The Market-Oriented Component focuses on households with more farming assets and history of market engagement that could be enhanced by access to a wider range of more productive cash inputs and practices that can substantially raise productivity.

We expect the Household Capitalization Program to address pervasive food insecurity and provide capital that households can invest in further agricultural intensification or in nonfarm engagement. Business Development Services would be available for those households wanting them.

Agricultural processing support is discussed for soya, cassava, sesame, sunflower, pigeon pea, moringa, and groundnut. We note that this sector may be especially accessible to women, though primarily in more densely populated rural areas rather than more remote areas.

Women and youth face unique constraints in the development process. Recognizing those constraints is critical to developing programs to enhance their opportunities. We review literature on how best to engage these demographics and suggest how this intersects with the programmatic design laid out in this report.

I. Introduction

This report was produced by Michigan State University for USAID/Mozambique as an input into the mission's decision making regarding agricultural programming in Nampula and Zambézia provinces over the coming years. We collaborated closely with Elim Consultoria (Tatiana Mata) and Dr. Antony Chapoto of the Indaba Agricultural Policy Research Institute in Zambia.

The report is organized as follows. Section II lays out data, methods, and literature used. Section III provides extensive background on Mozambique's current status, reviews challenges and opportunities for transformational growth, and summarizes USAID's challenge in today's environment. Section IV uses Mozambican household survey data to examine that status of rural households in the two provinces during 2012 and 2017 and draw conclusions regarding the extent of transformation. Section V lays out the overall programmatic approach and presents the theory of change behind it. Section VI presents more detailed investment options consistent with the programmatic approach and theory of change.

Our approach in this paper is rooted in the concept of the structural and rural transformation of economies, in which rising specialization and productivity in farming is paired with the movement of labor off the farm into better-paying activities, whether own business or wage labor. The process also involves a decline in informal self-employment, replacing it with better-paying wage jobs. Because such a transformation is a *sine qua non* for broad poverty reduction - other than a small number of island- and city-states, every wealthy country in the world has gone through this process – our empirical analysis focuses on evidence of this happening in Mozambique, and the program options we lay out are designed to foster it. We will return to this idea frequently in the report.

II. Data, methods, and literature used

A. Online survey of key informants

In December 2020, using a Google survey document, we solicited input from 58 key informants in Mozambique and achieved a response rate of 31%. The key informants came from the public sector, from NGOs, from private enterprise and from the donor community. The survey listed 19 major projects in Mozambique in recent years (some of which are still active) and asked questions regarding their programs and the efficiency in achieving results in a range of areas. In addition to ranking questions about how well a given project did in addressing topics such as productivity and farmer access, open ended questions were asked to include perceptions and judgments of the key informants. This type of survey can be biased as respondents may be involved directly with projects, but it gives a chance to get insights and understand how people are thinking about key issues. See Annex A for copy of the survey instrument and basic results.

B. Key informant interviews in Mozambique

We followed the survey with key informant interviews conducted on Zoom or other platform, with two or more of the team on the line, during December through February. These conversations were generally 30 minutes to 1 hour long. A team from USAID had previously conducted interviews in mid-2020 with key informants and the responses to that survey were used to identify key areas of focus for these new interviews. The team asked key informants to address specific questions concerning their challenges and prospects, as well as addressing individual thoughts concerning aspects of success and new opportunities. See Annex B for a list of interviewed people.

C. Regional review of programs

We contracted Dr. Antony Chapoto of the Indaba Agricultural Policy Research Institute in Zambia to conduct a review of programs in the region. Dr. Chapoto has over 20 years of experience in the region, and drew on his own knowledge of Zambia and the region while consulting also with MSU country programs in Malawi and Tanzania to identify the key programs for review. We integrate his findings with our own findings from the survey and interviews in Mozambique in this document. His full report is found in Chapoto and Kabisa (2021).

D. Literature consulted

All of the projects, programs and initiatives in Mozambique provide a wealth of studies and other documents useful in diagnosis and planning. We cite key documents in the Reference List. In addition, a List of Thematic References is in Annex C with URL links to ease access for many of the documents. These are documents that we have accessed, that may be of interest, but are additional to those cited in the report. Among those resources are many value-chain assessment documents, designed to help identify the best opportunities for private sector investments. Those include ACDI/VOCA (2016), FTF Inova (2017), and Cambridge Economic Policy Associates (2016) Agribusiness Country Diagnostic. Each document provides an assessment of the potential value chains, weaknesses, opportunities using SWOT analysis and other types of analysis.

Project design, final reports, and evaluation reports: Another key source of information for this report were the project design documents as well as final reports, and in some cases evaluations, conducted for key projects in Mozambique, focusing on projects since 2010. While many of the documents are public access, the availability of this grey literature was often compromised by projects ending and websites no longer being maintained, lack of public release of documents, and other issues. Within-project or program reports are also known for bias, especially in reporting weaknesses or failures of activities or strategies. We took all these issues into account as we reviewed these documents.

Research Literature: Finally, there are various policy documents and other research that provide insight into the dynamics of rural development in Mozambique and elsewhere in the region or in sub-Saharan Africa. International institutions, including IFPRI, World Bank, FAO, and AGRA, have produced strategic documents on Mozambique and throughout sub-Saharan Africa that can help guide programming. Those too are found in the Thematic References in Annex C.

E. Household data

We used 2012 and 2017 IAI (MASA/DPCI 2012 and 2017) rural household surveys to examine changes in livelihoods, farming practices, farming income, and food security in Nampula and Zambézia provinces. All results were weighted by the sample weights included in those survey databases. These surveys are very comparable on the farm side, allowing a thorough examination of changes in farming behavior between these two periods. However, IAI 2017 did not use the detailed nonfarm employment module that was used in 2012, instead collecting only a few indicators of nonfarm engagement of each household member. As a result, we were unable to generate the same rural household typology (see next section for a brief discussion of this typology) in 2017 that we did in 2012 and were therefore limited in our ability to directly quantify broader aspects of rural transformation during that period. Nonetheless, based on the detailed picture of change we were able to develop at the farm level between the two periods, and the member level indicators of nonfarm engagement, we believe we can speak with some broad confidence regarding the very limited transformation that has taken place over this time.

F. Definition of zones and rural household types

Designing programs to spur rural transformation requires targeting of different interventions to the areas and types of households where they can have greatest impact. To aid this targeting we drew on existing livelihood zones and agroecological zones (see Annex D for maps), used our own judgment to define four zones in Nampula and Zambézia provinces, and then assigned whole districts to these new zones. We also used IAI-2012 to develop a rural household typology rooted in the concept of the rural transformation and building off the approach of Hazell (2017).

Zones: Figure 1 maps each zone. Table 1 shows the districts they contain and provides a summary characterization. These four zones differ primarily in agroecology and thus in the crops that USAID might support. But one zone (Lowland Southern Zambézia) stands out for better access to improved roads, relatively uncommercialized farming and higher engagement in the nonfarm economy: in both 2012 and 2017 this zone sold only about 10% of its farm production, compared to a range of 17% to 26% in other zones; and in 2012 it earned nearly 50% of its total income from nonfarm sources, compared to no more than 25% in any other zone. The other three zones differ little in these three aspects and all zones differ remarkably little in their agricultural practices. Mean and median incomes are also very similar, varying in 2012 (no data for 2017) by less than 40% and 15%, respectively, between the poorest and least poor zones. Food security indicators are quite comparable and suggest a need in every zone for food security and nutrition programing beyond programs to promote inclusive growth.

Table 1. Zones of Nampula and Zambézia province to guide programming

Zone	Districts	Characterization
Lowland Southern Zambézia (LSZ)	Chinde, Inhassunge, Mopeia, Namacurra, Nicoadala, rural areas of Cidade de Quelimane	Mostly subsistence rice farming with strong integration into non-farm economy
Eastern / Coastal Northern Zambézia and Nampula (COASTAL)	Angoche, Erati-Namapa, Maganjha da Costa, Meconta, Memba, Mogincual, Moma, Monapo, Mossuril, Nacala Velha, Nacarora, Pebane, C. de Nacala	Isolated with manioc, groundnuts, coconut, cashew, and some other cash crops, moderate nonfarm engagement
Mid-elevation Nampula and Zambézia (MID-ELEVATION)	Gile, Ile, Lalaua, Lugela, Mecuburi, Mocuba, Mogovolas, Morrumbala, Morrupula, Muecate, Nampula, C. de Nampula	Somewhat isolated with manioc, beans, maize and some cash crops, and moderate non-farm engagement
Western Nampula and Alta Zambézia (WNAZ)	Alto Molocue, Gurue, Malema, Milange, Namarroi, Ribaue	Isolated with heavy dependence on maize and moderate nonfarm engagement

Source: Authors' elaboration from AEZ and livelihoods maps plus LAI 2012 results

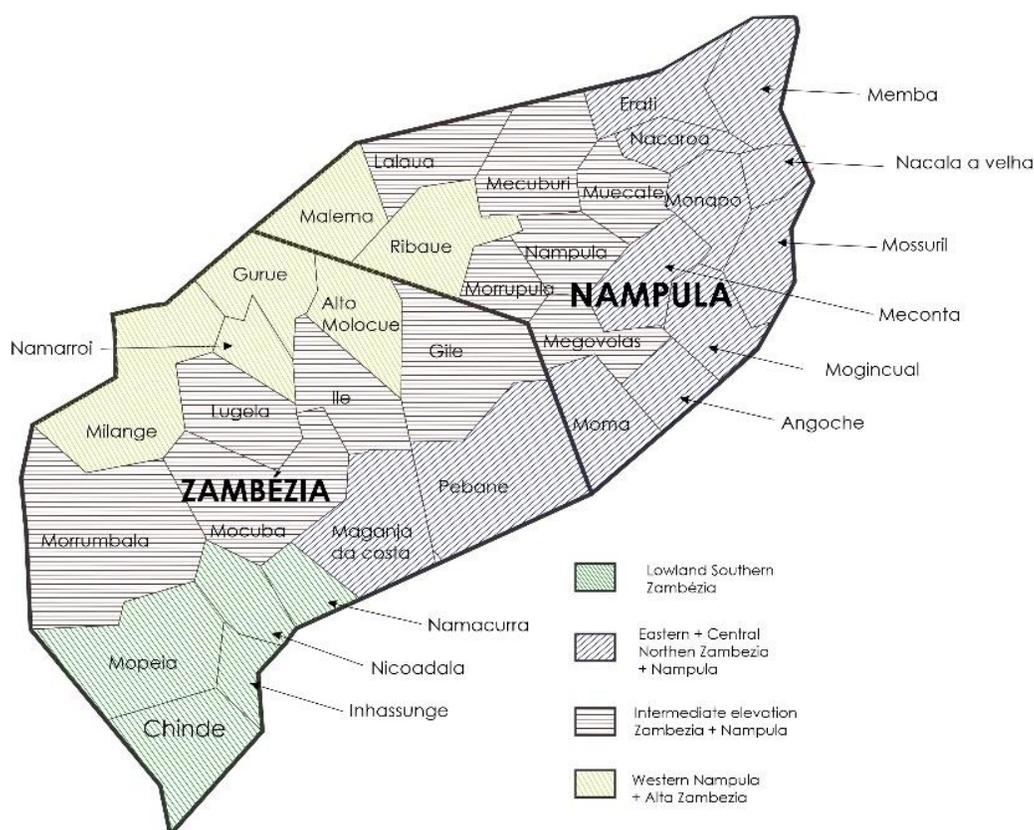


Figure 1. Map of zones used in this report

G. Household types

It is widely understood that cropping patterns and livelihoods vary quite a bit over rural areas in Mozambique. There is much less understanding of diversity among smallholder farmers. The persistent tendency in Mozambique to refer to nearly the entire set of smallholder (sector familiar) farmers as “produtores de subsistência” (subsistence producers) hides substantial variability within this sector that needs to be taken into account in program design. This reality is widely appreciated

among empirical researchers and is summarized in accessible form by Harris, Chamberlin, and Mausch (2019).

We aim to capture this diversity in our rural household typology. We base the typology on one developed by Hazell (2017) for AGRA’s 2017 African Agricultural Status Report (AGRA, 2017). Using data from the 2012 IAI (later IAIs have no data on nonfarm income so could not be used for this purpose), we compute two variables for every surveyed household: (1) the share of their farm production that they sell, and (2) the share of total household income (farm plus nonfarm) that comes from nonfarm activities. Together, these two variables define a “transformation space” in which we can locate rural households; higher farm sales out of total farm production and higher nonfarm income out of total income both reflect greater transformation, though along different axes.

Table 2 maps our typology and its terminology into terminology commonly used today in Mozambique and shows the percent of all households from the 2012 IAI in each category. Figure 2 shows the size of each group and where they lie in the “transformation space” captured by our two variables, and Table 3 shows the distribution of household types across our four zones.

Table 2. Mapping of rural household typology into common terminology used in Mozambique

Current/common terminology	Our terminology (% of all farmers in 2012 IAI)	Short name	Short description	Precise definition (from IAI 2012)
Subsistence – all smallholder farmers (“sector familiar”)	Subsistence and semi-subsistence smallholder farmers (27%)	Type 1, Type 2	Sell little or none of their farm production and earn little or no nonfarm income	Sell < 5% of their farm production; Nonfarm income < 33% of total income
	Semi-commercial smallholder farmers (32%)	Type 3	Sell little of their farm production; little or no nonfarm income	Sell 5-50% of farm production; Nonfarm income < 33% of total income
	Commercialized smallholder farmers (8%)	Type 4	Sell most of their farm production; little or no nonfarm income	Sell 50-100% of farm production; Nonfarm income < 33% of total income
	Nonfarm oriented rural smallholder households (31%) “Transitioning Out”	Type 5	Sell little of their farm production; most income is from nonfarm	Sell < 50% of farm production; Nonfarm income > 33% of total income
	Diversified rural smallholder households (3%)	Type 6	Sell most of their farm production, but most income comes from nonfarm	Sell > 50% of farm production; Nonfarm income > 33% of total income
Emerging – Mostly medium-scale market-oriented farmers, often targeted as service providers by programs such as SUSTENTA	Commercially oriented medium-scale farmers (~1%)	Emerging	Mostly medium scale farms but not all of them – some are not successful farmers	Not adequately represented in IAI
Commercial – Large-scale farming operations	Large-scale farming businesses (<1%)	Large-scale	Large-scale farming businesses	Not adequately represented in IAI

Table 3. Percentage of smallholder and “medio” households by zone and type

HH characteristic (mean or %)	Type of rural household						Total
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	
	Subsistence	Semi Subsistence	Semi-Commercialized	Commercialized	Non-farm oriented	Diversified	
Lowland S. Zambézia	16	13	9	0	57	6	100
East/Coastal N. Zambézia & Nampula	12	14	36	6	28	3	100
Mid-elevation Zambézia & Nampula	8	17	36	11	25	3	100
Alta Zambézia & W. Nampula	12	15	39	10	22	1	100
Total	12	15	32	8	31	3	100

Source: Authors' calculation from LAI2012; small- and medium sample

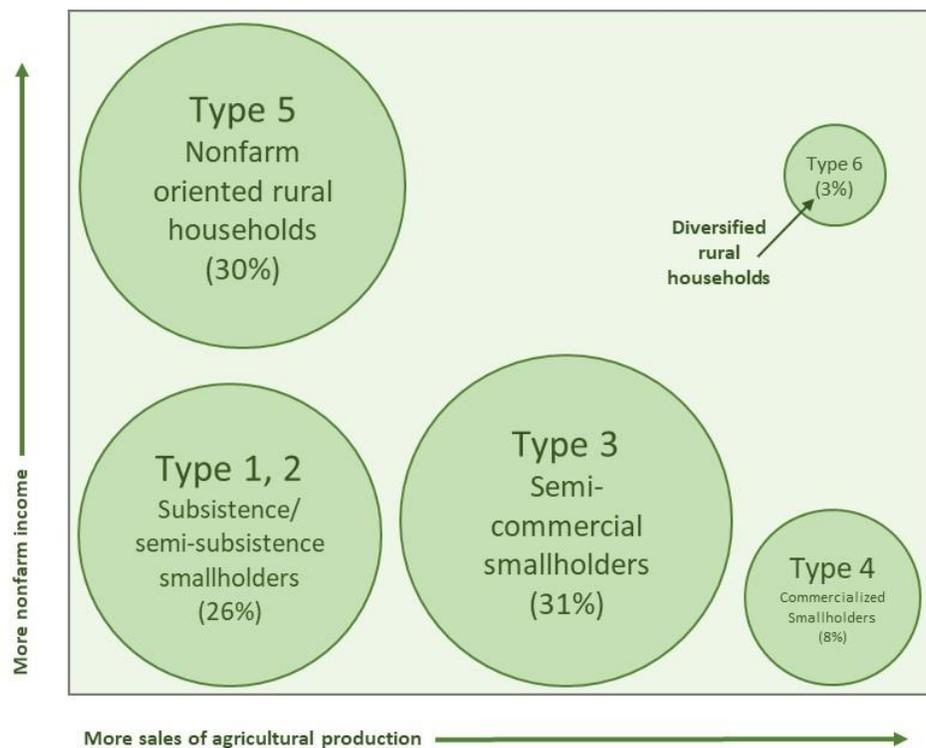


Figure 2. Rural household “transformation space” with relative sizes of each household type from our typology (includes all “pequeno” and “medio” farmers in the 2012 IAI; does not include “emerging” and “large-scale” farmers from Table 3 as we have no survey data

This simple categorization shows clearly that the smallholder farming sector, commonly seen in Mozambique as an undifferentiated set of “subsistence farmers”, instead shows quite a lot of diversity, ranging from true subsistence farmers who engage little if at all with farm- or nonfarm markets (Types 1 and 2 in the bottom-left of the figure, about one-quarter of all households), through households that sell most of their farm production even as they earn most of their income off the farm (Type 6 in the top-right, just 3% of households), and with much variation in between.

Table 4 examines this variability across household types in more detail. Four points stand out. First, types 5 and 6 earned much higher total incomes and showed much higher nonfarm incomes shares than other types.

Second, farm incomes vary much less across household types than do total incomes. In fact, household types 5 and 6, with the highest total incomes, have either the lowest (type 5) or third-lowest (type 6) incomes from farming. Subsistence farmers (type 1) have *higher* farm incomes per ha than do commercialized farmers (type 4), though the latter's higher land holdings mean that their total incomes from farming are nearly double those of subsistence farmers. Semi-subsistence farmers (type 2) far exceed other types in mean farming income per ha. This pattern shows shockingly little payoff to agricultural commercialization in Mozambique as of 2012.

Third, these patterns mean that households generating the highest incomes are doing so through nonfarm income, not through farming. Yet the fourth point is that, despite this, farming is still claimed as the most important economic activity for most adults across every farm type. In other words, nearly all households consider farming a central part of what they do, even those who earn a great majority of their income off the farm.

Finally, food insecurity is pervasive across all household types, with at least 30% having experienced hunger over the past 12 months in every group. Thirty-nine percent and 34%, respectively, of types 5 and 6 (the highest income groups) experienced hunger over this period.

Table 4. Livelihoods, incomes, and food security by household type, 2012

HH characteristic (mean or %)	Type of rural household						Total
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6	
	Subsistence	Semi Subsistence	Semi-Commercialized	Commercialized	Non-farm oriented	Diversified	
% of all households	12	15	32	8	31	3	100
Incomes							
Mean total income/ΔE (real contos)	3,099	7,055	5,795	5,889	11,374	17,490	7,776
Mean gross farm income/ae	3,108	6,479	5,393	5,608	2,787	3,278	4,442
Mean gross farm income/ae per ha	3,051	4,610	3,349	2,761	2,474	1,917	3,168
Farm sales share in total farm income	0.0	1.1	21.7	68.7	9.9	71.2	17.7
Non-farm/total income	0.0	10.1	7.7	7.6	68.5	63.3	27.5
HH received remittances (%)	0.0	23.8	16.4	17.1	32.6	28.2	21.0
Remittance income/total income	0.0	1.4	1.4	1.0	8.3	11.5	3.7
Economic activity							
Adults with farming as principal activity (%)	77.6	82.5	86.9	95.5	66.8	59.5	78.8
Adults with wage employment (%)	5.8	19.6	14.1	14.6	25.1	21.4	17.6
Adults with own business activity (%)	3.0	25.1	21.8	30.6	37.5	36.8	26.2
Food security							
Experienced hunger past 12 mths (%)	39.3	56.5	46.5	29.8	38.7	34.0	43.1

Source: Authors' calculation from LAI2012

Together, these patterns highlight in stark form the importance of promoting both farm and nonfarm income among rural households in Mozambique: farming must transform enough to be able to provide a way out of poverty for motivated farmers with enough land and other assets to make farming a business, it must also continue to provide the food security backstop that even the most nonfarm oriented households clearly still use it for, but many rural households must also be helped to move into more remunerative nonfarm income if they are to escape from poverty.

III. Background and context: Challenges and opportunities for growth and transformation

A. Major global, continental, and national challenges

Mozambique faces a daunting array of overlapping challenges to achieving the inclusive agricultural and rural transformation that it needs to sustainably and rapidly reduce poverty, inequality, and food insecurity. Understanding these challenges – and the options they likely close-off and those they may leave open - is key to designing and deploying workable development strategies. We briefly review these challenges at the global, continental, national, and sub-national levels before turning in the next section to the growth opportunities the country does have.

The global setting: Narrowing options for transformative growth: The development challenge facing Mozambique – and every other low-income country – is to achieve a structural and rural transformation of its economy. These transformations involve increasing productivity and specialization on the farm and progressive movement of labor off the farm into more remunerative rural nonfarm activities and urban-based wage and business activities. In parallel, it involves movement out of informal self-employment into better-paying wage jobs that may also offer social protections. Without such a transformation, broad poverty reduction is impossible. In fact, every wealthy country in the world today, aside from a small number of island- and city-states, has gone through this process, moving from a primarily rural and agricultural economy to one dominated by non-agricultural employment based primarily in urban areas.

Such a transformation cannot happen without large and sustained increases in agricultural productivity, since this productivity is central to raising rural incomes both on and off the farm, and to affordably feeding the population. Making the transformation *inclusive* means that the profound changes the country goes through provide opportunity to a wide range of rural residents, including women, youth, and the very poor. In practice, this typically involves combining targeted safety net assistance with growth-oriented strategies focused on increasing productivity among those households that are able to profitably adopt needed technology. In fact, designing these two elements in tandem can lead to far greater positive impact on rural households than either one alone; this idea becomes a central pillar in the design of investment options we lay out later in the report.

Historically, today's high- and upper middle-income economies have achieved this transformation through export-oriented, labor-intensive manufacturing that “pulled” labor out of farming and out of rural areas into more remunerative and stable jobs mostly in urban areas. The US and European countries saw industrial employment rise well beyond 20% and even near 40% of total employment during their most intensive industrialization phases (Rodrik, 2015). More recently, China, Brazil, and

some other Asian countries saw industrial employment rise as high as 15% – lower than the previous generation of western industrializers due to technology change, but still a very substantial share of employment. Notably, the US and European countries reached peak industrial employment at income levels averaging around \$14,000 per capita (in 1990 USD), while the later industrializers appear to have reached their peaks at incomes of around US\$5,000 or less: peak industrial employment is now clearly lower than in the past and is being reached at lower incomes than in the past.

For countries that have not yet industrialized – much of Africa including Mozambique, and some South Asian countries - this avenue to transformation is now much less available, for two overlapping reasons. First, as countries progress into upper-middle and high-income status, consumer expenditure progressively moves towards services instead of manufactured goods. In a relative sense, this means that global demand for manufactured goods declines as incomes in the global economy rise. Though some suggest otherwise (Kenfemichael and Morshed, 2019), most experts agree that the service sector does not offer the same “escalator” out of poverty that manufacturing does, due to lower technological intensity of production and skill demands (McMillan, Rodrik, and Sepulveda, 2017). If true, this means that the decline of manufacturing employment will limit growth in wages and incomes in countries that have not yet industrialized.

Second, automation, which is increasingly driven by artificial intelligence and thus has vastly broader scope than in the past, is dramatically reducing the amount of labor needed for manufacturing output, and global trade is spreading this impact across the world. Countries thus face the combined negative effect of falling relative demand for manufactured goods and falling demand for labor per unit of those goods. There has been strong debate and wide disagreement over whether these forces will lead to a net reduction in employment. Many note that similar fears over the past three centuries were never borne out, as technological change led to the emergence of previously unimaginable jobs, and overall employment increased (World Bank, 2019b). Others note the rise of artificial intelligence (including much more rapid advances just in the past year than many experts thought possible) and fear that “this time might be different”: that the confluence of robotics, exponentially expanding “Big Data”, and ever-increasing computing power may push automation so far into jobs previously doable only by people that increasing shares of the world’s population will be unable to find remunerative employment. (Brynjolfsson and McAfee 2011; Brynjolfsson and McAfee 2014; Autor 2014; Ford 2015).¹

Regardless of where analysts stand on the issue of the level of employment, there is wide agreement that “the bar has been (substantially) raised” for entry into export-oriented manufacturing. Today, sustained entry into most of these markets is not possible without adopting new, knowledge-intensive technologies and collaboration processes that underpin an ability to ensure high- and continuously improving quality (Hallward-Driemeier and Nayyar (2018). Among other things, this requires a skilled workforce and an “entrepreneurship ecosystem” favoring pragmatic collaboration between government and private sector to spur continuous innovation. Such requirements put countries such as Mozambique – with low incomes, poor governance (see below), a largely unskilled

¹ We also note that recent research (Acemoglu and Restrepo, 2020) for the first time has documented net declines in employment and wages linked to robotization – one type of smart automation.

workforce, and minimal industrialization - in an extremely difficult situation as they struggle to ensure sustained, broad-based growth for their populations. In section II.C, we consider the implications of these patterns for Mozambique and for USAID's investments in the rural sector.

The continental setting: A much more precarious environment than five years ago: Africa's economic situation is much more precarious now than it was even five years ago, based on two facts. First, there has been a general bust in African GDP growth since 2013 or 2014 (Figure 1; see Tschirley, et. al., 2020). From 2000 to 2013, the continent achieved steady and rapid growth, with mean per capita consumer expenditure in constant dollars rising from under USD900 to USD1300, implying an annual per capita growth rate of about 3% per capita. Since 2013, growth has clearly faltered through 2018. The downturn in growth did not affect every country on the continent but was very broad: of the 29 countries with data for the entire 2000-2018 period, nine bucked the continental trend and achieved higher growth after 2013 compared to before; yet 20 countries had lower growth during this second period. Furthermore, while only one of the 29 had negative growth during the boom period prior to 2013, 10 had negative growth since 2013. Mozambique followed the continental pattern, with growth faltering around the same time (see next section for more detail).

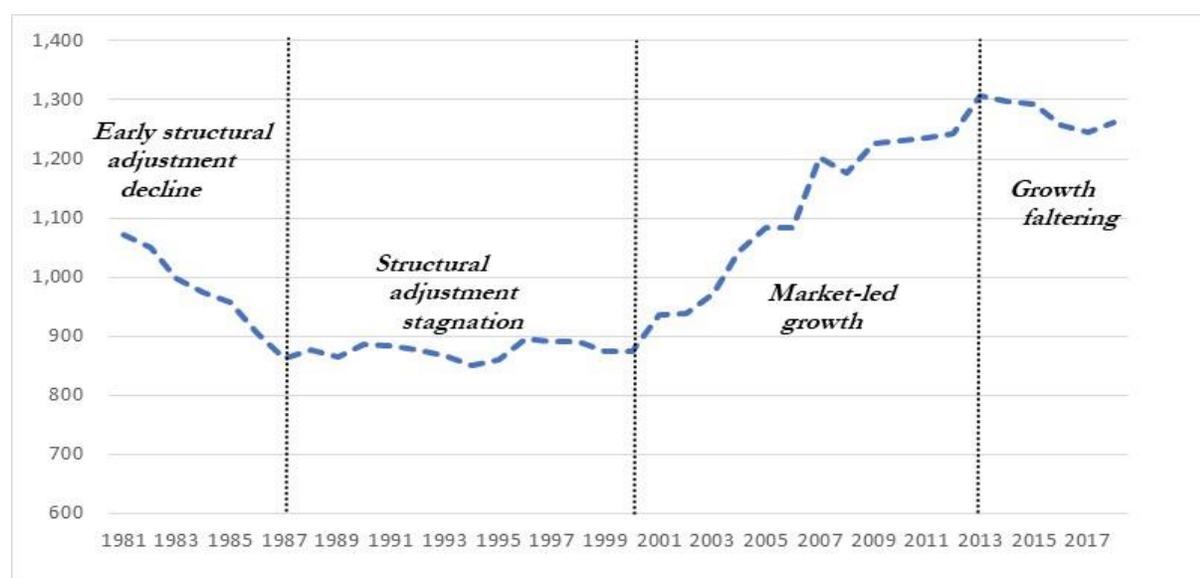


Figure 3. Per capita final consumer expenditure in constant 2010 USD, Sub-Saharan Africa, 1981-2018 (Source: Elaboration by author using World Bank Indicators, Final consumption expenditure estimated from national accounts data (excel file API_NE.CON.TOTL.KD_DS2_en_excel_v2_1129220)).

This growth faltering has a major effect on Africa's rural and agricultural sectors, for a simple reason: broad poverty means that large shares of increased income is spent on food in Africa, making domestic demand for food linked to rising incomes and urbanization a major motor of growth in rural areas. When that growth falters, rural areas suffer.

The second factor contributing to Africa's precarious position today is the impact of the COVID-19 pandemic, which continues to worsen on the continent. Prior to the pandemic, the IMF forecast 3.5% growth in GDP on the continent 2019 and 3.6% in 2020, barely positive in per capita terms, given the continent's very high population growth. Now, with the COVID-19 pandemic, the severe

locust outbreak in East Africa, the Fall Armyworm infestation since 2016, and growing security problems in the Sahel, the IMF forecasts GDP growth of *negative* 3.2% in 2020 (negative 5.4% per capita!) and a recovery to 1.1% overall (still negative in per capita terms) in 2021 “*assuming that the pandemic abates, and lockdowns ease further in the second half of 2020*” (IMF, 2020, p. 5). By the end of 2021 under these projections, per capita incomes on the continent would be back to where they were 10 years ago. If the pandemic instead worsens (as it appears now to be doing) and economic life is further disrupted, the regression will be even greater.

The national setting: major challenges accentuated by governance and the difficulty of effectively managing the natural resource boom: Mozambique faces an array of challenges including entrenched poverty, faltering economic growth, poor governance that has worsened over the past 10 years, and a high share of population in rural areas compared to SSA and the region, which makes the rural development challenge more difficult. We briefly address each of these issues in this section.

First, among countries with data since 2010, Mozambique has had the seventh highest headcount poverty rate in the world, at 64% (based on \$1.90 per capita per day, World Bank data). While growth in per capita consumption (as reported by World Bank) averaged 5.5% per year from 2000 to 2013, it averaged only 2.0% from 2013 to 2016 and was negative in 2017 and 2018.

Second, addressing growth and poverty is made more difficult by low and declining institutional effectiveness and governance quality combined with the difficulty any country faces managing a natural resource boom.² The discovery of major natural gas reserves in Mozambique in 2011 heightened the need for strong governance to effectively manage the country’s exchange rate and avoid rapid appreciation that would hurt local productive sectors compared to imports. To do this, natural resource proceeds need to be aggressively invested in productive and labor-absorbing sectors of the economy to counteract the strong tendency in resource-rich countries for productive sectors to lag. Yet trends since this time are not encouraging (Figure 4): across six governance indicators monitored by the World Bank, Mozambique in 2019 ranked in the bottom 25% globally in five, ranked lower in 2019 than in any year since 2000 in all six, and ranked lower than neighboring Malawi and Zambia in all six.

Of particular concern for rural development are indications of a return to state-led approaches that may undermine the development of sustainable, broad-based markets for agricultural inputs and output. The approach to input and service provision under the country’s flagship agricultural development program – SUSTENTA – may be a prime example of this, with some knowledgeable observers concerned that its approach of distributing heavily subsidized seeds and other inputs to a limited number of farmers may “destroy many of the nascent commercial market systems that have been developed” (quote from online survey respondent). Part of this impact is due to the size of SUSTENTA purchases, which observers say lead to scarcity of certified or other quality seed and

² Though revenues from the LNG fields have not yet begun to flow and will be further delayed due to COVID-19 and concerns about security in the north, Mozambique’s dependence on natural resource (extractives) exports has risen dramatically over the past 20 years, from 10% of all exports in 1996 to 70% in 2014. FDI in Mozambique, driven largely by LNG, was the third highest in Africa in 2017. See Roe (2018).

thereby starve the emerging agrodealer network of the supplies that it needs. This network is key to broad and sustained input access by smallholder farmers.

A second example relates to the role conceived for the new Instituto de Algodão e Oleaginosas de Mocambique (IAOM), which replaced the old Instituto de Algodão. Among other things, the proposed regulations released in February 2021 (IAOM 2021) do the following:

- Seek to “regulate the production, marketing, industrialization, exportation and importation” of all oilseeds;
- Register all private sector actors, including a requirement that they file annual workplans for crop production and processing each year;
- Propose a reference price established by the Council of Ministers by March 30th each year;
- Permit sales by farmers only to an identified commercial operator or development group that is expressly authorized.

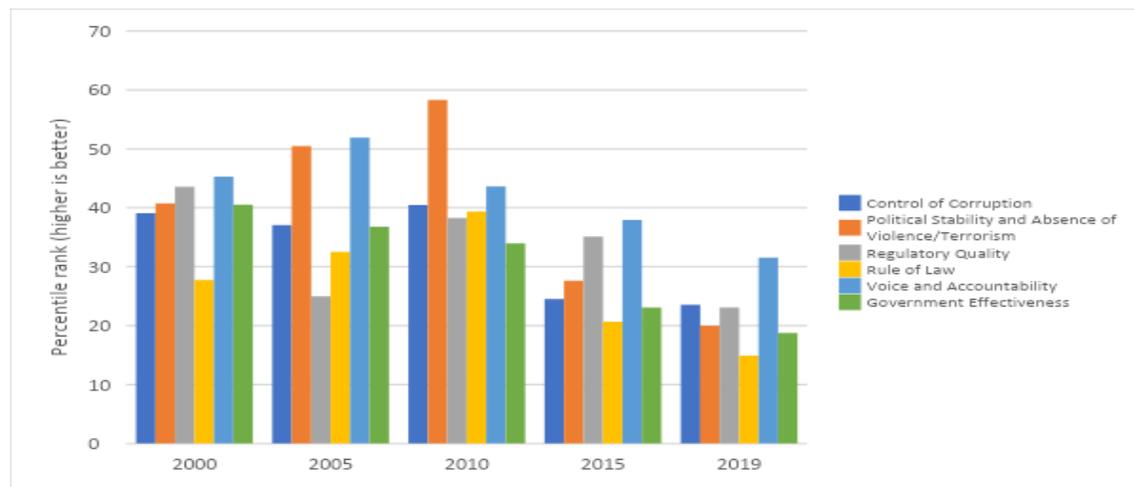


Figure 4. World Bank measures of governance quality in Mozambique, 2000-2019 (Source: World Bank Worldwide Governance Indicators)

It is unlikely that the government of Mozambique will be able to implement these regulations, and to the extent that it does, they could dramatically undermine incentives for farmers, processors, and traders to invest in the system.

Third, though urban populations are rising rapidly, the country still has a high share of its population living in rural areas. Using Africapolis data (OECD/SWAC, 2020), Mozambique’s population in 2015 was 33% urban, compared to averages of 50% in Southern Africa, 47% in West Africa, 43% in Central Africa, 37% in East Africa, and 44% in SSA overall. This low level of urbanization makes Mozambique’s rural development problem more challenging for a simple reason: given the difficulty of breaking into global markets and the instability that the country has experienced in these markets, domestic consumption needs to be a central driver of growth, and a low urban population share means that the domestic market is small for local farmers.

On the other hand, this very fact means that, as urbanization proceeds and especially if it is paired with income growth, the size of the market for food per rural resident rises extremely rapidly. This makes growth in domestic food markets – and, ideally, nearby regional markets – a foundation for rural development.

Sub-nationally: Vulnerability to cyclones and a growing conflict: Zambézia and Nampula face two additional challenges that condition the kind of assistance they need to transform their economies more rapidly. First, the region, and especially Zambézia, features extensive lowlands that are subject to destructive cyclones that appear to be increasing in frequency and intensity (Fitchett, 2019). These have generated large loss of life and sometimes catastrophic destruction of physical infrastructure. The landfall of *Idai* – the strongest cyclone on record on the eastern seaboard of Africa – and *Kenneth* within six weeks of each other in early 2020 was particularly devastating. Combined with poor quality road construction and repair (see below), these storms have had been a major reason that conditions of road access have improved little in Mozambique over the past decade despite substantial investment. It is worth quoting a World Bank assessment (World Bank, 2019b) at length on this issue:

“Mozambique is highly exposed to extreme rainfall and flooding that may become even more frequent because of global climate change ... Due to recurrent climatic events and the lack of maintenance, the road and rail networks have suffered extensive damage over the last 20 years, with substantial sums being diverted from network improvement to the repair of flood-related damage. Because the Mozambican road network has a low redundancy, those disruptions sometimes isolate communities for extended periods of time and thus have a significant detrimental impact on their local economics.”

Second, the conflict in Cabo Delgado currently has indirect effects on Nampula by raising the cost of supplying markets near the gas field development around Pemba. Currently, the suspension of investment activities in Palma and the violence that caused it has stopped nearly all external food supply into that region. Many small and commercial farming investments have been compromised and smallholder farmers once supported by the multinationals have become displaced. With the intensification of the conflict, trade has shifted from the oil-based region to supply Pemba (south of the oil area) as it is increasingly in need of food to feed the displaced populations through humanitarian assistance programs by Government and international agencies. While a source of demand, it implies a major change from the market-based flows of food that were occurring.

B. Opportunities for agricultural growth and transformation

Despite the profound challenges outlined in the previous section, Mozambique has many strengths that if properly harnessed could facilitate sustained rural growth and inclusive transformation. We review four factors here: a diverse agroecology that supports the growth of a wide variety of crops; a geography and natural ports that could make the country an important exporter and maritime transport hub; rapid urbanization that spurs even more rapid growth in demand for food, including value added processed foods and animal foods; and substantial investments in roads over the past five years with at least some major improvements in road access. In section V we review the evidence on emerging dynamism in the inputs sector and emerging commodity success stories.

Varied agroecology: Zambézia and Nampula provinces have a varied agroecology that supports the growing of a wide variety of crops. Its vast coastal plains allow for production of many tropical fruits and tree crops, and broadly support production of cassava, rice where irrigation is available, and maize, though the latter has substantially lower yield potential than it does in other areas (Box 1). Mid-elevation zones provide good soils and climate for production of a range of food crops (maize, cassava, many pulses, and groundnuts), cash crops such as sesame, cotton, and pigeon pea, and small- and large livestock. Higher elevation areas (western Nampula and Alta Zambézia) are ideal for maize, soybeans, pigeon pea, and year-round vegetable production. Small ruminant and poultry production is supported throughout the region.

Box 1: Why is Mozambique’s agricultural productivity so much lower than its neighbors?

Mozambique’s yields are substantially below those of its neighbors across a wide array of crops. We illustrate this below using FAOSTAT data for maize, which likely reflects the situation for most other grains. Maize yields from 2014-2019 in Mozambique are slightly below those in Zimbabwe and half or less those in Malawi, Tanzania, and Zambia. The pattern is similar for cotton, where yields in Mozambique averaged 490 kg/ha over the period compared to 580 in Tanzania and 860 in Zambia. Groundnut yields are also very low, ranging from 30% of those in Malawi to 64% of those in Zimbabwe. We note also that Dunavant, which operated a successful contract farming scheme for cotton in Eastern province of Zambia, consistently failed to meet yield

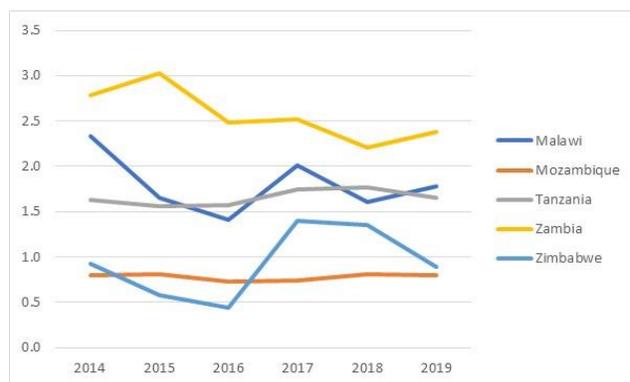


Figure B1. Maize yields in Mozambique and neighbors 2014-2019

expectations after expanding its operations into agroecologically similar Tete province and eventually southwestern Zambézia and left the country after several years of effort. Though data quality make comparison problematical, yields for staple vegetables such as tomato, onion, cabbage, and potato are also likely substantially lower in Mozambique than in its neighbors.

We attribute this persistent yield gap between Mozambique and its neighbors to several factors. The first is agroecology. Mozambique’s extensive hot and humid lowlands meant that its average elevation is far lower than its neighbors: 345 meters compared to a range of 779 in Malawi to 1,138 in Zambia. Lowland areas have lower potential yields for most grains, oilseeds, and temperate season vegetables. At the same time, they may drive higher yield potential for some tropical fruits but exploiting these

fruits even for the domestic market requires a much higher level of organization in production and marketing.

Second, Mozambique is far more vulnerable to flooding and other damage from cyclones, which destroys infrastructure in addition to crops and over time drives the cost of market access up and reduces incentives to use purchased inputs.

Third, historical and institutional factors contribute to Mozambique’s low yields. The country was among the very poorest in the world at independence, with much lower levels of education and civil service employment among the local population than its neighbors. The brutal 17-year civil war following independence decimated what existed of a rural trading network and made sustained development of developmental institutions exceptionally difficult. Since the ending of the civil war in 1992, Mozambique enjoyed over 20 years of political stability and sustained (if not highly equitable) economic growth, but since 2010 the political situation has worsened even as cyclones have inflicted more frequent and more severe damage in key production areas.

Fourth, the most productive mid- and high elevation areas of the country - western Nampula, Alta Zambézia, far western Manica, and much of Niassa - are far from large urban markets and in most cases have poor road connections to trunk roads that could provide access to those markets. In contrast, Malawi, Zambia, and Zimbabwe (less so Tanzania) have much more productive areas close to their main urban markets. Increasing distance to markets combined with poor road infrastructure dramatically reduces production incentives for farmers in Mozambique’s most productive zones to intensify their production for the market.

Finally, all these factors combine to make agricultural input use in Mozambique among the lowest in the world. As one example, Mozambique ranked 26th out of 33 African countries in 2016 in fertilizer use per hectare of arable land, with an average of 3.7 kg/ha vs an SSA average of 16 kg/ha. Use of other inputs is comparably low (see Annex F for data from the 2017 IAD).

The challenge is that this same agroecology, given Mozambique's geography, road infrastructure, and rudimentary organizational capacity within value chains, has resulted in quite low average yields for many crops important to the country (see Box 1). Reversing this pattern and taking advantage of its agroecological endowments to efficiently produce the wide range of crops that its agroecology allows requires targeted investments that we discuss later in this report.

Geography and natural ports: Mozambique's long coastline and major ports in the south (Maputo), center (Beira), and north (Nacala and Pemba) has historically made the country a major provider of overland and maritime transport. Historically and to this day, Malawi, Eswatini, South Africa, Zambia, and Zimbabwe have all relied on Mozambican ports for part of their exports and imports. Yet Mozambican ports have been plagued by poor management over time, and World Bank (2018) lists Beira and Nacala, along with East London in South Africa, as the least efficient among 110 global ports matched for size and scope. Coastal shipping has also remained extremely inefficient. As World Bank (2018) states, not every port will have the opportunity to become a regional hub, and they expect that Durban and Djibouti will take on those roles, not any of the Mozambican ports.

Rapid urban population growth feeding even more rapid growth of domestic food markets:

The relationship between urban population growth and growth in the size of the food market per rural resident is illustrated in Figure 5, which shows the ratio of the urban-to-rural population as a function of the share of the urban population in total. This relationship establishes a lower bound on the rate of growth of the food market per rural resident, since as urbanization proceeds, rural residents also begin to purchase more food and thus actual marketing possibilities grow even faster. The key point is that *the size of the urban population per rural resident increases exponentially as the urban population share rises*. For Mozambique, a rise in the urban population share from its current 33% to just 40% would increase the size of the urban market by more than 35% for an average rural resident (note small callout graph to see this more clearly).

The good news for Mozambique is twofold. First, because urban populations are growing rapidly, the size of the domestic market for an average farmer is growing even more rapidly. This is true even if most of those moving to or born in urban areas are poor, as they rely on markets to a much greater degree than do rural residents (though they, too, are increasingly relying on markets for food). Evidence also shows clearly that urban incomes are far higher than rural – by about 80% in Mozambique in 2010. Though scant, available evidence also suggests that urban incomes have risen more rapidly than rural in most areas of Africa; this is almost surely the case in Mozambique, given the structure of growth in the country (T'schirley et. al., 2020, table 3 and discussion).

Second, the growth in this urban food market is far more predictably accessible than it is for export markets. While export markets might grow steadily, quality and other requirements and changing policies in importing countries (witness India and pigeonpea) can make access to those markets very unstable. This rapid growth of, and predictable access to, the domestic food market makes it an obvious focus for investment seeking to improve rural welfare by enhancing access to reliable and profitable markets for farmers.

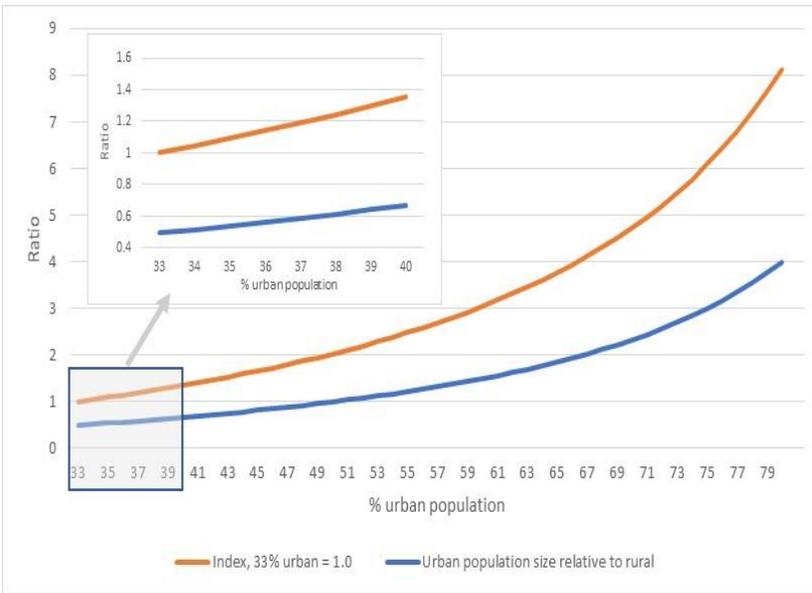


Figure 5. Minimum relative size of urban food market relative to rural population, by share of urban population in total population (Source: Author's calculations)

Looking at Nampula and Zambézia, the second-largest city in the country – Nampula City with an official population of over 660,000 in 2017 – lies in this zone. Both it and urban populations in general in Nampula province grew at least as rapidly as they did nationally between 2007 and 2017: Nampula City grew by 41% (3.3% annually) and total urban populations in the province grew by 50% (4.1% annually) during this time, compared to overall urban population growth of 41%. Urban populations of

Zambézia and its main city, Quelimane, grew slower, at 21% and 28% total growth, respectively, during the period.

This spatial pattern of urbanization emphasizes the importance of road links from the hinterland areas of northern Zambézia and all of Nampula to the Nacala corridor road, to take advantage of the robustly growing markets for all the food crops mentioned above. This includes maize, which can grow on the back of direct demand for human consumption and derived demand through animal feeds for the rapidly growing poultry, beef, and even aquaculture industries. Soya faces strong demand through animal feed and the possibility of growing human consumption demand if investments are made to promote such consumption as now occurs in Malawi. Yet in both cases, investments and policy must drive productivity in domestic value chains if the local product is to compete with imports. Also, feed markets for beef and aquaculture are currently very small, and their growth depends on continued income growth especially in urban areas.

Vegetables also see a rapidly growing urban market and, in Nampula and Zambézia, much less import competition than in the south of the country.

Table 1 and Figure 6 draw on Tschirley et. al. (2016) and Tschirley et. al. (2017) to assess growth prospects at national level in domestic demand for various food commodities over a five-year period. The original analysis was based on demand elasticities and size of consumption estimated from the 2009 *Inquérito aos Agregados Familiares (IAF)* (INE 2009), together with assumptions about per capita income growth and rates of urbanization. Because prospects for broad based economic growth in Mozambique are much less certain than they appeared five years ago, we focus instead on a qualitative assessment of the expected rate of growth in demand assuming continued urbanization and some growth in per capita incomes. We then add, in Figure 4, the projected contribution of that growth to total growth in demand for food. The latter depends on the proportion that the food

item occupies in total food expenditure at the start of the period: rapid growth starting from a small base, for example, gives the food item a moderate contribution to total growth, while moderate growth starting from a large base can result in a large contribution to total growth. By identifying foods based on their anticipated rate of demand growth together with the total size of that anticipated growth, we can distinguish between items that offer strong growth prospects for a relatively small number of households and items that offer smaller but strong growth opportunities for a larger number of households.

Table 5. Estimated domestic market growth prospects for key food commodities in Mozambique

Commodity group	Summary characterization of growth prospects	Favorable agroecology? Where?	Accessible for smallholders?	Scope for import substitution?
Dairy	Very rapid growth from a very small base: Very low current production. Pasteurization presents opportunities for agribusiness links with farmers. Very strong opportunities for a small number of farmers.	Only in higher altitude areas of Alta Zambézia and western Nampula	Only a very small number	Yes, but major investments needed (animal health, pasteurization, cold chain)
Beef	Rapid growth from a very small base; veterinary services must be competitive; large operations may compete with small producers but some currently source from them	Only if tsetse fly controlled	Only a very small number	Not clear. Transport costs and exchange rate critical to compete
Poultry and eggs	Rapid growth from a moderate base; large opportunities but a lot of competition from big producers and imports; small producers could be competitive close to urban areas.	Yes, much broader than dairy	Some, mostly near urban areas	Yes
Wheat and Rice	Rapid growth from a large base; water control an important issue for rice.	Wheat no; rice yes, in lowland areas with proper water control	Yes, for rice, but water mgmt. a major constraint	Yes, but has been persistently uncompetitive
Oilseeds	Strong growth from a small base; rapid import substitution could spur very strong growth	Yes, in mid- altitude and higher elevation areas	Yes, sunflower especially	Yes, but need to compete with imported crude oils
All other cereals (<i>mainly maize</i>)	Strong growth from a large base; forecast to account for nearly 40% of all demand growth; will be complemented by additional growth in demand for animal feed; strong opportunities for many producers in vast areas.	Yes, primarily in mid- altitude and higher elevation areas	Yes	Minor (few imports currently)
Fish (capture and aquaculture)	Strong growth from a moderate base; coastal production depends on road links; aquaculture could open opportunities in vast geographical areas, but requires investment	Yes. Fish breeding would greatly extend the potential geographic area	Only a very small number	Probably, but data limited
Fruit	Strong growth from a very small base; specific fruits may see very rapid growth; industrialization for juice production presents opportunities for agribusiness links with farmers	Yes, for tropical fruit, especially in lowland areas	Only a very small number	Yes, for fruit juice and fresh market in Maputo
Vegetables	Strong growth from a moderate base; production is risky and requires purchase of inputs; winter water control opens up seasonal possibilities in hot lowland areas	Yes, primarily in mid- altitude and higher elevation areas to avoid disease	Only top tier, but larger than dairy & fish	Yes, especially in south (but transport is a constraint)
Pulses	Strong growth from a moderate base; groundnuts, nuts, common beans, and pigeon peas have the best possibilities	Yes, very broad	Yes	No

Commodity group	Summary characterization of growth prospects	Favorable agroecology? Where?	Accessible for smallholders?	Scope for import substitution?
Roots and tubers	Slow growth for direct consumption; however, industrialization of cassava for beer and other industrial uses could create greater possibilities for growth.	Yes, very broad	Yes	Yes – fortified cassava flour to replace wheat in bread

Source: Drawn from Tschirley et. al. (2016) and Tschirley et. al. (2017).

The four key points mentioned in the 2017 report still stand. First, growth will be the most rapid for perishable goods of animal origin: dairy, poultry and eggs, other meat, and fish. A related point, not included in the 2017 report, is that this table does not include “derived demand”, which refers to demand for something as an input to another product. In this case, the key examples are demand for maize as an input to animal feed (which is itself an input for poultry, other meat, and fish) and for soya also as an input to animal feed. Though this kind of derived demand is relatively small now, it will grow rapidly as meat and dairy consumption rise.

Second, growth in demand for cereals - wheat, rice, and maize - will also be strong. In this respect, Mozambique distinguishes itself from other countries in East and Southern Africa, especially with the anticipated continued rapid growth in demand for maize. In most other countries, growth in demand for maize for human consumption is expected to be substantially lower.

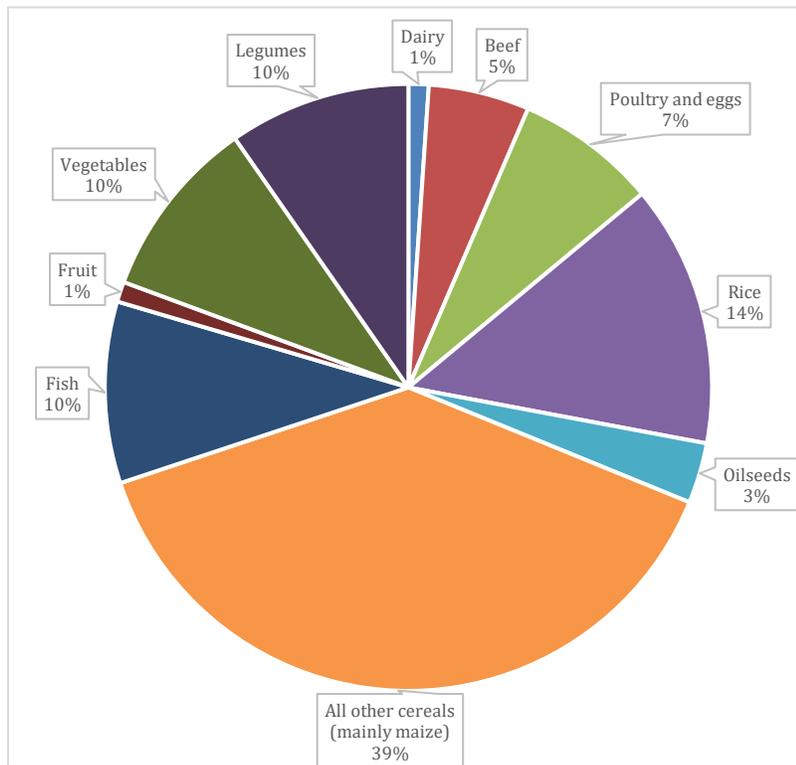


Figure 6. Projected contribution of various commodities to total growth in domestic demand for food over five years (adapted from Tschirley, et. al., 2016)

The third point is that the contribution of maize to total growth will be by far the largest of any other food item, at 36%. Note also that the demand for yellow maize - in contrast to traditional white maize - is growing rapidly for animal feed. Yellow maize is especially preferred for poultry production because its vitamin A content results in more yellowish egg yolks, which are attractive to consumers. This raises the possibility of contract production, since the side selling that typically plagues contract farming may be less with yellow maize than with white maize due to limited demand for yellow maize for human consumption.

If this is the case – if Mozambican consumers continue to strongly prefer white over yellow maize - then feed mills supporting yellow maize production with input credit will face less risk of producers selling it to other traders to avoid repaying their input credit. Maize production, whether white or yellow, thus looks to be a major growth opportunity for

farmers in Mozambique. Perishable animal products and oilseeds will be very attractive opportunities but for a small number of producers.

Fourth, given Mozambique's heavy reliance on imports, import substitution opportunities exist for most of the products considered in Table 1. This means that, if appropriate investment are made, production could grow faster than growth in local demand.

Investments in road infrastructure: Despite the problems with roads noted above, these two provinces have seen significant investments in road infrastructure over the past five years, which key informant interviews indicate have improved road- and market access for many poor farmers. This has led to some emerging commodity success stories (see below). Yet overall, it must be noted that Mozambique ranks very low even in Africa on all assessments of rural road adequacy; improvements are clear in some areas and response by farmers has often been robust, but much more needs to be done to improve the quality of road construction and maintenance in the face of intensifying cyclone pressure. See Annex E for information on current and recently completed road projects in the two provinces, and general information on the adequacy of rural roads in the country. Road investments in turn lead to investments in electricity, as well as education and health facilities, contributing further to rural growth.

C. USAID's challenge: Designing investments to promote rural structural transformation

USAID/Mozambique's challenge is to promote a structural rural transformation in its intervention area. Doing so requires doing two things simultaneously: increasing productivity in farming and facilitating progressively more engagement in nonfarm activity. As it does this, it needs to address the food insecurity that pervades all zones and types of rural households in Nampula and Zambézia.

The necessity of promoting profitable exit from farming is based on the argument – amply supported with empirical evidence across Africa (see Harris, et. al., 2019 for a multi-country perspective, Nuhu et. al. (2021) for very recent evidence on soya from Zambia, and Carter et. al. (2019) for evidence from Nicaragua) – that increased productivity in smallholder farming is necessary for rural economic growth and food security but is not sufficient to pull most of these households out of poverty: the majority of smallholder farmers will not be able to “farm themselves out of poverty” (Harris, et. al., 2019). Instead, many if not most of those escaping poverty in Africa and in Mozambique are doing so by entering the rural nonfarm economy or migrating to urban areas, even as many of these keep one foot firmly in farming. Fan and Rue (2020) and Hazell (2020) further develop the argument for why it is necessary to target technical assistance to smallholder farmers to help some “move up” in farming and others over time to “move out” of farming into increased nonfarm engagement. See Box 2 for the contribution that “moving in” might provide to Mozambique's agricultural sector.

USAID must promote this transformation while dealing with the constraints, and taking advantage of the opportunities, outlined above. Most fundamental among the constraints is the decline of export-oriented labor-intensive manufacturing, driven by automation and globalization. Because technological change is so rapid and increasing in pace, there is yet little agreement on the precise implications of these forces for development strategy.

Four areas of broad agreement do exist, however. First, these countries must invest aggressively in their “fundamental capabilities” - human and institutional capacity (including transparent policies and effective regulations) and the hard infrastructure of a modern economy including roads, electricity, and internet connectivity. Micro-grids and mini-grids, based on renewable solar or wind energy or hydropower, need to be a central part of at least the medium-term strategy to rapidly extend energy access for residential and productive uses to rural areas.

Second, government and private sector need to emphasize a pragmatic, development-oriented relationship between the two – neither adversarial nor *laissez-faire*, nor the clientelism, elite capture, and embedded corruption that continues to permeate so much governance in Africa (Van de Walle, 2001).

Box 2: What about “moving in”? The rise of medium-scale farms in Africa

Jayne and colleagues (Jayne, et al., 2019) document the rise of medium-scale farmers (farming between 5 and 100 ha of land) in several countries of SSA over the past 15 years. In Ghana, Tanzania, and Zambia – all relatively land-abundant countries similar to areas of Mozambique – they estimate that at least 45% of all increase in agricultural production between 2008/09 and 2014/15 came from medium-scale farms. During this same period, the share of all marketed farm production accounted for by medium-scale farmers rose from a range of 7%-23% to a range of 18%-42%. In the early phases of growth of this sector, when global agricultural commodity prices rose to historically high levels, they suggest that most medium-scale farmers had “moved-in”, using revenues from successful rural or urban businesses or from wage employment in rural and urban areas to move into commercial farming. The rise of the term “telephone farmers” in some countries further suggests the importance of urban-based entrepreneurs in the sector, buying or renting land and managing the agricultural production while maintaining their urban residence. Overall, they suggest that about half of these medium-scale farmers moved into farming from other occupations while another half “moved up” from smallholder farming. Note that this latter group is high as a proportion of medium-scale farmers but small in absolute number, representing at most 3-4% of all smallholder farmers.

Two characteristics of this phenomenon may be relevant for Mozambique. First, the rise of this sector occurred “under the radar”, with little or no overt support by government. Broad economic transformation, the global commodity boom of 2008/09, rapid rises in demand for food driven by urbanization and income growth, policy reform, and the associated rise of land markets (for sales and rental, including long-term lease) and markets for mechanization services were key contributors to the rise of these farmers.

Second, the presence of such farms tends to generate positive spillover effects for smallholder farmers. These effects come through greater investment by large-scale grain buyers that also help surplus-producing smallholder farmers (Burke, Jayne, and Sitko, 2019), better access to mechanization services, some provided by medium-scale farms but most by dedicated mechanization service providers (Van der Westhuisen et al., 2018), and better access to inputs as input companies target these farmers but then sell also to market-oriented smallholder farmers (Wineman, et al., 2018).

Negative factors in the rise of this sector include reduction in the stock of allocable traditional lands available to smallholder farming households and an associated rise in rural landlessness in some countries (Mueller and Chan, 2015). Jayne et al. (2019) also note that positive effects on local communities tend to be stronger in areas where the smaller end of the medium-scale segment (5-20 ha) predominates. These farms appear to have stronger historic and social ties to local communities than do larger farmers, who may have come more from outside the area.

We see two implications for Mozambique. First, steps to overtly encourage the growth of such a sector will be much less important than maintaining a policy environment friendly to private investment and ensuring adequate public investment in roads, energy and communications that are the backbone of a modern economy. Second, while these farmers could potentially be targeted as service providers in their own right, their biggest impact on market-oriented smallholder farmers may be through spillover effects as entrepreneurs in output, input, and mechanization markets invest to serve this sector and in so doing create better access also for smallholder farmers.

Third, growth in domestic demand for food provides a huge and relatively stable opportunity for growth in rural economies in these countries. This is because agriculture remains a major sector of their economies and because low incomes mean that a large portion of any rise in incomes is spent on food. Increasingly, this growth will include food manufacturing, as the processed food revolution is rapidly making itself felt in Africa (Reardon, et. al., 2021; Tschirley et. al., 2015a). Policies, programs, and public investments must be oriented to facilitating private sector investment in these kinds of activities, especially among small- and medium enterprise.

Fourth, these countries need to expand their “domestic” markets through much more efficient regional trade with economies at similar levels of development but with different comparative advantages. This would go against long-term trends of low and stagnant intra-African trade (Malabo Montpellier Panel, 2020; see same for policy priorities to spur such trade). By vastly expanding the size of the market and allowing economies of scale in manufacturing, such a policy could allow growth in manufacturing GDP and employment for some time, though employment levels will certainly not rise to those seen among earlier industrializers. Food manufacturing needs to be central to this strategy *but must be based on fostering competitive food processing*, not hindering trade in raw products. Without question, the country should avoid potential “white elephant” investments in highly demanding manufacturing processes. As the most recent World Bank jobs report for Mozambique says, “target food manufacturing not aircraft” (Lachler and Ricaldi, 2021). In the case of Mozambique, this means a commitment to the new African Continental Free Trade Agreement (AfCFTA) that goes well beyond the tepid support and routine violation of previous regional agreements that has characterized policy in so many African countries.

In Section 6, we bring together these four broad areas of agreement on requirements and opportunities for promoting transformation in low-income countries, and knowledge of what programmatic approaches tend to work for promoting farm productivity and access to nonfarm incomes while enhancing food security, to lay out options for USAID investment. The approach we lay out fits within the growing interest and emerging practice of combining social assistance with investments explicitly focused on productive activities, to take advantage of synergies between the two (Croppenstedt, Knowles, and Lowder, 2018).

IV. Mozambique’s rural areas: Very slow progress on the farm but some promising opportunities

We used 2012 and 2017 IAI rural household surveys to examine changes in livelihoods, farming practices, farming income, and food security in Nampula and Zambézia provinces over this five-year period. Results showed some progress on the farm, but from very low levels and too small to suggest the kind of transformation needed to rapidly and broadly pull rural households out of poverty. Here we summarize the main outcomes of this analysis - more details are available in Annex F. Tables 6-9 show values of selected variables in 2012, 2017, and the percent change between the two years.

We highlight five points. First, as shown in Table 6, area planted and total value of agricultural production per AE increased substantially and across all zones. The reasons for this very robust change are not yet clear.

Second, soybean production in Alta Zambézia increased sharply, with 12% of farmers producing it in 2017 compared to 1% in 2012 (Table 7). Yet the share of farmers growing three other important cash crops – sesame, pigeon pea, and cotton – dropped. Overall, we see no broad increase in the orientation of farmers to key cash crops.

Table 6. Land cultivated, % of farmers classified as medios, and gross farm income, by zone (2012, 2017, and % change)

HH characteristic (mean or %)	Zone 1 Lowland Zambézia	Zone 2E/Coast N.Zamb & Namp	Zone 3 Mid Elevation	Zone 4 Alta Zambézia & W.Namp	Total
2012					
Size measures					
Total cultivated area (ha)	0.80	1.44	1.55	1.58	1.40
Total cultivated area (ha) median	0.64	1.26	1.32	1.36	1.16
Total cultivated area per AE (ha/AE)	0.24	0.43	0.51	0.50	0.44
% of HHs that are "medios"	0.15	0.19	0.20	0.10	0.17
Agricultural production & incomes					
Gross farm income per AE (real contos)	3,692	4,042	5,093	4,524	4,442
Gross farm income per AE (r. contos) median	2,030	2,235	2,916	2,617	2,510
2017					
Size measures					
Total cultivated area (ha)	1.53	1.62	1.91	2.20	1.83
Total cultivated area (ha) median	1.07	1.40	1.47	1.69	1.46
Total cultivated area per AE (ha/AE)	0.47	0.51	0.61	0.75	0.59
% of HHs that are "medios"	0.28	0.44	0.39	0.23	0.36
Agricultural production & incomes					
Gross farm income per AE (real contos)	6,406	4,125	4,750	5,463	4,892
Gross farm income per AE (r. contos) median	2,714	2,783	2,479	2,900	2,668
% change, 2012 - 2017					
Size measures					
Total cultivated area (ha)	90%	12%	23%	39%	31%
Total cultivated area (ha) median	66%	11%	11%	24%	26%
Total cultivated area per AE (ha/AE)	95%	16%	21%	48%	33%
% of HHs that are "medios"	87%	133%	101%	122%	113%
Agricultural production & incomes					
Gross farm income per AE (real contos)	74%	2%	-7%	21%	10%
Gross farm income per AE (r. contos) median	34%	25%	-15%	11%	6%

Source: Authors' calculation from LAI2012 and 2017

Third, use of variable inputs and tractorization increased broadly but remains extremely low, as shown in Table 8. The only large changes were a large *decrease* in the share of households using pesticides (from 5.2% to 1.3%), driven by a decrease in cotton planting; and a meaningful increase in the percent using improved seed, from 4.5% to 8%. The small increases in tractorization were

despite large public investments in this input. The rise in improved seed use is at least partially due to the large increase in soy production and to seed system investments.

Fourth, nonfarm activities became more important over these five years: the share of adults not involved in farming rose in three out of the four zones and households in every zone strengthened their engagement with the nonfarm economy. This nonfarm engagement was primarily through own business activities, which increased by nearly 10 percentage points, from 26% to 35% (Table 9).

Finally, food security remains an important problem throughout the provinces and likely across every type of household, with 30% to 41% of households during 2017 experiencing hunger at some point during the past 12 months (Table 10). Note also that the pattern of food insecurity across zones changed between the two periods: while LSZ was the worst in 2017, in 2012 the mid-elevation zone was worst and LSZ was similar to western Nampula and Alta Zambézia.

Table 7. Percent of households growing selected cash crops, by zone (2012, 2017, % change)

HH characteristic (mean or %)	Zone 1 Lowland Zambézia	Zone 2 E/Coast N.Zamb & Namp	Zone 3 Mid Elevation	Zone 4 Alta Zambézia & W.Namp	Total
2012					
% of HH growing soya	0.0	0.0	0.1	1.9	0.4
% of HH growing sesame	10.7	9.6	10.1	4.3	8.9
% of HH growing pigeon pea	24.2	32.6	71.0	72.8	52.1
% of HH growing cotton	0.0	5.7	9.4	2.8	5.5
2017					
% of HH growing soya	0.0	0.0	0.0	12.4	2.7
% of HH growing sesame	4.3	5.8	5.7	2.2	4.8
% of HH growing pigeon pea	17.2	22.3	48.8	56.2	37.7
% of HH growing cotton	0.0	2.0	4.0	0.9	2.2
% change, 2012 - 2017					
% of HH growing soya	NA	NA	-79%	560%	582%
% of HH growing sesame	-60%	-39%	-44%	-49%	-46%
% of HH growing pigeon pea	-29%	-32%	-31%	-23%	-28%
% of HH growing cotton	NA	-65%	-57%	-70%	-60%

Source: Authors' calculation from LAI2012 and 2017

Table 8. Percent of rural households using variable inputs and tractorization, by zone (2012, 2017, and % change)

HH characteristic (mean or %)	Zone 1 Lowland Zambézia	Zone 2 E/Coast N.Zamb & Namp	Zone 3 Mid Elevation	Zone 4 Alta Zambézia & W.Namp	Total
2012					
Variable inputs					
HH used inorganic fertilizer (%)	0.00	0.08	1.20	2.22	0.86
HH used pesticide (%)	0.00	5.22	7.26	5.72	5.17
HH used improved seed variety (%)	4.21	2.60	2.69	11.43	4.53
Mechanization					
HH used machinery, land prep (%)	0.25	0.00	0.50	0.03	0.22
HH used own mach, land prep (%)	0.00	0.00	0.00	0.00	0.00
HH rent/borrow mach, land prep (%)	0.25	0.00	0.50	0.03	0.22
2017					
Variable inputs					
HH used inorganic fertilizer (%)	0.09	1.19	1.61	3.57	1.71
HH used pesticide (%)	0.33	1.60	1.03	1.84	1.31
HH used improved seed variety (%)	5.38	6.53	6.04	14.36	7.92
Mechanization					
HH used machinery, land prep (%)	3.51	1.16	0.35	1.48	1.24
HH used own mach, land prep (%)	0.00	0.00	0.00	0.00	0.00
HH rent/borrow mach, land prep (%)	3.51	1.16	0.35	1.48	1.24
% change, 2012 - 2017					
Variable inputs					
HH used inorganic fertilizer (%)	NA	1330%	34%	61%	99%
HH used pesticide (%)	NA	-69%	-86%	-68%	-75%
HH used improved seed variety (%)	28%	151%	125%	26%	75%
Mechanization					
HH used machinery, land prep (%)	1288%	NA	-30%	5634%	464%
HH used own mach, land prep (%)	NA	NA	NA	NA	NA
HH rent/borrow mach, land prep (%)	1288%	NA	-30%	5634%	464%

Source: Authors' calculation from LAI2012 and 2017

Table 9. Adult involvement in farm and nonfarm activities, by zone (2012, 2017, and % change)

HH characteristic (mean or %)	Zone 1 Lowland Zambézia	Zone 2 E/Coast N.Zamb & Namp	Zone 3 Mid Elevation	Zone 4 Alta Zambézia & W.Namp	Total
2012					
% of adults not involved in farming	11	4	5	2	5
% of adults with wage income	20	14	19	19	18
% of adults with business activity	32	25	26	22	26
2017					
% of adults not involved in farming	9	9	9	6	8
% of adults with wage income	22	16	21	16	19
% of adults with business activity	38	31	33	40	35
% change, 2012 - 2017					
% of adults not involved in farming	-24%	109%	89%	181%	59%
% of adults with wage income	11%	12%	15%	-16%	5%
% of adults with business activity	19%	23%	26%	82%	32%

Source: Authors' calculation from LAI2012 and 2017

Table 10. Percent of households experiencing hunger over the past 12 months, by zone (2012, 2017, and % change)

HH characteristic (mean or %)	Zone 1 Lowland Zambézia	Zone 2 E/Coast N.Zamb & Namp	Zone 3 Mid Elevation	Zone 4 Alta Zambézia & W.Namp	Total
2012					
Experienced hunger past 12 mths (%)	43	37	48	43	43
2017					
Experienced hunger past 12 mths (%)	46	30	31	35	33
% change, 2012 - 2017					
Experienced hunger past 12 mths (%)	6%	-19%	-35%	-20%	-23%

Source: Authors' calculation from LAI2012 and 2017

V. Emerging success stories not evident in the IAI data

The results we just reviewed from the IAI surveys suggest some, but very small, positive change in Mozambique's rural economy through 2017. By our own judgement, these changes do not approach the depth and speed of change that is needed to drive transformation that rapidly reduces poverty. Yet fieldwork by MSU in 2017 and by Elim since that time, and interviews with knowledgeable stakeholders as part of this study, all suggest that real and potentially sustainable change has been happening and that, with good policy and well-designed programmatic support, it could soon begin to make a much broader positive impact among rural households. Here we review

two broad areas of positive change: emerging dynamism in input markets, and emerging commodity success stories.

Emerging dynamism in input markets: We saw in 2017 through key informant interviews and see now in new interviews and in the 2017 IAI, hints of emerging dynamism in the inputs sector based in part on donor investments. Investment by USAID, the EU, and FAO in start-up seed companies such as Oruwera and Ndzara Yapera, and the entrance of established regional firms such as Klein Karoo and Phoenix, have improved access for many farmers to quality seed of improved varieties.

The EU and FAO have also made sustained investment in input voucher programs channeled through agrodealers, as a strategy to build private sector capacity. In doing this, they have helped coordinate supply and demand by linking new input and seed companies with agrodealers, and agrodealers with farmers. Farmer field schools have been a key mechanism to increase farmer understanding of input use and of how the voucher system works, and to then link farmers to those agrodealers through, for example, input fairs.

These efforts have shown some positive effect (Tschirley et. al., 2017) and have continued to the present time. De Vletter (2019) documents the expansion of the agrodealer network and argues based on his own interviews that most agrodealers believe their business would be sustainable even in the absence of the voucher program. Carter, Lajaaj, and Yang (2021) show lasting impacts of the program on farmer adoption of improved seeds and fertilizer, which we see as a strong argument for its continuation and strengthening.

Concern about donor dependence of the seed company start-ups is reasonable, and their sustainability and that of the agrodealer network cannot be taken for granted. Ill-conceived policy and programmatic approaches by government, as in some aspects of the SUSTENTA program, could undermine the progress that has been made. But at the same time, most observers on the ground indicate that there has been real progress over the past five years, that an organic growth process has become apparent, and that, with proper policy and continued investment under programs informed by evidence, further important progress can be made. The key imperative is that government programs to promote input access contribute to the further development of this system rather than bypassing and thus undermining it.

Emerging commodity successes: Mozambique has had difficulty maintaining commodity booms but has nevertheless seen the emergence and persistence, despite periodic busts, of several important cash crops. Chief among these – and potentially the most sustainable – is soya. This is the most recent commodity boom and should provide a solid basis for continued growth based on steady growth in domestic demand from the poultry sector, the beginnings of demand growth for beef, and, potentially, a growing human consumption market. Aquaculture should also present strong growth prospects, though from a very low base, and the sector currently imports all or most of its feed from Zimbabwe and South Africa.

2012-2017 saw a huge increase in the share of households growing this crop in Alta Zambézia, from 1.9% to 12.4%. However, productivity needs to be increased on the farm and in the post-farm marketing and processing system, to compete with imported soy meal; currently poultry feed producers in the south import all their soya cake from South Africa and aquaculture firms import all

or most of their feed from Zimbabwe and South Africa. Improvements in the processing of soy could take advantage of oil and other products to generate income and lower the domestic cost per unit of feed.

As noted above, maize also provides a very solid basis for sustained growth in demand. This growth will come from direct human consumption by rapidly growing urban populations and increasingly market-dependent rural populations, for beer production, and for animal feed. Note that all these products require post-farm processing, fueling growth in agribusiness employment.

Cassava is a main source of calories in human consumption in the north. Across our four zones, 58% to 89% farmers grew it in 2017 and an average of 56% reported that it was their main food staple (IAI data). As documented in Donovan et al. (2011), in northern Mozambique, most households consume cassava flour in a porridge, with home processing common. However, in the past decade, cassava has begun to be processed in mobile processing units and is now used successfully in commercial beer making, for example in Impala Cassava beer brewed in Nampula by Cervejas de Mocambique. These mobile processing units enable larger scale processing and open the door to more industrialization of cassava for other uses, including starch, animal feeds, and flours. Researchers and bakers in Mozambique and elsewhere have assessed the potential to substitute fortified high quality cassava flour (HQCF) for a portion of the imported wheat in bread and other baked goods (Aristizabal, Garcia, and Ospina, 2017). As has been found in Nigeria and Ghana, HQCF can reduce imports, but to achieve this, there must be reliable supply, competitive price, consumer acceptance, access to processing machinery, and policy incentives. Similarly for animal feeds, the CAVA study for Ghana (Kleih et al. 2013) suggests how to partially substitute cassava for maize in rations for broilers and livestock. Starch has an international market, but the need for high volume processing and exports makes it less likely to succeed in the near term. Starting in the local market and expanding that production while improving quality would be the best way to eventually reach the larger and potentially more lucrative – but very competitive – global market.

Vegetable production for the market grew rapidly in western Nampula since the improvement in the Nacala corridor road over five years ago. Farmers around Ribaue and as far west as Malema began supplying Nampula city and Pemba. Road investments connecting areas of Alta Zambézia to the Nacala Corridor road (Annex E) should greatly expand the production areas that have access to this market. Urban population in Namialo in Nampula has grown very rapidly (as has Ribaue) over the past decade and will also provide growing demand for this production. The conflict in Cabo Delgado, however, will increase the cost and risk of supplying Pemba and the oilfields.

Export crops are often more difficult due to quality and other requirements, and they are also potentially more unstable, but do provide opportunities. Sesame production grew tremendously through 2015, dropped in 2017 as a result of both floods and droughts, but continues to present great export potential if varietal, pest, and disease problems can be dealt with. Among pests, *Podagrica puncticollis*³, also known as the flea beetle, poses a risk to productivity, often driving losses of at least 70%. Farmers have to sow the crop twice in the season especially in regions that are cotton producing, which is another host crop for the pest. The use of agrochemicals has risen

^{3 3} Agegnehu E. et al. (2019) <http://dx.doi.org/10.4314/ujas.v19i1.3>

among more market- oriented farmers. These farmers also tend to purchase improved white sesame seed, which has higher yields, and to spray pesticides in the 5 days after seedlings emerge as a way of avoiding the devastating loss caused by the flea beetle.

The most prominent diseases of sesame are angular leaf spot and fusarium blight. There are treatments available for these diseases, but many farmers are unaware or don't have access to the pesticides needed. The low yields of sesame in Mozambique also relate to lack of crop rotation with soils quickly losing fertility. Jasse (2013) has a good summary of sesame production issues for Mozambique.

Pigeon pea saw explosive growth through 2016 before India temporarily closed its market, leading to much unharvested production in 2017. The proportion of farmers growing the crop declined from nearly 50% in 2012 to 35% in 2017, but it remains an important cash crop for hundreds of thousands of households and the recent negotiation of a relatively assured quota for the India market may provide a solid basis for continued growth. Opportunities to supply regional markets could be an alternative to traders unable to reach the quota-system for the Indian market.

Mozambique remains one of the potentially top producers of cashew in the world but needs policy change regarding the role of INCAJU (now Instituto de Amendoas) in the sector: the institute needs to move out of direct provision of seedlings and spraying services and instead support the continued growth of the nascent private sector operating in each of these areas. Unfortunately, there has been little if any progress in this direction over recent years. Macadamia nuts are emerging as a new crop, but the ability of smallholder farmers to enter and profitably remain in this sector remains to be seen. We note that one outgrower project in Niassa now being rolled-out, and should be followed for lessons.

VI. Programmatic approach

In this section we first summarize key lessons from the review of programs and projects in Mozambique and the region. Following this, we lay out the essential logic behind the approach suggested in this report, as preparation for the more detailed treatment of investment options in section VI. Finally, we return to the zones and farmer types that we have developed and discuss how this information, complemented with additional information especially on the local status of road access, can be used to target appropriate assistance to farmers based on their own characteristics and behavior and the situation in which they find themselves.

A. Insights from program reviews in Mozambique and the region

Annex G contains a list of Mozambique project and Annex H provides more detail on many of them. Here we summarize 10 key lessons. First, several points emerged regarding developing sustainable seed systems. One is that this requires policy reforms and often re-evaluation of the roles of private and public sector to go along with assistance to emerging companies and rural input retailing networks. Demand for quality seeds, especially costly certified seeds, is diminished by widespread certified seed falsification, and inspection systems do not currently have the capacity to address this threat to seed system sustainability. This is a key issue to address through governance programs that promote collective action by stakeholders. Another is that key crops for food

security, including many pulses, are open pollinated and present lower profit margins and uncertain markets for the private sector, suggesting that continued public sector engagement is important. Finally, treating seed production as a business – and ensuring that legal and regulatory structures permit and promote this - has proven to be important for new seed producers.

A second set of points revolves around support to SMEs. Projects supporting SMEs in agricultural production and agro-processing through technical assistance combined with financing were generally rated favorably. However a key point is that training was not considered sufficient by itself. Successful projects provided technical training (seed production, use of inputs, crop management in conservation agriculture) while linking farmers to finance and to market opportunities (OFSP, FTF INOVA, InovAgro, etc.). A second point is that those that focused on creating farmer associations or groups had difficulties and needed sustained effort over program cycles. Sustainability of efforts based on farmer associations is questionable, though incorporating private sector know-how may be helpful (lessons from Tanzania IFAD AMSDP project). Associations formed based on a valuable value chain, such as soy, tend to last longer. Finally, support to SMEs in input provision can be undermined by large public programs that may tend both to increase subsidy levels and to bypass emerging decentralized input retailer networks (agrodealers) in their desire to quickly distribute seeds and other inputs. Persistent policy engagement is required to anticipate and head-off such heavy-handed government approaches. Overall, investments need to strengthen market systems and ensure enterprise resilience.

A third set of points relates to soil fertility and sustainable land management programs. Donors have invested to some extent in this, for example in the Farm Income Diversification Programme in Malawi. Linking these training and other activities that promote adoption of healthy soil practices to market opportunities is essential if they are to be fully successful. This includes mechanization programs with conservation agriculture technologies, using implements such as rippers instead of standard plows. Production diversity contributes to a range of outcomes, although the link to consumption diversity is not strong, so these programs will need to link to whole-household nutritional education along with agricultural training to impact both soil and human health.

Our fourth set of points relates to large publicly supported programs. Programs such as the Farm Input Subsidy Program (FISP) in Zambia and SUSTENTA in Mozambique are shown to have potential negative consequences for long-term sustainability related to the size of the subsidy they offer and the way in which they deliver the subsidized products. Some subsidy, if delivered through private sector channels to help feed its development, can be highly beneficial through direct learning effects (farmers learn about an input they haven't used before) and spillover effects as neighbors observe (Carter et. al., 2019). Yet in Zambia, the level of resources devoted to FISP crowded out resources for research and other investments, and in the early years of the program, delivery mechanisms undermined the private sector. SUSTENTA in Mozambique has been heavily criticized by many practitioners for undermining emergent market systems both with its heavy subsidies and because it does not work through the emerging but still fragile network of rural agrodealers.

Fifth, several points can be made about the many programs in the region that are targeting Small Commercial Farmers (SCF) or Small Emerging Commercial farmers (SECF)⁴ to be the conduit for inputs, training, and mechanization services of other smaller and less commercialized smallholder farmers in their area. These include NAFAKA in Tanzania, SUSTENTA in Mozambique, and other programs under TechnoServe leadership in Mozambique. One concern with this approach is that the SECF may prioritize tending to their own production before anyone else's production. If the SECF is also a buyer of the produced commodity, then they may have more incentives to provide timely services to the farmers they support and buy from. Training SECF farmers who have been provided with mechanization equipment on how to develop business services is part of the challenge.

In Mozambique, this approach is constrained by small numbers of SECF and, as a result, over-targeting of the same producers by multiple programs. Identifying lead farmers or future entrepreneurs will continue to be a challenge. SUSTENTA and others have developed a special program for young people, to train them and then enable special financing options for them to set up agro-dealerships, poultry production, or as Village Based Agricultural Advisors or Business Development Advisors. The combination of training and funding is generally needed to sustain interest.

Sixth, we took several points regarding financial innovations. These can be valuable, as formal financial institutions have shown very little interest in agriculture. Innovative financing strategies have been found such as input company credit with SECFs to help finance SHFs, use of e-vouchers and MMS, and adding insurance products to financing for seeds and other inputs. Inovagro works with Village Savings and Loans Associations (VSLAs) connected to mobile wallets and agrodealers as agent bankers. Having clear "up and out" criteria with e-vouchers to make sure they are temporary, and limiting the size of the subsidy, are important to avoid destroying organic demand and creating dependence on donations. Experience indicates that training on financial literacy and mobile banking are important to overcome women's constraints to accumulating financial capital

Seventh, the agroprocessing sector has been a focus of development programs in all three countries of the region. A fundamental point here is that processing requires regular and sufficient provision of raw material, so linkage to production must be a key part of such programs. Projects including NAFAKA in Tanzania, COMACO in Zambia and AGRIFUTURO in Mozambique also demonstrate the need for training linked to resource access and development of market linkages as key components of success. Building skills in a market-based approach with an entrepreneurial spirit in marketing can lead to success over time, based on project leadership with an exit strategy to avoid dependency.

Eighth, nutrition-smart agriculture ties in well with sustainable agriculture. Many of the priority crops identified by the World Bank (2020b) for Nutrition Smart Agriculture for Mozambique are

⁴ While the exact definitions may vary between SCF and SECF, we will use SECF here to represent these farmers considered to have the potential to grow into larger scale farmers, working with their neighbors and with market input and output systems.

pulses, including pigeon peas and common beans. These same crops are also fundamental in enhancing soil fertility and adapting to climate change under sustainable agriculture.

A ninth key lesson is that training programs, while critically important for developing business management skills, technical skills in such as areas as mechanization as a business, maintenance of machinery, and agroprocessing technologies, are insufficient to spur MSME growth. Such programs are more effective when combined with financial resources, mentors, and business/marketing internships. Rural economic growth in food-related non-farm enterprises can be a major source of employment and income growth.

Finally, we see that development projects benefit from attention to two issues: 1) length of time; and 2) geographic area. Longer term projects, or projects that build on the work of existing and previous projects, are more likely to achieve sustainable changes, as with PROMER in Mozambique and the food security policy research projects (FSRP) in Zambia and Mozambique. Building capacity for sustainable change takes time, whether it is done among farmers to improve yields and engage in markets, among MSMEs in food processing or other sectors, among ministry personnel to collect, organize, and maintain good data, or research analysts to inform policy decisions. Geographically, projects that spread human and financial resources across too wide an area are less likely to be successful, as with the Agricultural Marketing Systems Development Programme (AMSDP) in Tanzania.

B. Theory of change: Program design for rural transformation

This paper has stressed the centrality of the rural structural transformation to poverty reduction in Mozambique and noted that this requires simultaneous improvement of productivity at the farm level for those households who can adopt the needed technology, and assistance to households to move or strengthen their existing engagement beyond farming in remunerative nonfarm activities.

Our household typology was built around this idea and shows the extent to which this transformation has been happening (though only through 2012, due to lack of data since that time). Specifically, the typology showed lots of heterogeneity across rural households – these households are definitely not all subsistence farmers. It also shows that variability across households is driven largely by nonfarm incomes: farm income and agronomic practices vary much less, even among households heavily focused on farming and selling a large portion of their production. This highlights the fact that farming *per se* has seen very little transformation, according to the IAI data.

But at the same time we have noted the widespread perception of real progress – even if still very fragile - in development of a private sector rural input distribution system. We have also noted strong response by farmers in some areas to market opportunities (e.g., vegetables in western Nampula and soya in Alta Zambêzia) and the related emergence of commodity success stories, especially in value chains oriented toward domestic demand. This progress on private input systems and emerging commodity success stories for domestic consumption can be built on by USAID as it rolls out investments to raise farm productivity and simultaneously facilitate greater engagement by many households in nonfarm activities. In doing so, USAID needs to remain cognizant of another key finding in our analysis – that food insecurity is pervasive across zones and farmer types and will not be quickly resolved by increased productivity in farming.

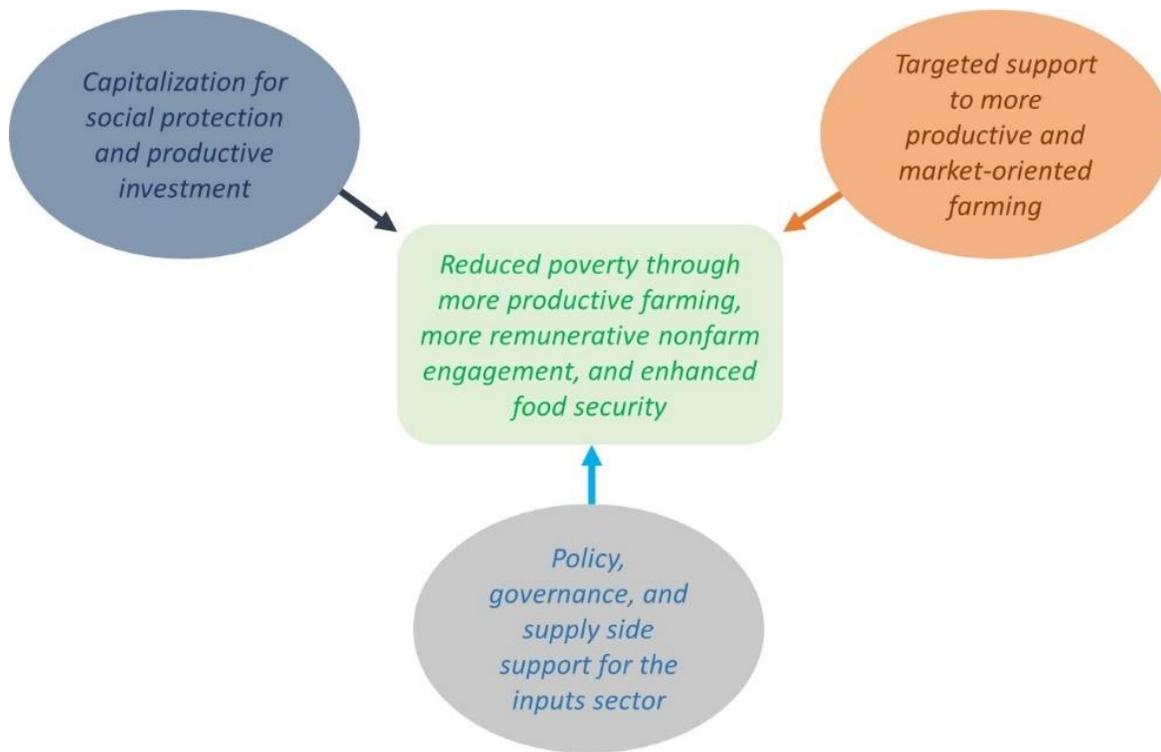


Figure 7. Theory of change for USAID investments in rural Zambézia and Nampula

Figure 7 shows a broad view of the proposed approach and the theory of change it is built on. Our contentions are: (1) support to farming that is targeted geographically and by household and informed by output market possibilities will efficiently improve productivity among those households able to engage strongly with markets; (2) savings mobilization and cash transfers across all households (combined with business development services for those who want them; see below) will foster entry or expansion by some households into nonfarm activities and for others (with some likely overlap) will allow increased farm investment; and (3) improved policy and governance in the inputs sector, together with supply side support that builds on past investments that have generated emerging successes, will foster increased supply of more affordable and better quality inputs that facilitates more productive farming among those households who choose to invest in the farm.

This approach falls within the emerging tendency to purposefully combine social assistance with agricultural programs, based in part on evidence that the former nearly always has productive impacts by enabling recipients “to manage risks, build assets, and undertake activities that are more remunerative” (Croppenstedt, Knowles, and Lowder, 2018). The proposed approach here has, however, an important twist: it explicitly conceives the social protection portion as part of the productive investment and uses it to ease entry into nonfarm activities among those households who choose to do so. The literature encapsulated by Croppenstedt and colleagues is conceived as “social protection and agriculture”, with little attention to nonfarm activities. The approach outlined here is based on the contention that such attention is crucial in light both of the requirements for economic transformation and the reality in Mozambique (and generally across African countries) that rural

nonfarm engagement plays a large and necessary role increasing incomes and allowing escape from poverty.

Figure 8 delves further into the logic and evidence for combining these approaches, for the program's inclusion of nonfarm objectives, and for the emphasis on access to capital for this purpose. Dark blue bubbles show logic and evidence related to capitalization of households; orange bubbles relate to logic and evidence regarding the need for actions in support of farm productivity to consider how farmer characteristics and geographic location drive what is sustainable in this regard; and green bubbles show actions that need to be taken to implement the approach. We discuss each of these in turn.

Household capitalization: We laid out earlier the conceptual and empirical basis for asserting that productive farming is necessary but not sufficient to pull the majority of smallholder farmers and rural residents out of poverty (C1, top left of the figure): the empirical regularity of the structural transformation in currently high- and middle-income countries; micro empirical evidence in Harris et. al. (2019) Nuhu et. al. (2021) and Carter et. al. (2021); and synthesis of these ideas by Fan and Rue (2020) and Hazell (2020). The evidence behind this proposition is overwhelming.

The weak evidence base on what is effective in promotion of RNFE, and concerns about the cost-effectiveness of such interventions (C2 in the figure), was reviewed by Haggblade, Hazell, and Reardon (2007). Despite the popularity of such programs, little is known about their effectiveness (Cravo & Piza, 2016). As Danida (2009, p. 5) states, “recommendations are often based on speculation about what would work rather than on evidence of what works”, noting also that the few evaluations that are done some years after the end of a project “seem to show very different [less positive] results” (brackets added). We note this also in our synthesis of lessons from local and regional programs. Haggblade and colleagues also notes that it is hardest for these programmes to reach those who most need it, meaning that benefits are typically concentrated among the top-tier of poor people (not the poorest) or those already above the poverty line (Haggblade, Hazell, and Reardon, 2007).

The fact that capital is a constraining factor in enabling rural households to get into remunerative nonfarm enterprises (C3) is a direct outcome of poverty, the very weak state of financial systems, and the general wariness of lending in rural areas. Households need to generate their own capital to get into such businesses and this is hard to do.

The rapidly evolving evidence base on conditional and unconditional cash transfers suggests that they may have lower costs of implementation and spur asset accumulation and increased income (Robertson, et. al., 2013; Haushofer et. al., 2016 and 2018; Handa et. al., 2018a and 2018b; Baird et. al., 2019; Blattman et. al., 2020; Bahru et. al., 2020; see also <https://www.givedirectly.org/research-on-cash-transfers/> for a summary of evidence, and <https://www.givedirectly.org/cash-research-explorer/> for a searchable database of research on cash transfers). Note that, in responding to the economic fallout from COVID-19, World Bank (2020a) recommends assistance to “family businesses” through social assistance such as cash transfers rather than through business development programs.

Combine approaches to spur capitalization with ...

... targeted and differentiated support to farming

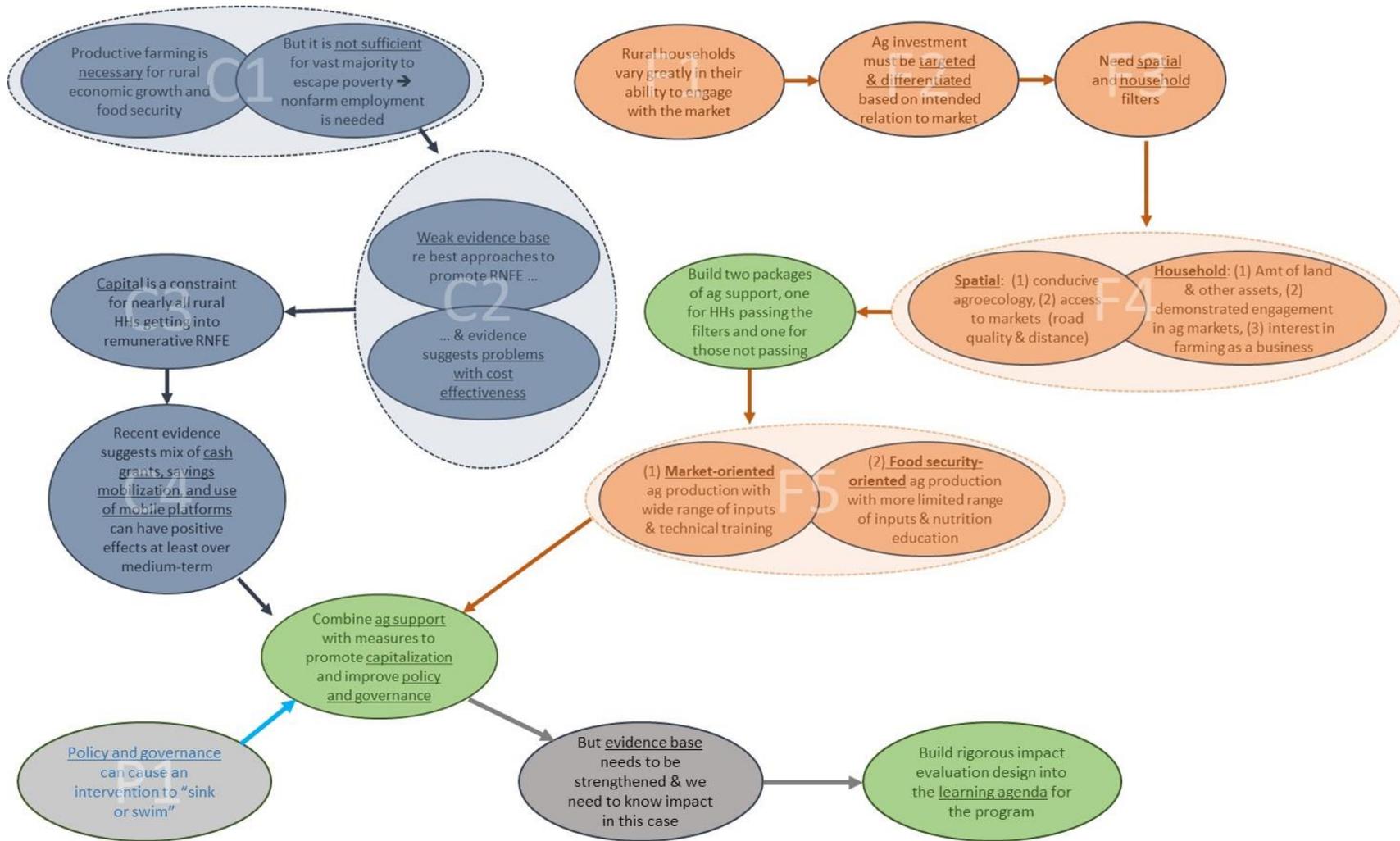


Figure 8. Structure and logic of proposed approach to spur rural structural transformation

Experimentation in this area, with rigorous studies built into programmatic design, has exploded in recent years and is increasingly gaining the attention of policy makers in developed and developing countries. The evidence of long-term impacts is mixed, but evidence is strong that cash transfers (including unconditional transfers) are seldom spent on discretionary expenditures such as alcohol and that impacts on incomes and assets are generally strong in the short- and medium-terms.

Support to farming: Our reasoning regarding support to farming starts with the widely demonstrated fact – including in this report – of meaningful heterogeneity across farmers in Africa and the obvious fact that some geographical areas are better connected to markets than other areas (F1, right side of figure). It follows that, to ensure an economic and social return on donor or government investment at the farm level, that investment must be targeted and differentiated based on a combination of household and spatial factors (F2 and F3). At household level (F4), these could relate to assets including land, history of engagement in markets, and demonstrated interest in farming as a business. At geographic level, the two important factors are agroecology (for choice of crop) and the cost of market access. At its simplest, one would build two different packages of support to farming based on how farmers score on this combination of factors, one for households judged to have strong prospects for engaging profitably in markets and being able to grow their production, and another for those judged unlikely to be able to do so and who instead need assistance primarily to ensure food security (F5).

Combining approaches and building the evidence base: As these two elements are combined – household capitalization that includes cash transfers and savings mobilization together with differentiated and targeted support to farming – two other things must be done. First, because policy always matters and governance is crucial to performance especially in the inputs sector (P1, bottom-left of the figure), this aspect has to be addressed to improve sustainability of the investments over time. Second, because this kind of combination is relatively rare, the program has an opportunity to make important contributions to knowledge about effective programming approaches if a learning agenda is built into it from the beginning. Ideally, this learning agenda will include re-visits 2-3 years after project completion to examine evidence of sustained impact.

C. Targeting of support to farming

Program design requires targeting. Typically, this involves two broad steps: selecting a geographic space in which to carry out the program; and selecting the households or firms to work with. Here we lay out a framework for these steps, drawing on the zones and farmer typology we developed but interpreting them in the practical context of a project leader needing to make better targeting decisions.

Spatial dimension: Because the four zones are so similar in their farming practices and outcomes, the key issue here is variation *within* them. As we said in section III.E, these zones differ primarily in two regards: agroecology and thus the crops that USAID might support and, in Lowland Southern Zambézia compared to the other three zones, better access to improved roads and higher engagement in the nonfarm economy. The other three zones differ very little in these two aspects and all four zones are remarkably similar in their agricultural practices and the incomes they generate from farming. Food security is also prevalent across all zones and household types. All of this is a natural outcome of the fact that agriculture in this area of Mozambique remains highly traditional with little use of external inputs, except in particular areas and for particular crops.

Identifying areas within zones that have better or worse market access is the main task at this stage of targeting. We expect that areas of better market access will have more of farmer types 5 and 6, and perhaps farmer type 4, than areas with worse access, but this would have to be empirically confirmed.

Physical market access is a function of three things. The first is distance to the nearest market of reasonable size. This could be an urban area or, for particular crops, a large assembly point or a processing plant. Distance to input dealers should also be considered. The second is the quality of roads linking to those markets. Third is the typical distance a farmer needs to travel, and by what means, to get to an all-weather road. The best way to summarize this information is in measures of the time and financial cost of getting to these markets, done separately for the dry and wet seasons. Simple questionnaires and rapid appraisal techniques with selected farmers and key informants can be used to collect such information and, within an intervention area, define areas of greater and lesser market access.

The time dimension is also important: designers should consider road projects that are underway that will improve access, and the area's vulnerability to storm damage which, as we have said, is a major issue in large portions of Nampula and Zambézia.

Targeting farmers: Our rural household typology helps clarify understanding about diversity in Mozambique's rural areas and thus highlights the need for targeting at this level. However, the typology itself is not likely to be replicated by a project implementor, nor is household level (as opposed to community level) targeting always feasible. We therefore summarize here the broad implications of the typology and suggest how this understanding might be used in targeting on the ground:

- About one-quarter of households can be considered subsistence or near subsistence farmers in that they sell none or very little of their farm production and earn little or no income from nonfarm activities. These Type 1 and 2 farmers crop the least area (a little over 1 ha in total, and less than half a hectare per capita), hire labor at the lowest rates (only about 5% do so), earn the lowest total (farm + nonfarm) incomes, but earn farm incomes that are slightly *higher* than some other groups;
- Slightly more than 10% are heavily engaged in agricultural markets. Of these, about three-quarters (7-8% overall) focus almost exclusively on farming. These Type 4 farmers (commercialized) crop the most area (about 2 ha total and 0.7 ha per capita), are among the most likely to hire labor, earn average total incomes only slight above subsistence farmers, and earn the highest farm incomes, though not much higher than subsistence households;
- The other quarter of farmers strongly engaged in agricultural markets— about 3% overall — are also heavily engaged off the farm. These Type 6 households (diversified) crop a little less land than those in type 4 but more than other groups, are the most likely to hire labor, earn the highest total incomes (at least triple those of types 1 and 3), but earn among the *lowest* farm incomes, not meaningfully different from the farm incomes of subsistence farmers;
- About 30% of farmers sell little farm output but earn substantial income off the farm. These Type 5 households (nonfarm oriented) crop small areas of land - roughly the same amount

as subsistence farmers – but hire a lot of labor to work the land, earn the second-highest total incomes (about double Types 1 and 2), but earn the *lowest* farm incomes;

- Finally, about 30% earn little off the farm and also don't sell much of their farm production (5-50% in our definition, but an average of only 22%). These Type 3 farmers (semi-commercialized) crop similar areas to Type 4, are less likely to hire labor than types 3, 4, and 5; and look very much like Type 3 in total incomes and farm incomes.

From a programming standpoint, the question to ask is: which of these farmers are in a position, in terms of the assets they have and their farm-oriented motivation, to “move up” in farming, and which will be unable to do this, either because they lack resources or prefer to devote them to nonfarm activities, and should instead be assisted to “move out”? In other words, in which households does it make sense to invest scarce program resources to try to *sustainably* increase their productivity in farming?

We suggest that about 15-20% of households fall in this “move up” category, including most household in Type 4 and Type 6 (a bit over 10% in total), those Type 5 who want to put more effort into farming (probably few of them), and some of Type 3 that have more land and are motivated to excel in farming. The other 80-85% need two things: assistance to produce enough staple food for their own food security, and a way to progressively “move out” of farming into nonfarm activities that could give them a higher return and a hope of getting out of poverty.

We emphasize that “moving out” will take place over a long period of time and that nearly all households during a regular project cycle, even if they are able to gain wage employment or enter into a remunerative nonfarm activity or expand one they were already running, will choose to keep one foot firmly in farming. We see this already in the data, where even type 5 and 6 households show a majority of adults with farming as their primary economic activity.

In designing a program, we suggest that USAID and its partners do the followings:

- Assume that not more than 20% of households, and probably less, will sustainably benefit from efforts to help them treat farming as a business, meaning adopting input packages that imply some risk and strongly focusing on market sales. This percentage could be higher in more market-connected areas and lower in more remote areas;
- Develop simple field and programmatic procedures to identify who these households might be. This could include baseline surveys if funds are available, necessarily combined with screening procedures for individual farmers to qualify for particular forms of assistance; and
- Deploy a differentiated approach that provides those farmers with the tools they need to make it in farming, while providing the rest with the means to protect their food security through more productive own production and potentially improve their engagement off the farm. The next section outlines the particular investment options that could be considered under such a program.

VII. Investment Options

A. Broad categories

We discuss here the three broad categories of investments outlined in the theory of change (Figure 7). Together, they emphasize the need to achieve broader and more rapid increases in farming productivity while at the same time (a) doing so in a differentiated way across households depending on their capacities and interest in farming, (b) actively providing avenues for households to increase their engagement with the nonfarm economy, and (c) addressing pervasive food insecurity.

The broad categories are (1) support to policy, governance, and the supply side of seed and other input markets; (2) direct support to rural households under a Farm Production Program that is targeted and differentiated as explained below (and initially explained above in the discussion of Figure 8); and (3) direct support to rural households under a Household Capitalization Program for social protection and productive investment based on cash grants and savings mechanisms. We also review possibilities for a program of support to nascent agricultural processing sectors that would complement the Farm Production Program and the nonfarm orientation of the Household Capitalization Program.

The Farm Production Program is organized under two components with very different objectives. The Food Security Component works with households with few assets and little or no agricultural market engagement (or little interest in commercial agriculture) to improve their production of food security crops through better seed but without relying on multiple expensive cash inputs. The Market-Oriented Component focuses on households with more farming assets and with a history of market engagement and a desire for more, that could be enhanced by access to a wider range of more productive cash inputs and practices that can substantially raise productivity. Seeds and technical advice under this component could include food security crops but would also include – unlike the Food Security Component – seed for cash crops such as soya, sesame, pigeon pea, sunflower, and vegetables (depending on agroecology and access to market outlets) and maize hybrids.

Based on cash transfers and savings mobilization, we expect the Household Capitalization Program to play a dual role of addressing the pervasive food insecurity we identified and providing capital that households can invest either in further agricultural intensification or in nonfarm engagement. We anticipate that many, perhaps most, will use the funds to enhance their nonfarm engagement. As part of the productive orientation of this program, Business Development Services would be available for those households wanting them.

B. Governance and the supply side of seed and other input markets

Background: Donor investments and government and stakeholder commitment has generated some progress in governance structures for agricultural inputs over the past several years, especially with APROSE in the seed sector. MOSTA (Associação Moçambicana de Empresas de Comércio de Sementes) is a seed sector advocacy group formed in 2013. It has been relatively inactive but there is

interest among seed traders in APROSE in reviving it. AMOFERT appears to have been less active in the fertilizer sector but does play some role connecting public and private sector stakeholders.

The most serious threat to the seed and broader input system now involves the approach that SUSTENTA is using in seed and other input distribution, which largely bypasses most commercial houses and local agrodealer networks, to concentrate seed and other inputs into a limited number of commercial houses for supplying the SUSTENTA network of commercial farmers (for onward distribution to smallholder outgrowers). As SUSTENTA is quite large and the seed market and agrodealer network is still small, many observers are concerned that this approach will undermine six- to seven years of work building up this private sector system.

The sector faces at least four other governance-related challenges. First, seed falsification is rampant and an open secret among institutional buyers of seed, chief among them relief agencies. This falsification is a direct result of greater demand (due primarily to institutional demand) for certified seed than the system is able to produce (including limited supply of basic seed), combined with weak regulatory capacity. Stakeholders need to organize to get control of this problem, as it can undermine the emergence of a robust certified seed market.

Second, current seed policy and regulations do not guarantee protection of intellectual property. As a result, international and regional commercial seed companies and others may refuse to allow the importation of their seeds into Mozambique. We discuss below how this might be dealt.

Third, Mozambique's seed law and its 2013 Fertilizer Regulation have not been harmonized with regional policy frameworks for these inputs. Given the importance of trade and the presence in Mozambique of foreign companies in both these sectors, this policy harmonization deserves some priority in governance efforts.

Fourth, though seed legislation in 2013 legalized the production and marketing of Quality Declared Seed (Semente Garantida Melhorada – SGM – in Portuguese) and allowed private seed inspectors, regulations need greater clarity and implementation of both measures needs to be improved. Without this, local seed production of SGM and private inspection of its quality will not be able to become well-regulated but profitable enterprises in rural Mozambique.

Seed sector governance: USAID should consider continuing to support APROSE with a focus on⁵:

- Working with government and SUSTENTA to ensure that SUSTENTA activities do not undermine the continued growth of local seed companies and agrodealers. Issues to be addressed are the size of the subsidy in SUSTENTA distributions and the use of the network of agrodealers for channeling seed to farmers. More detailed assessments need to be made of exactly how SUSTENTA is operating in order to identify the problematic and positive aspects of its activities and properly orient any APROSE agenda;

⁵ We have sought to identify areas of new or current need that are not being addressed or where additional resources could be helpful. More work will have to be done, however, to ensure that there is not duplication between these activities and other current or new activities.

- Conducting a general assessment of seed policy and identifying where legislation needs to be changed and where emphasis should be on better implementation within existing legislative structures and regulations;
- Developing a financial sustainability plan for APROSE drawing on sector stakeholders;
- Working also with USEBA (Unidade de Sementes Básicas) and the National Seed Authority (ANS) of MADER to define workable controls and incentives for public and private seed inspectors to ensure the quality of their work while not undermining the profitability of the business;
- Encourage Mozambican entry into the International Union for the Protection of New Varieties of Plants (UPOV). This is important to improve the private sector's access to new seeds and varieties, as it provides the property rights on varieties that are increasingly required by the private sector and even with the public sector.

Broader input sector governance and services: Soil health is a key issue that fertilizer practices can either improve or worsen, depending on formulations used, how they are chosen, and related practices around fertilizer use and soil fertility. Though fertilizer use by smallholder farmers is very low at present, it will only grow over time, and increasing numbers of medium- and large-scale farms certainly are using the input. Key concerns revolve around the lack of soil testing capacity and uncertain quality of imported and locally blended fertilizers. Also, as fertilizer use grows, Mozambique needs to be sure that it encourages the broader approach that is finally emerging in Africa that recognizes fertilizer as only one part of a balanced approach to improving soil fertility. The Abuja II “fertilizer” summit will be reflecting this thinking, taking a soil health approach not based simply on promoting fertilizer. Programming in Mozambique around this issue needs to reflect this.

De Vletter (2019) reports the emergence of new technologies including portable, low-cost soil testing for farm fields and industrial sector “ribbon blenders” that cost approximately \$50,000 for a full set-up. Together, these two technologies could revolutionize fertilizer use by allowing the tailoring of fertilizer blends to a farmer’s particular soil. Whether this technology can be adapted to help smallholder farmers remains to be seen. Also, even without the ribbon blending, tailoring fertilizers to farmers’ soils can be improved. Achieving precise site-specific fertilizer recommendations with access to those blends would require a regulatory framework that encourages uptake of the technology by commercial farmers and entrepreneurs, who could potentially serve as service providers for groups of farmers involved, for example, in farmer learning groups such as Farmer Field Schools (see below for discussion of FFS). Emerging commercial producers of vegetables could be a good place to start, given their intensive use of inputs in general including fertilizers. In the meantime, greater use of diagnostic tools such as leaf-color diagnostics and simple soil testing kits will make a difference for farmers assessing which and how much fertilizer to purchase.

USAID should consider the following either in collaboration with or through direct support to AMOFERT:

- Review the status of existing soil labs in Maputo (IIAM), Mocuba (Instituto Agrario de Mocuba), and Nampula (under PROSAVANA), estimate the cost of rehabilitation and

operation, identify a specific, feasible plan of action for each, and decide whether the investment and ongoing costs justify the potential payoff. Currently, lack of ability to do soil testing results in one-size-fits all fertilizer recommendations that dramatically reduce the productivity of this input;

- Assess the economics of ribbon blending and portable soil testing, including models of service provision that might give at least the most advanced smallholder farmers access to this technology;
- Review systems for monitoring the quality of imported fertilizer, and of the fertilizers that are now being blended in Mozambique, and work with AMOFERT to propose and implement a better control system.

Credit: Formal credit is exceedingly scarce in the agricultural sectors of developing countries across the globe. For large-scale and emerging farmers, however, this input can be crucial to responding to opportunities. While we rate this a lower priority at the present time, USAID could consider the following:

- Assess innovations in collateralization, including mobile collateral registries. Tanzania is currently considering such legislation and Mozambique could learn from that experience;
- Support systems for issuing use permits for land (DUAT), especially in Nampula where the cadastral system is not yet fully digitized;
- Assess existing loan guarantee programs with banks to understand reasons for lack of uptake and how that might be modified to facilitate formal sector credit to agriculture; and
- Support analysis of mobile banking options, ensuring that privacy concerns, safety of funds, and other aspects within those systems are adequately addressed.

Direct supply side initiatives: In addition to improving the operating environment for seed and other input companies, donors and government over the past decade have promoted the emergence of new seed companies, have simultaneously worked to build-up a network of agrodealers who can retail inputs to farmers, and have fostered coordination between these (and other more established) companies and this network, and of the network with farmers. Though the payoff to these efforts was not evident in survey data by 2017 (in the form of large increases in input use, though use did appear to have risen broadly though modestly), the widespread view is that real progress has been made and could lead to much more substantial change in coming years.

Yet gains remain fragile. USAID should therefore continue to support this system while working to ensure increasing self-reliance by new companies and agrodealers over time. Key issues to be addressed with direct supply side activities are the availability of basic seed (on which both certified and SGM depend), and the need to continue strengthening the system for certified and SGM production, marketing, and inspection. USAID should consider:

- Working with MADER (IIAM, USEBA, ANS) and CG centers (e.g. IITA) to ensure that sufficient pre-basic and basic seed is produced to feed both the SGM and certified seed systems. USAID should consider partial privatization of pre-basic and basic seed production, but this should be in the study phase only at this point. A key issue is the need

to maintain public provision of pulse seed and OPVs of other less demanded crops, since the private sector is likely to under-provide these types of seed.

- Support to associations that meet capacity criteria and demonstrate an active interest in developing community seed producers for food security crops and limited cash crops producing certified seeds, or SGM seeds where costs of full certification cannot be covered;
- Ensuring that the seed production educational modules for "Seeds as a business" (IITA, 2018) are available in formal institutes of learning (such as technical schools) in Nampula and Zambézia, based on past experiences, with financial planning and business plans;
- Support to Business Development Services (BDS) entrepreneurs with a special grant/loan program to increase availability of BDS for sustainable business development in rural areas
- Focusing on programs with seeds sold at market rates (with any subsidy coming through an e-voucher- see below), rather than supporting any programs with free seed distributions, especially with public sector funds, with the possible exception of seeds for demonstration plots. This would include avoiding large public sector and donor seed purchases from the private sector that take seeds off the market and crowd out agrodealers from seed supply.
- Ensuring seed access for participating farmers always through agrodealers (including using e-vouchers redeemed with agrodealers – see below) and actively promoting coordination between agrodealers, seed companies, and farmers through seed and other input fairs and other mechanisms.

C. Direct support to rural households

Our proposed approach to directly supporting rural households is based on the need to spur household capitalization that also addresses food insecurity, and to combine this with targeted and differentiated support to farming. We outline the key elements of each program here, building off the logic and evidence presented in Figure 8.

Program design: Farm Production Program: The Farm Production Program has two components: a Market Oriented Component and a Food Security Component. We suggest that each be built around (1) primary use of e-vouchers tied into the network of agrodealers to promote technology uptake, and (2) Farmer Field Schools or other learning fora, taking advantage of any existing farmer groups, for learning on technical farm production and food security/nutrition.

The two components differ in their farmer focus, objectives, and locations. The Market Oriented Component works with farming households with good prospects for adopting the technology and practices needed to meaningfully increase productivity and become increasingly commercialized. As we state above, we expect this group to be not more than 15-20% of farmers: most of types 4 and 6 (only 10% of all farmer per IAI2012), a few of type 5, and the better off and more motivated among type 3. Type 1 and 2 farmers and the rest of types 3, 4, 5, and 6 would participate in the Food Security Component.

The Food Security component works with households with too few assets or too little orientation towards farming to make farming a business. We anticipate this will be 80-85% of farmers in any area: most if not all Type 1, the less well-off or less farm-oriented in type 2, and probably most of type 5, who may have the resources but not the orientation to treat farming as a business.

Geographically, the Market Oriented Component should be limited to areas with road access that allows profitable access to markets. Measures of cash- and time cost of reaching markets in the dry- and wet seasons should be developed to guide this decision. The Food Security Component could be implemented in these areas (for farmers not qualifying for the market component) and in areas less well connected to markets.

The seeds, other inputs, and technical advice included in each component would also differ. Seeds in the Market Oriented Component will emphasize certified seeds (including hybrids for maize), with SGM probably limited to pulses. Crops would include food security crops (recall that nearly all household types suffer from food insecurity) and cash crops with strong marketing potential in the area the program is being implemented. Other inputs would include fertilizer and, potentially, herbicides. Consideration should be given to including mechanization services where these are available and a provider is willing to accept a voucher. The program would need to work with potential providers to make this possible.

Piloting the participation of private industry with FFS and other farmer learning groups to test whether highly specific fertilizers will be profitable for both fertilizer companies and farmers would be valuable, either in the voucher or through other means with partial and temporary subsidies.

Farmer extension for this component would include training for food security and nutrition but will also emphasize higher productivity through topics such as buying the right fertilizer for your type of soil, pest management with chemical and IPM control, planting in rows, soil conservation and soil restoration measures, and farming as a business. Many radio programs have been developed during the COVID pandemic due to restrictions on in-person meetings. These should continue to have investments and be used even after the pandemic, especially but not solely for women. Video-mediated extension approaches have been found to have positive effects on knowledge and technology uptake and should be integrated into the approach (Abate, 2019; Nakasone and Torero, 2018; Van Campenhout et. al., 2018). These approaches may be especially effective with women and youth.

Input promotion in the Food Security Component would be limited to seed and, where practicable, mechanization services (many Type 5 farmers may be interested in this, as they have relatively high incomes and may want to save the time – not necessarily expand area, given their nonfarm focus - through mechanization). Seed will be quality seed (SGM, certified OPV) of improved varieties at accessible prices. E-vouchers should also be used here. FFS in this component will emphasize food security and nutrition messages and not farming as a business. Crop choice within this component will thus be more limited (for example, soya, sesame, and sunflower would not be included).

Program Design: Household Capitalization Program: Nonfarm engagement is key to escaping poverty in rural Africa, but poor households face many hurdles to entering remunerative nonfarm employment. Chief among these is start-up capital: even the starting stock of the tiniest of micro-entrepreneurs engaging in petty trade of food items may be beyond what some can generate. A second hurdle is technical knowledge, especially in basic areas such as keeping accounts.

Capitalization can be spurred through a combination of cash grants (with or without conditions), savings mobilization through Village Savings and Loans Associations (VSLAs) or Accumulating Savings and Credit Associations (ASCAs), and use of mobile money services and mobile banking to

get around the lack of formal banking institutions in rural areas. Having a safe, easily accessible, low-cost way to save small amounts at a time is one of the goals, so that households can accumulate capital over time to use as they think best – on new or more farm technology, start-up capital for a micro-enterprise, or other needs. Lessons from INOVAGRO’S Fundo Agricola could be useful in the design of these VSLAs and ASCAs.

Having a mix of approaches is especially important to ensure inclusivity of women and youth. Evidence from Kenya (GSMA Connected Women, 2015) suggests that women prefer savings groups over VSLAs and mobile money. For the latter, women tend to engage in more, smaller transactions and so are put off by transactions fees and are less likely to use MMS. FinScope (2019) confirms women’s lesser use of MMS in Mozambique and emphasizes that “consumers generally use a combination of financial products and services to meet their needs.” Youth, on the other hand, may prefer mobile-based approaches, though transactions fees may also be a problem for them. FinScope (2019) confirms that youth under 35 are nearly 50% more likely to use mobile money than those older than 35, at 32% compared to 23%.

We suggest minimal targeting of the cash grants, for three reasons: (1) poverty and food insecurity are pervasive, so even many better-off households could see major changes in their circumstances from such grants, (2) targeting on something like this is expensive and highly imperfect, and (3) most slightly better-off households who may be most able to enter remunerative nonfarm employment are likely still to be capital constrained in doing so.

We also suggest minimal conditionality on the grants, since enforcing conditionality is costly and knowing the proper conditionality to impose is not straightforward. Instead, we suggest that USAID build a rigorous learning agenda regarding the most innovative aspect of this program, which is the pairing of social protection with farm production assistance to simultaneously promote food security, on-farm productivity growth, and increased nonfarm engagement within one program and with many of the same farmers. This is a major opportunity to learn not just what works but what farmers choose when they are provided with livelihood options. Rigorous learning would require some randomization of access to the household capitalization program. Details would have to be worked out at a later date. The best design would involve a 3-4 year timeline so that one can look at medium-term outcomes, not just short-term.

D. Support to agricultural processing

The post-farm portion of Africa’s agrifood system – in particular processed foods and the transport, logistics, processing, packaging, and distribution they entail – is growing rapidly and absorbing large amounts of labor (Tschirley, et.al., 2015a; Tschirley et. al., 2015b; Dolislager et. al., 2020; Reardon et. al., 2021). This portion of the economy especially provides opportunities for women, as shown by Tschirley, Kondo, and Snyder (2016) and Dolislager, et. al. (2020). Food processing is thus likely to be an attractive area for support, both for domestic consumption and the regional markets that we emphasized earlier were important to expand markets, develop economies of scale, and learn.

Successful agroprocessing requires five things. The first is a reliable market for outputs. We identified what look like promising markets for domestic consumption in Table 1, and to that add soya and potentially sunflower for their derived demand as part of animal feed.

The second requirement is sufficient regular production of adequate quality of agricultural commodities that can make it to the factory door, whether through delivery or pick-up by the processor. This is a challenge in a country like Mozambique with low farming productivity and precarious road infrastructure.

The third requirement is technical and managerial capacity to run and maintain equipment, manage people, coordinate supply of raw material, and identify and exploit sales opportunities. This is the essence of entrepreneurialism.

The fourth requirement is an enabling environment featuring enough communications and transport infrastructure to keep logistical costs manageable and a policy and regulatory framework that minimizes uncertainty and undue bureaucratic procedure that imposes high costs of doing business. Here Mozambique is also quite challenged in light of the governance record we reviewed in section 2. The World Bank's "Doing Business" report (World Bank, 2019a) notes that starting a new business in Nampula takes more than twice as long as starting one in Maputo City (40 days compared to 17 days, respectively). Taxation issues are a policy aspect, related to duty free or reduced duty imports for competing products, and taxation on needed inputs to processing.

The oilseeds industry faces key challenges regarding imported crude oils competing with domestic oils, and whether reasonable protection of limited duration can be effective in jump-starting an efficient local industry. It is unclear if the new Instituto de Algodao e Oleaginosas will be evaluating these policy issues. Lessons might be learned from Tanzania, which has seen tremendous growth in local processing of sunflower for oil in the last decade.

A fifth requirement is the ability to mobilize capital, ideally through credit at reasonable cost. Commercial banks in Mozambique have limited interest in taking risks in agriculturally related businesses and so have relied on donor and government guarantees and grants, as well as high interest rates, yet they still commit few funds. Non-bank financial institutions are the most likely agents to fund SMEs in agroprocessing, including GAPI, Banco Oportunidade (now MyBucks) and AMODER as they are more familiar with rural conditions and agriculture. They are familiar with credit and collateral systems more adapted to the smaller scale and limited resources available.

One of the key lessons of the past is that financing should be tied to training on agribusiness and the relevant processing industry to ensure investments are made in viable businesses. Training on business plans, cash flow and stock management, food safety, legal requirements for labor and taxation, marketing, and more are necessary for entrepreneurs to survive. Are the technical schools linked sufficiently to agribusinesses to train workers for them and prepare a new generation?

One of the clear gaps for agroprocessing is the weak infrastructure throughout most of Nampula and Zambézia. Road, port, and rail investments have made a dent in high time and costs of transport for agricultural goods. Access to all-weather roads is still limited and continued investments in construction and maintenance are needed. Cyclones and flooding will continue to undermine access, so construction specifications and maintenance must address those threats. With the major consumption market in Maputo, transportation cost reductions for commodities using the ports will be valuable, especially for competing with South African and World imports. Lack of storage facilities and port handling facilities are costly for Mozambique. Support to the transport sector with analysis and geospatial tools to identify key bottlenecks could reduce costs.

Agroprocessors need not just roads, but electricity, water and communications. Efforts at creating minigrids using solar, hydro, wind, or biomass offer excellent opportunities with capacity greater than the household-level solar investments, responding to processing needs. Fundo de Energia (FUNAE) and Electricidade de Mocambique (EDM) are working with a World Bank program and sponsoring pilots on minigrids in Nampula based on solar. Wind depends on sustainable high winds and so must be sited carefully, but is an option to the solar and hydro. The electrical facilities can be modular and scalable, designed to meet needs including access to water and to communications. Additional direct investments will be needed in clean water systems to ensure food safety and for many processing activities. Communications advances offer some excellent new ways to connect processors to technology, to markets for inputs, markets for output and coordinating the value chain to get the products to the markets. As was seen earlier, linking financial institutions to mobile financial options can facilitate development outside the main cities.

All of the infrastructure investments make it more likely for agroprocessors to attract skilled workers. Even the small and medium enterprises can provide employment and training for growth. The youth will be more attracted to SMEs in zones with these electrical, transport, and communications facilities.

There are other aspects related to technology acquisition, including machinery and packaging for value added products. Poor quality local packaging and high cost imported packaging is a major limitation for the local processing industry (GAIN 2020). USAID has released a competition on innovations in packaging, and following up with the winning candidates will be valuable, as all agroprocessing enterprises need less expensive, environmentally friendly, and locally produced solutions for dry and wet products. Bags, pouches, jars and more are in demand. Otherwise, the import cost of attractive and environmentally sound packaging from South Africa, China and elsewhere needs to be reduced.

On food safety, aflatoxin is a key issue and should be addressed carefully so as to avoid scaring the public about an invisible menace. Engaging food processors with nutrition and higher quality food, with systems to avoid aflatoxin and other factors affecting food safety, would enable expansion of markets for locally produced peanut butters, jams, juices, honey and other commodities. In general, human behavior change for nutrition is an area for development, as shown by the experience with OFSP in Mozambique.

We have identified several value chains that have potential for agroprocessing growth and employment generation in Zambézia and Nampula. These include soybeans, cassava, sunflowers, sesame, pigeon peas, groundnuts, moringa, and tree nuts (macadamia). Agroprocessing is more economically feasible for multi-functional crops such as sunflower, soybean, maize and cassava, which can be used to produce multiple products and thus are less reliant on any single market. For example, maize has a huge market for direct consumption as maize meal, as well as a small but rapidly growing market for animal feed; cassava is consumed directly and can be an input to beer or used to produce starch among other products; soybeans and sunflower can be processed for meal as an input to animal feed, oil for human consumption, and (mostly for soybeans) other products for human consumption. Investments to increase their production and improve quality would enhance the capacity of the local industry to meet its raw material demand and serve human consumption demand at the household level. This is especially so for soybean and sunflower.

Soybean: This is a relatively new crop to Mozambique and as mentioned earlier, has a key role in poultry feeds in northern and central Mozambique. With strong demand growth from a stable domestic base, soybean presents excellent processing opportunities. Oilseeds in Mozambique are primarily used (80% or more) to supply the animal feed industry. However, using soybean solely for animal feed loses a lot of value. Soybean can be used for human consumption (soy milk, soy yogurt, soy flour, soy bean oil) with animal feed demand still satisfied by the soy cake. Alif Quimica in Quelimane already uses its processing facility to generate edible soy oil and soy cake for animal feed. Imported soy products for human consumption, such as Tasty Soy chunks, are now found in urban and rural markets, indicating potential local demand that could be exploited, and there are SMEs with soy processing developing in Manica and Nossara Cooperativa in Alta Zambézia, with TNS assistance. In the case of Nossara, project assistance enabled the cooperative to access electricity, install a flour mill, and expand oven capacity. For soy milk, with electricity, stoves are needed to prepare the milk efficiently, rather than the time-consuming preparation over a fire.

Options to consider for soybean are: 1) Include soy in the input package and extension (FFS) portion of the market oriented component of the Farm Production Program in Alta Zambézia and potentially other areas, ensuring extension and support through agrodealers; 2) Work with industry to identify options for soy processing using existing facilities that integrate animal feed and human food needs, and support SME processors with grants to expand capacity and acquire equipment, packaging and R&D; 3) Co-financing of the training needed for local firms to use the investments profitably and sustainably, including packaging and marketing of soy products, safe food handling, and operation and maintenance of flour mills; 4) Develop a communication strategy to promote soy milk and other soy products for human consumption, including home processing options, as part of nutrition communications.

Cassava: This is an especially multifunctional crop with many potential uses. It is well known by Mozambican farmers and would benefit from innovations to be used more often in animal feed (both leaves and pulp), as well as for processed consumer goods. It is constrained by the need to process or eat fresh cassava within 48 hours of harvest and it has issues with cytotoxins and aflatoxins that need to be addressed. In northern Mozambique, CDM contracted with DADTCO for mobile processing units to ensure cassava cake supplies to the brewery (Costa and Delgado 2019). IFAD's ProSUL program also worked with DADTCO to establish mobile processing units in the south. Various NGOs have also worked on small scale washing and peeling machines as well as chippers and solar dryers that can be used at household or MSME level for dried cassava chips which can be milled into flour.

Cassava may also have potential as a biofuel for the domestic market and possible starch production, mainly for export. Both would require larger scale investments.

Cassava flour markets appear as the greatest opportunity, for use in breads, biscuits and other baked goods. Scaling Up Nutrition Business Network (SUN-BN) is interested in this. Maize flour fortification systems for large, medium and small-scale mills are available and can be adapted for cassava flour. Dadtco has developed new mobile units with cassava starch flour as the output, as needed by bakeries (Monitor Deloitte and FSDMozambique. 2016). Cassava flour substitution for a portion of the imported wheat in bread and other baked goods is an option, although wheat is

imported with only 2.5% tariff and no VAT taxes to keep the price of bread low for consumers. This policy may need to be re-visited if import substitution is desired.

Options to consider for cassava are: 1) Examine the costs, benefits, and recipes for use of fortified cassava flour in breadmaking; 2) Examine policy support for imported wheat with an eye for cassava flour substitution; 3) Work with millers to adapt processes for fortification to include fortified cassava processing in flour, as would be needed with bakeries; 4) Support the acquisition by industry of mobile processing units for cassava cake production for beer industry and newer mobile processing capacity for cassava starch flour for bakery use to scale through training and import policy review; 5) Support production, development (technical side), and acquisition (funding resources) of small-scale peelers, chippers and solar dryers and other implements to lower labor in SME processing.

Sesame: Increased production and greater adoption of productive varieties of white seed could be used in developing consumer products for local and export markets. Sesame seed can be processed into roasted seed for the bakery industry. The key to exploiting this market is to increase production volumes of high quality white sesame and ensure good cleaning of the product. ACDI/VOCA and Galli (2019) point to the possibility of sesame seeds for confectionary uses. It would be valuable to examine the work in Ethiopia and elsewhere of SNV on the development of sesame production and markets.

Sesame oil can also be produced, though it is important to distinguish between edible oil and cosmetic oil, since production of edible oil requires more infrastructure and higher investments. Competing in edible oil markets will be difficult for Mozambique due to the low production quantities and the lack of quality seeds for varieties with high oil content. Cosmetic oil can be produced at small scale and then expanded into medium or larger, as production quantities grow. It could initially target the nascent local cosmetic industry.

All analyses of sesame in Mozambique point to the lack of price differentiation in the markets and thus the lack of incentives for farmers to grow quality sesame (white/cream colored, high oil content), in addition to the lack of quality seeds in the markets. Traders have experienced problems with side-selling when working to develop quality markets, so there may be a role for the new Institute in setting up standards, advertising them and encouraging market segmentation for sesame. If value chains can be organized sufficiently to pay a price premium for quality production, then outgrowing arrangements for this high quality production may be possible to maintain .

Options for sesame include: 1) Support enhanced seed system capacity for high quality seeds of white sesame varieties (eg. Lindi) which are in demand but available in only limited quantities; 2) Provide BDS to medium-scale firms to develop business plans, and provide co-financing or credit guarantees for the acquisition of processing units that cost \$40,000 to \$45,000; (3) Support linkages to producer associations and large aggregators to ensure volumes and quality of product received; and (4) work with policy research to conduct a study to assess local and regional demand for sesame products.

Sunflower: Sunflowers have been produced in Mozambique through the years and several new focal production points are arising, including among soybeans farmers in Gurué. There are about 10,000 small emerging and medium-size farmers that supply Alif Química with sunflower which is

processed into edible oil and exported as Non-GMO sunflower oil to Switzerland. In the case of Tanzania, additional growth in sunflower edible oil production was accomplished with UNIDO helping to identify the technology for SME production and the facilitation of processing parks with Dodoma Sunflower Oil cluster to lower per unit costs (UNIDO 2021). The government of Tanzania also put four fiscal measures in place to assist investment, including large-scale industrial investment, in the sector: (1) a moderate (and in principle temporary) tariff on imported oil (primarily palm oil), (2) efforts to ensure that refined palm oil was not presented as raw oil in attempts to evade import duties on the refined product, (3) a VAT exemption on agricultural processing equipment that includes equipment for solvent extraction used in medium- and large-scale sunflower oil processing, and (4) a VAT exemption on sunflower seed cake, which is a by-product of oil production and can be used in animal feed manufacturing⁶. See United Republic of Tanzania, 2016, for further detail on the sector.

A broad and balanced approach like this may enable greater production of edible sunflower oil for Mozambique's domestic market. Increasing production is critical and the sunflower producers in Gurue and elsewhere have had the support of ex-TNS staff members and have equipment and experience acquired from previous TNS and AGRA programs. They could be critical to increasing sunflower production and similar models could be used in Angonia and Manica. The two largest edible oil processing industries in southern Mozambique have expressed interest in purchasing more local product to replace oil-cake imports, and SUSTENTA is supporting some sunflower investment to feed the industry.

Options to be considered for sunflower include: 1) Increase production of sunflower by including sunflower seed in farmer voucher programs in the same areas where soybeans are included, though this will require coordination with agrodealers to ensure availability and with aggregators to ensure markets; 2) Identify and train on the equipment, packaging, and handling needs for SMEs in processing edible oils; 3) Facilitate a value chain study on edible oils for Mozambique and for export to the region and internationally, including the relevant policy, and (4) promote sunflower outgrower programs as a crop rotation with pulses and long-term fruits trees.

Pigeon peas: While the export market for pigeon peas to India has had difficulties, there are local processing units in Gurué and Nacala that are underutilized. These units can be used to supply the local market and to export to countries with no quota system, such as Zimbabwe, UK and US, all based on existing trade agreements.

Options to be considered for pigeon pea include: 1) Continued investments in varietal development and seed systems are needed; 2) Consumer studies on domestic demand would be valuable to motivate private investments. Pigeon pea has numerous uses in animal feed. Leaves and pods can make palatable and protein-rich fodder. Leaves are sometimes used to replace alfalfa in ruminant diets in areas where alfalfa cannot be grown. Seed processing by-products, and sometimes the whole seeds, are used as livestock feed (Phatak et al., 1993). The seeds can be fed to poultry, and mixtures of pigeon pea with maize grain were successfully used in Hawaii (Orwa et al., 2009). Plant breeders have created varieties adapted to drier conditions, more resistant to diseases and suited to different

⁶ See <https://dalberg.com/our-ideas/tanzanias-sunflower-sector-is-paving-the-way-for-future-industrialization-and-sustainable-growth/> for more detail.

production systems and cropping cycles (Valenzuela, 2011). Varieties available have increased since the 1990s, allowing selection of cultivars with higher forage yields and crude protein content, in addition to higher agronomic yields (Phatak et al., 1993).

Moringa: Moringa and other tree crops have potential for growth within the processing sector. There are new investments in moringa plantations in Nampula and Zambézia, with smallholders as outgrowers. The leaves are used in the production of teas, capsules and transformed into cosmetic creams and gels for regional and other export markets. The farms have been certified GAP and for organic production. With proper investments and value chain coordination, this could provide good opportunities for a small number of market-oriented smallholder farmers. **Option:** 1) Trade policy efforts are needed to enter the EU/AGOA and Chinese markets; 2) Possible training or internships related to success with processing and marketing of niche commodities such as with COMACO in Zambia may be valuable. An example of this relates to the integrated of honey production with moringa production. Slowly in southern Mozambique bee pollination services are emerging among the commercial fruit farms to increase productivity. As a result, scented honey, a specialty product, is rising for a niche market.

Groundnuts: Over 50% of farmers are growing groundnuts in regions of Zambézia and Nampula, but aflatoxin contamination is a known problem. Along with cassava and maize, groundnuts are identified as contributing to liver cancer and other health problems and new research by the FTF Nutrition Innovation Lab in Mozambique is looking at exposure issues (Nutrition Innovation Lab 2018). Reducing aflatoxin and developing options for value added products could improve marketing and prices, while providing an incentive to grow healthier nuts. Processing into peanut butter or salty snacks could be a local SME activity, if aflatoxin and packaging concerns are addressed. The rigorous aflatoxin standards for Europe are difficult to meet for export and are stricter than the Codex Alimentaris standards in Mozambique. However, reducing aflatoxin levels would both enhance processing options as well improve health in production regions of Mozambique. There are technologies known for aflatoxin reduction (Njoroge 2018). For example, Aflasafe has been tested and is now authorized in maize and groundnut production in Mozambique, having been shown to be effective in reducing aflatoxin during the production period. Research for Helvetas found “... with the use of aflasafe in the production phase and Biospray or salt in the post-harvest phase with proper application of the drying and storage methods, Aflatoxin levels can be controlled avoiding public health problems” (Helvetas 2019). Other methods for harvesting and storage are available, with a recommended practice to aggregate unshelled groundnuts as quickly as possible after harvest, and only shell under adequate controlled low humidity storage conditions. Additional sorting out of moldy appearing nuts also helps. Agrifuturo invested in the Lurio Laboratories for Aflatoxin and supporting ICRISAT initiatives on training technicians, farmers, aggregators, and processors would contribute to lowering aflatoxin. **Options:** 1) Invest in aflatoxin mitigation systems, taking advantage of previous work and new technologies (Aflasafe, Biospray and others) especially at the farm and storage levels with both training and inputs access; 2) Identify options for SMEs to test and meet quality standards for aflatoxin for domestic markets with strengthened laboratories in Nampula; and 3) include groundnuts in nutritional and ag extension education, emphasizing handling for safe and nutritious foods.

E. Support for women and youth

Women and youth face unique constraints in the development process. Recognizing those constraints is critical to developing programs to enhance their opportunities. The ProEjuma project design by ELIM Servicos, Ltda for MADER (Mata, et. al., 2020) provides excellent diagnostics on constraints and opportunities. They elaborate a program that includes the skills building, the enterprise development, and the national policies to encourage employment in the agricultural sector that informs our thinking. Key is the recognition of societal and cultural norms that can limit access and there can be unintentional negative effects if not recognized (see Land O'Lakes/Venture 37 2020 and aspects related to violence against women). Working with women and youth to build relationships with service providers, financial operators, traders and potential employers is part of the overall goal. There are a myriad of programs for women and youth in Mozambique and the region, but a key will be returning in several years' time to see what has worked and why, a plea from Sumberg et al (2014).

Women: A key feature of the intervention options proposed here is the support for farmers for capitalization, whether with VSLAs, ASCAs, mobile money, or other means to enable savings that can be attributed to the women. Much research, cited earlier, focuses on women's participation in different financial mechanisms, and these lessons need to be incorporated into program design. For women with some marketed product, this form of savings is valuable for accumulation. By including the links with mobile wallets and assisting women with financial literacy, rural women can have more control over financial resources. Cash grants can be arranged and under control of women. Seed production and SME development programs should have targeted options for women, with additional training programs on business management. iDE SMART is one such program, identifying good candidate with the background and entrepreneurial spirit to be engaged in training and skills building for seed production, agroprocessing, and other activities (iDE 2018).

Since women are more invested in legume and vegetable crops, involving them in value chain activities with those crops is logical. Training on crop management, post-harvest, value addition and financial management (with numeracy) can be organized around the women's schedules, adapting to childcare and other responsibilities. The World Bank Women Entrepreneurs Finance Initiative (We-Fi) (World Bank 2020d) focuses financial resources for women entrepreneurs, with the additional training, mentoring, and market analysis, while working with policy makers to remove legal and regulatory constraints for women entrepreneurs. The program adapted in the era of COVID to conduct all training online (World Bank 2020c).

Small scale agro-processing machinery is available that specifically reduces women's labor time, such as peelers and chippers for cassava, and threshers for cowpea and pigeon pea. Programs should include creative financing options with collateral based on cash flow, using partial grant strategies, given that women are less likely to have DUATs and less likely to have bank accounts (Finscope 2020). This is where financial literacy and business skills development are critical.

Despite rising literacy and improved education levels, literacy among rural women remains low. Thus, educational and training materials need to be designed for low literacy people. PROMER is one of the projects that has evolved over time given its experience with rural women (IFAD 2020). Things such as the animated of SAWBO and live videos on YouTube (Land O'Lakes/Venture 37, 2020) and radio programs are valuable and should continue to have investments. Due to the

COVID pandemic and rules against meeting in person for agricultural and health extension, many radio programs have been developed and those should continue to have investments and be used even after the pandemic, especially but not solely for women.

Youth: Research shows that youth are attracted to business opportunities (Dadzie et al. 2020; see also IFAD 2019, whose entire Rural Development Report focused on rural youth). So youth, particularly rural youth, can be targeted for scholarships to technical institutes to learn about agricultural production, business development, planning, and management, but also be engaged with private sector initiatives such as internships to ensure hands on experience. The SNV OYE Youth Employment program for rural youths in Mozambique, Tanzania and Rwanda learned lessons along the way that demonstrate there is a push factor (youths with low employability wanting options), a pull factor (internships with private sector or support to establish start-ups) and a match factor (matching youth to markets and access to start-up funding and financial institutions (SNV 2018). Mechanization, agricultural information systems, Business Development Services are all possible directions for youth employment, as well as the poultry sector experiences of earlier programs. The Gapi ProJovem Programme is an example of an initiative to identify youth coming out of educational institutions with potential funding for business development (Mata 2020). Engaging UniZambeze students in agriculture has proven successful for the Rama BC team (Land O'Lakes/Venture 37 2020).

The literature suggests that youth of today are more likely to participate in activities that use modern information and communications technologies (ICT), and the SEMEAR results for their last year of the program confirm that more youths were engaged when there was greater use of ICT (IITA 2020). IFAD (2019) notes “a renewed interest among entrepreneurial youth in farming that is closely linked to the possibility of serving growing markets with technology-enabled farming and marketing practices” (p. 218).

BDS may be one area for use of ICT. Mechanization services can also use more ICT in the business management and be more attractive. As indicated in Mata 2020 and found in Finscope 2020, youth are more engaged with cell phones and mobile money services than their elders, and taking advantage of this for training, linkage to markets, and financial tools will be important. Sumberg et al (2014) stress the need to identify transformative employment activities, ones that youth will see as developing their potential into the future, that may not be directly in farming, but rather in agroprocessing or farm services. Dolislager et. al. (2021) show that 21% of employed rural youth (in wage or self-employment) are engaged in the post-farm segment of the agrifood system, but this is much more common in relatively densely populated rural areas than in hinterland areas.

VIII. References

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IX. Annexes

- A. Google Survey Instrument for Key Informants 2020 and Google Survey Results**
- B. Persons Consulted**
- C. Thematic References**
- D. Maps of Mozambique**
- E. Road Projects in Zambézia and Nampula Over the Past Five Years, and Perspectives on Adequacy of Roads Infrastructure**
- F. TIA Results**
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