



Food and Agriculture Organization
of the United Nations

Cropping systems diversification to enhance productivity and adaptation to climate change in Mozambique

BRINGING TOGETHER EVIDENCE AND POLICY INSIGHTS

KEY MESSAGES

- ▶ **Farmers in Mozambique are diversified, but subsistence-oriented.** Thirty-seven percent of farmers in Mozambique grow a three-crop system based on maize, a legume, and an alternative staple, such as cassava or sorghum. This system is an effective adaption strategy, as it reduces crop income volatility compared to less diverse systems, but it is also associated with low levels of productivity, input use, and incomes.
- ▶ **Adoption of cash cropping system improves farmers' welfare.** Farmers who adopt cash crops have higher average incomes and higher productivity levels. However, only 19 percent of farmers grow cash crops. Limited household resources and isolation from markets constrains the adoption of cash crop systems.
- ▶ **Enhance commercialization by incentivizing value chain investments and improving market competition.** Supporting investments in the trading and processing for widely grown crops, combined with improved pricing policies for cash crops can facilitate the adoption of more commercialized cropping systems.
- ▶ **Expand and strengthen the improved seed sector.** Increasing the availability of improved seeds is critical to promote commercialization and diversification. To this end, there is urgent need to develop and implement a National Seed Policy to regulate activities in both the formal and informal seed value chains.

Introduction

The recently completed extension of the National Agricultural Investment Plan for Mozambique (*Plano Nacional do Investimento do Sector Agrário* [PNISA] 2018–2019), articulates a clear vision for the agricultural section. Through the PNISA, the government seeks to improve household food security, augment the income of food producers and the profitability of agriculture production, while supporting a rapid and sustainable transition to market oriented agricultural production. Identifying policies and investment to support agricultural producers to adopt more productive, profitable, and climate adaptive and resilient cropping systems is, therefore, critical for achieving the objectives articulated in the PNISA.

The effect of a particular cropping system on the welfare of agriculture producers depends on the agronomic and market attributes of the crops that comprise the system. For example, some crops, such as legumes, can fix atmospheric nitrogen and improve soil nutrient balances, but often suffer from weak value chain linkages, including limited improved seed availability and thinly traded output markets. Alternatively, many cash crops, such as cotton or tobacco, have stronger input and output market linkages, which are beneficial for farmers. However, diversification into cash crop production can expose producers to considerable market volatility due to international price movements, exchange rate fluctuations, and policy related uncertainty. In the absence of proper investments and policies, diversification into these crops can expose households to considerable risk and lead to a potential deterioration of household's welfare.

This brief provides empirically-based insights to help identify and prioritize policies and investments that can increase the benefits from cropping system diversification and improve adoption of more profitable and resilient cropping systems. Specifically, the brief focuses on smallholder maize producers, the most widely grown crop in Mozambique, and identifies policies options based on an analysis of: a) the factors that influence the adoption of relatively more subsistence or market oriented cropping systems; and b) the effects of adopting different cropping systems on farm income, input use, maize productivity and resilience, measured in terms of crop income volatility.

Defining and analysing cropping systems in Mozambique

The brief focuses on seven different cropping systems, which are based on combinations of four categories of crops: dominate staple (maize), alternative staple (e.g. cassava, millet, sorghum, rice, sweet potato), legumes (e.g. groundnuts, pigeon pea, soy, beans, cow peas), and cash-crops (e.g. tobacco, cotton, cashew, sesame). To do this, the analysis uses of the national representative *Inquérito Agrário Integrado* (IAI – 2015), which collects information on individual-, field-, and community-level characteristics for the agricultural seasons 2014/2015. Drawing on these data, a multinomial endogenous treatment effect econometric model is used to estimate the effects of each of these seven systems on household maize productivity and crop income volatility (relative to maize monocropping), as well as the key socio-economic, institutional, and biophysical factors that push or pull a farm to adopt a particular cropping system.

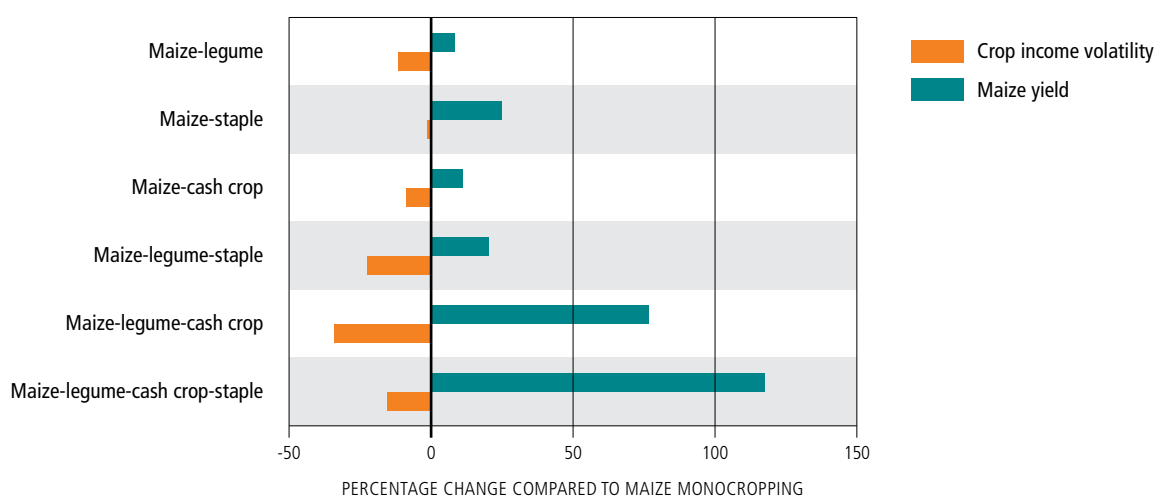
Key findings

The most prominent cropping system for maize producers in Mozambique is a three-crop system comprised of maize, with a legume, typically beans, groundnuts or pigeon peas, and an alternative staple food, such as cassava or sorghum. As shown in Table 1, this system is adopted by 47 percent of all farmers in Mozambique. This system is associated with relatively low levels of input use – only 3 percent use inorganic fertilizer – and low average crop incomes. This dominant system is, therefore, primarily subsistence oriented. Farmers are drawn to this system, in part, because it has relatively low barriers to entry compared to cash crop production, and, as shown in Figure 1, it is one of only two systems in Mozambique that is significantly associated with a reduction in crop income volatility. A significant reduction in crop income volatility due to this system suggests high resiliency benefits for farmers. Given this, an important policy challenge in Mozambique is how to support this dominant system to be more productive and profitable for farmers, while maintain its resiliency benefits.

TABLE 1 CROPPING SYSTEM: ADOPTION RATES, FERTILIZER USE AND CROP INCOMES

Cropping system	Share of households adopting	Inorganic fertilizer adopters	Crop income (USD 2010)	Change in crop income compared to maize monocropping
Maize monocropping	6%	4%	220	–
Maize-legume	19%	4%	397	180%
Maize-staple	9%	2%	448	113%
Maize-cash crops	2%	23%	741	165%
Maize-legume-staple	47%	3%	361	49%
Maize-legume-cash crops	5%	28%	1 100	305%
Maize-legume-cash crops-staple	12%	10%	688	63%

In total, 19 percent of maize producers grow cash crops under three different cropping systems (maize-cash crop, maize-cash crop-legume, and maize-cash crop-legume-alternative staple). Systems that include cash crops are associated with significantly higher levels of fertilizer use and crop incomes. They are also associated with a significant increase in maize productivity (Figure 1). However, only when cash crops are combined with legumes in a three-crop system is there a significant reduction in crop income volatility (Figure 1). Taken together, this suggests that identifying policies to pull more farmers into the production of cash crops can have a beneficial effect on productivity and household incomes. However, the promotion of cash crop production must be attentive to its impact on the volatility of household's income. Promoting cash crops in combination with legumes is an effective approach to raise farm incomes and productivity, while reducing income volatility risk for farmers in Mozambique.

FIGURE 1 ASSESSING THE IMPACT OF CROPPING SYSTEMS ON MAIZE PRODUCTIVITY AND CROP INCOME VOLATILITY

Source: FAO, Economic and Policy Analysis of Climate Change (EPIC) team.

The analysis shows that the adoption of more productive and profitable cropping systems is constrained by the combination of low levels of household resources and limited access to markets. In terms of household resources, larger land holdings and greater asset endowments emerge as particularly important drivers of cropping system choice. Larger land holdings and higher levels of asset wealth enable farmers to more easily cover the cost and reduce the risks to household food security of transitioning from a subsistence oriented system to one that is more commercially oriented. For example, a household with 3 hectares of land is two times more likely to adopt the maize-legume-cash cropping system than a household with 2 hectares of land, which is the average smallholder land size in Mozambique. This suggests that addressing household resource constraints, including land access, must be prioritized in order to achieve more widespread adoption of commercially oriented cropping systems.

Proximity to urban markets, where demand for agricultural markets is high and where input access is less constrained, is also an important factor driving the adoption of more diverse and commercial systems. In particular, as the distance from urban markets increases, farmers are significantly less likely to adopt cropping systems that include more than two crop categories, and this effect is more pronounced for market-oriented systems that include cash crops. Improving access to urban markets, through investment in road infrastructure, combined with strategies to facilitate investments in output and input markets in rural areas, is therefore critical for promoting the adoption of commercially oriented cropping systems.

Policy options for consideration

What steps can policymakers consider for facilitating diversification pathways that could enhance productivity and resilience of farmers? The study identifies the following three broad areas of intervention:

- ▶ Improve the commercialization of crops that are already widely adopted by farmers.
- ▶ Support farmers to transition toward commercial oriented crops.
- ▶ Support the seed market intensification.

Improve the commercialization of crops that are widely adopted by farmers

The majority of farmers in Mozambique adopted cropping systems that are primarily subsistence in nature. Improving the market conditions for these crops can help to enhance farmers' market orientation and incomes. Changes in excise duties on cassava-based beer production offer some insights into the value of such an approach. This policy has resulted in significant investment in cassava beer production and increased market demand for cassava. Identifying similar areas where policy incentives can trigger market demand for commonly grown smallholder crops can help foster greater commercialization.

Investment in markets for widely grown crops can also be stimulated through changes in the allocation of existing credit systems, such as the *Fundo de Desenvolvimento Agrário*. Prioritizing the dispersal of credit to private investors in processing and trading of widely grown crops such as cassava, sorghum, beans, and groundnuts, can have beneficial effect on the market conditions for these crops and thus improve commercialization outcomes for producers.

Support farmers to transition toward commercial oriented crops

Three strategies may be considered to support farmers to transition to the production of more commercially oriented cropping systems. The first is to improve farmers' access to reliable information on agricultural commodity prices. This information is critical for assisting farmers to make informed decisions about what crops to grow and the land area to dedicate to different crops. Price information in Mozambique is collected through two systems, the *Sistema de Informação de Mercados Agrícolas* (SIMA), which is managed by the Ministry of Agriculture and Food Security and gathers information producer prices, and INFOCOM, a platform lead by the Ministry of Industry and Commerce which collects data on wholesale prices. Integrating these two systems to allow farmers and other value chain actors to understand prevailing farm gate and wholesale price conditions in different markets, combined with strategies to improve the dissemination of this information should be considered.

Second, strengthening the country's extension service can provide farmers with the necessary information on crop management strategies needed to transition to new cropping systems. This is particularly the case for resource constrained farmers, who face considerable risks to their livelihoods from adopting unfamiliar crops. The findings from this study show that farmers residing in villages where public and private extension services are operating are more likely to move from maize monocropping to more diverse and commercially oriented systems. However, the number of extension service agents compared to the population of farmers is low. It is estimated that each extension office in Mozambique covers 1000 farm households. As a result, many farm households have limited access to extension information.

Finally, the processes for setting and implementing floor prices for some cash crops should be reviewed. In the cotton sector, for example, floor price setting combined with a monopsonistic structure of the market can contribute to higher levels of producer price volatility than would be the case in more competitive markets. This likely acts as a disincentive to produce cotton. Developing mechanisms to enhance competition in cash crop markets through, for example, mechanisms to help cash crop buyers manage exchange rate fluctuations, combined with policies to facilitate adjustments in floor prices in response to favorable international prices will have beneficial effects on the adoption of commercially oriented cropping systems. Moreover, actions that create market uncertainty, such as ad hoc trade restrictions or tax exports, should be carefully considered as they can distort competition, hinder farmers' profits, and limit future private investment in markets.

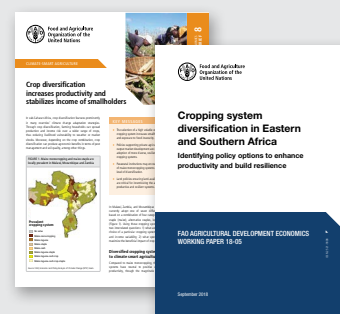
Support the certified seed market development

Seed prices and availability are prominent determinants of cropping system diversification and commercialization. However, markets for certified seeds in Mozambique remain small. Policies that both increase competition in the seed sector and support seed producers, both large and small, to multiply sufficient quantities of seeds that are appropriate for different agro-ecological conditions should be considered. This includes policies: i) to attract investments in the breeding seeds sectors, including by small-scale breeders and farmers' organizations, and ii) improve trading arrangements in the seed sector. More broadly, there is urgent need to develop and implement a National Seed Policy to regulate activities in both the formal and informal seed value chains.

The number of seed breeders is low in Mozambique, and this reduces the volume seed available on the market, leading to high prices and limited availability of improved seeds. At the same time, the majority of farmers rely on seeds acquired through informal systems, such as farmer to farmer exchanges. Policies aimed increasing competition and investment in plant breeding and improving condition within informal markets may include the following: first, insuring that the Plant Breeders' Rights is effectively in operation, thus ensuring that plant breeder are able to profit from their investments. Second, to improve the availability and use of quality seed by small-scale farmers, integration of formal and informal seed systems should be considered. This includes updating of existing regulatory framework in order to allow farmers groups to improve the planting material they use and to enable localized sales of improved seeds multiplied by farmers at communities. There is need to create conditions for recognition of the category of "Improved Guaranteed Seed" (equal to FAO Quality Declared Seed) as foreseen in the current Seed Regulation.



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