KEY MESSAGES

- Crop diversification is lowest in the case of poor smallholder farmers, who are therefore more likely to suffer from climatic shocks.
- Crop diversification is lower in dry regions than in wetter regions.
- Drought-tolerant varieties (for example of sweet potato) have been developed to improve food availability for households and improve diets, especially of children.
- Efforts towards diversification may be hampered by farmers' lack of access to capital.
- Farmer participatory field trials with improved crop varieties are helpful for co-learning of good practices for enhancing climate resilience in the farming systems with crop diversification.
- Provision of knowledge, through extension services or other channels, can help increase production and stimulate farmers to adopt coping strategies to reduce the impacts of climate change.

INTRODUCTION

Diversification is a significant component of Zambia's agricultural investment strategy (Arslan et al., 2018). However, established that the type of diversification targeted, and the policy measures used for its achievement are rarely well-defined (Maggio et al., 2018). Crop diversification for example, is an important agricultural policy objective in Zambia, that could provide an enabling environment for resilience against climate change. Other diversification strategies that are used to cope with climate change include replacing crops that require large quantities of water with drought-tolerant and short-duration crops, livestock, or income diversification (e.g. engaging in off-farm income-generating activities), adopting moisture-conserving practices, and early planting.

Crop diversification must be promoted in a holistic way to leverage investments by the private sector. Different crops have varied agronomic functions in the cropping systems, depending on their nutrient requirements, root structure and biomass production. In addition, crops in the diversified cropping systems face different market conditions and command diverse prices. Some crops are widely traded, with prices determined by the external markets, while others are traded locally, with prices dictated by local market conditions. Because of the diverse functions and market conditions of different crops, crop diversification...
is often considered a risk management strategy for smallholders. Diversification strategies differ in their effects on farmers’ welfare and resilience, and in the factors that influence their adoption. For example, cropping systems that include legumes generally produce better outcomes than those that feature for sale (such as Tobacco, Sunflower, Rice etc.) (Maggio et al., 2018).

THE STATUS OF CROP DIVERSIFICATION ON SMALLHOLDINGS IN ZAMBIA

Crop production on smallholder farms in Zambia in general is not highly diversified. According to the Rural Agricultural Survey Report (2019) about 89.7 percent of the households in Zambia grew Maize on their farms (IAPRI, 2019). Approximately 58 percent of smallholders grow maize either alone or in combination with legumes or other staple crops. Only 3 percent of smallholder farmers cultivate four categories of crops over the course of a single year. The degree of crop diversification and the combinations of crops grown vary according to the agro-ecological region (AER). Crop diversification seems to be higher in wetter regions (e.g. AER IIb and AER II) than in dry regions (e.g. AER I) (see Figure 1(b)). Zambia has three distinct AERs (Figure 1(a)) (MoA and MFL, 2016; World Bank, 2019), which are distinguished by varying rainfall, temperatures, and soil types.

- AER I, covers most of the country’s Southern and Western Provinces. The AER I is drought-prone and is characterized by low rainfall (< 800 mm/year) and a short, hot growing season of 60–90 days.
- AER IIa and IIb cover much of the eastern, central, and western regions and have the country’s highest agricultural potential with growing seasons of 90–150 days. AER IIa has slightly higher rainfall (800–1,000 mm/year) than AER IIb (600–800 mm/year).
- AER III covers the northern regions with 1,000–1,500 mm of rainfall each year and the growing season lasts 140–200 days (Braimoh et al., 2018).

Figure 1. Zambia’s map of (a) agro-ecological regions and (b) crop diversification
Note: The Gini — Simpson index for crop diversification refers to the area allocated to different crops. The higher the index the more diverse the province.
EFFORTS TOWARDS CROP DIVERSIFICATION

Integrating crop diversity into farming practices

Maize production has trended downwards in Zambia since the early 1990s, following marketing reforms and the withdrawal of large-scale maize subsidies. In recent years, the Zambian government has emphasized the need to reduce the country’s heavy dependency on maize. According to a World Bank (2017) report, the country’s Farmer Input Support Program (FISP) and the Food Reserve Agency (FRA) played a key role in catapulting Zambia to a surplus producer of Maize. However, these programs failed to enhance the productivity or food and nutritional status and have not sustainably reduced poverty in Zambia. For example, IAPRI (2012) showed that during a six-year period (2004 – 2010), poverty rates in rural Zambia increased marginally, from 77.3 percent to 77.9 percent. Furthermore, these programs have been found to encourage the expansion of maize into unsuitable agro-ecological zones (Biovision, 2018).

Since the late 1980s, the Government of Zambia (GRZ) focused on cassava and sweet potatoes as key crops in crop diversification programs, particularly in programs that focused on food and nutrition security and drought mitigation. Consequently, Cassava cultivation tripled in a period of 28 years from 1985 to reach a peak production of 1,114,000 t in 2013. This increase in cassava cultivation was largely attributed to the withdrawal of maize subsidies according to Chikoti et al. (2019). Also, the growth rate of sweet potato production was maintained at 10 percent from 1965 to 2004, except for the 1995 to 1999 period (Miyazaki et al., 2013). Other crops that have been promoted among farmers include drought-tolerant varieties of maize, groundnut, and cowpea. The government has worked to increase agricultural diversification by improving farmers’ access to agricultural extension services, assets (including land) and markets, and by investing in water harvesting and irrigation systems (Mofya-Mukuka and Hichaambwa, 2018).

Figure 2. Crop prevalence in Zambia for legumes (percentage of smallholders cultivating a crop), nationwide and in provinces

![Crop prevalence in Zambia for legumes](image)

Source: IAPRI, 2019
Legumes such as Groundnuts (*Arachis hypogaea*) are produced widely by smallholder farmers in Zambia (IAPRI, 2019; Figure 2). Groundnut is the most important legume crop in Zambia and is cultivated both for on-farm consumption and as a cash crop. It is important in terms of food security, as its kernels consist of 23 to 25 percent of protein and for 45 to 52 percent of edible oil. Groundnuts can be rotated or intercropped with other crops, which benefit from the legume’s ability to fix nitrogen. Thus, groundnuts can contribute greatly to the development of sustainable, climate-resilient cropping systems. But Zambian farmers realize very low groundnut yields as they use local varieties that are low yielding and long maturing (among other less desirable traits). It is therefore important to introduce farmers to improved varieties that are higher yielding and mature earlier.

Like groundnut, cowpea (*Vigna unguiculata*) is important in terms of both food security and climate change adaptation. The legume performs well in the hotter and drier parts of Zambia. In certain areas, it is grown as a food crop instead of common beans (*Phaseolus vulgaris*), for both its leaves and for grain. Due to the development of a strong taproot, cowpea has a good drought tolerance, which makes it better adapted to light and sandy soils than many other legumes. Cowpea can also contribute significantly to sustainable cropping systems, as it can be rotated or intercropped with other crops. The cowpea yields realized by Zambian farmers are very low. This is because farmers tend to use local varieties, which are low yielding and long maturing (among other less desirable traits). It is therefore imperative to promote improved, early maturing varieties with higher yields.

Beans are the second most grown legume at the national scale (Figure 1), followed by soybeans and cowpeas. Beans are grown by about 15 percent of farmers. Cowpeas and soybeans are grown by 13 percent and 4 percent of farmers, respectively. However, at province level, the order of ranking the three crops varies. Cultivation methods for legumes differ among regions. Legumes can be grown in rotation with non-legumes or intercropped with non-legumes. Therefore, they are an ideal crop for diversification (as well as for soil improvement).

The Government of Zambia partnered with the Food and Agriculture Organization of the United Nations (FAO) to implement a project aimed at enhancing climate resilience in the farming systems with crop diversification at the core among other technologies demonstrated. Under the project, (Strengthening integrated adaptation planning and implementation in Southern Africa smallholder agricultural systems to support food security) demonstration trials were set up for drought-tolerant crops (e.g. pigeon peas, maize, cowpeas, groundnuts, and sweet potatoes) and for technology packages used to grow those crops (see Box 1 for an example of a trial of ripping technology). In addition, demonstration trials were set up for *Gliricidia sepium* (a leguminous tree for soil fertility enhancement), *Faidherbia albida* (Musangu trees for soil fertility enhancement and livestock feed) and *Tephrosia* (a flowering plant in the pea family for botanical extract for pest control). The demonstration trials were followed by mother-baby trials and the multiplication of seed. The crop diversification strategies adopted enhances the resilience to climate variability and change within farming systems in eastern Zambia.
Enhancing climate resilience in the farming systems with crop diversification in Zambia
Farmer participatory field trials for demonstration of good practices and co-learning

Box 1: Crop technologies demonstrated by lead farmers: ox-drawn soil rippers

Under the project implemented by the Government of Zambia and FAO (Strengthening integrated adaptation planning and implementation in Southern Africa smallholder agricultural systems to support food security), lead farmers in the Mambwe district helped conduct group demonstration trials during 2017/18 rainy season. Instead of using traditional land preparation practices, the lead farmers prepared the soil with a minimum disturbance following conservation agriculture (CA) principles. With ox-drawn rippers, one lima (0.25 ha) of land could be prepared for planting in two hours, instead of the two weeks needed when using traditional means. However, some farmers were found to have limited access to ox-driven rippers (which cost about USD 25) and/or draught animals.

Water conservation practices such as the digging tied ridges and the construction of basins were found to better conserve soil moisture than the previously used shallow pits. The lead farmers reported that at slightly more than 2 t/ha, the 2017/18 yields of their maize production were triple the usual average (Figure 3). They also stated that other farmers had increased the frequency of their visits to demonstration fields and started adopting the CA practices they had seen implemented there. Farmers were also found to be more willing to join Farmer Field Schools (FFS).

Figure 3. Average yields (kg/ha) for various crops of five lead farmers in Mambwe, prior to and after CA interventions (2017/18)

Source: Adapted from FAO, 2020.

Addressing nutritional needs by stimulating the production of orange-fleshed sweet potatoes

Orange-Fleshed Sweet Potatoes (OFSP) are rich in vitamin A and are therefore being promoted to address food insecurity and vitamin A deficiencies in Zambia. Zambia has among the highest malnutrition and vitamin A deficiency rates in Africa, with 54 percent of children under five being vitamin A deficient (UNICEF, n.d.). The poor nutrition status in Zambia is partly attributable to the limited diversity of the foods eaten at household level. Against this background, efforts are currently underway to promote the adoption by Zambian farmers of improved varieties of orange-fleshed sweet potato (see Box 2).
Box 2: Promoting the production of orange-fleshed sweet potatoes

An FAO project, strengthening integrated adaptation planning and implementation in Southern Africa smallholder agricultural systems to support food security implemented (2017-2021) in collaboration with research and development partners in Zambia, introduced new varieties of early maturing, OFSP to smallholder communities as a suitable climate change adaptation crop. These new varieties, were developed by the Zambia Agriculture Research Institute (ZARI) in collaboration with the International Potato Centre (CIP), were tolerant to drought, heat stress and poor soils. In addition, they were developed to contain high levels of vitamin A, to help reduce vitamin A deficiency among children under five and expectant and lactating mothers. In addition to carbohydrates, they also provide minerals, such as zinc and iron. The improved sweet potatoes were new in Nyimba and Mambwe. Under the project, the new genotypes NC 09-350 MUSG and ZAMBEZI/2 were compared to the released Olympia variety and the local variety. The new varieties were found to outperform both the Olympia and the local varieties in terms of root yields (Figure 4).

Figure 4. Root yields of sweet potato varieties (kg/ha) in Nyimba and Mambwe, Zambia

![Bar graph showing root yields of sweet potato varieties in Nyimba and Mambwe, Zambia.](source: ZARI, 2019)

The project demonstrated that the adoption of OFSP varieties improved the nutritional status of households by providing Vitamin A, improving dietary diversity, and increasing the number of meals eaten per day (FAO, 2020). In June/July, the harvest period of OFSP in Zambia, the number of daily meals increased to two, as a breakfast of sweet potato was included in households’ meal plans. Farmers valued OFSP as a food security crop that matures early before the dry spell occurs. However, the tubers are also highly perishable and were sold quickly to alleviate immediate household cash needs. Prior to the project, OFSP were not commonly found in the project communities. To replicate the project activities, project staff propagated planting material on multiplication plots.
Enhancing climate resilience in the farming systems with crop diversification in Zambia
Farmer participatory field trials for demonstration of good practices and co-learning

The benefits of switching to drought-tolerant maize varieties

Under the project, drought-tolerant maize varieties were selected for demonstration trials, with the aim of reducing farmers’ vulnerability to droughts and improving food security. Early maturing, drought and heat tolerant maize varieties including KKS 501, KKS 603, ZMS 606, MMV 409, Panner 53 and a local check under minimum and conventional tillage practices were demonstrated in 2017/2018 (Figure 5). ZMS 606, PAN 53, KKS 603 and the local variety, planted in rip-lines, produced higher yields. The selected varieties have high potential yields and a yield stability that is 20 to 30 percent higher than that of other commercial varieties. In addition, they are resistant to major diseases, including Maize Streak Virus (MSV), Turcicum Leaf Blight (TLB) and Grey Leaf Spot (GLS). They also have superior milling or cooking qualities. However, the seed of these varieties must be purchased anew each season.

Figure 5. Yields of early maturing, drought and heat tolerant maize varieties using two tillage methods

Source: ZARI, 2018
POLICY OPTIONS

Crop diversification is one of the strategies used to improve households’ food and income security in the face of climate change. Of the different types of CSA practices, (crop, livestock, and income diversification), crop diversification into legumes, commercial horticulture, agroforestry, and strategies to reduce post-harvest are the most promising to achieving welfare and sectoral development strategies (World Bank, 2019). The likelihood that households will diversify their crops depends on their resource endowment (Sichoongwe et al., 2014). Poor households often perceive the diversion of scarce land resources away from staple crops as highly risky. Meanwhile, households with more land are significantly more likely to diversify their crops. This is an indication that smallholders require targeted policy interventions, especially where climate variability is expected to negatively affect the production of subsistence crops (FAO, 2016).

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