

Sustainable agriculture for small-scale farmers in Mozambique

A scoping report

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Sustainable agricultural approaches such as agro-ecology can help producers increase productivity while protecting the environment and strengthening resilience to climate change. Nonetheless, policymakers rarely support them on a large scale and take-up remains low. This report analyses the factors determining the adoption of sustainable practices in Mozambique, exploring whether a common understanding of ‘sustainable agriculture’ exists, how this is reflected in policy and practice, and what drives farmers (not) to adopt them. It identifies the technical and institutional constraints and discusses opportunities to overcome them. Further investigation is needed to understand how agro-ecology can make sustainable production intensification happen at different scales.

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Executive summary

This report explores issues surrounding the adoption of sustainable agricultural practices in Mozambique, seeking to understand whether there exists a common understanding of 'sustainable agriculture', how this is reflected in policy and practice, and why, in spite of the evidence about the social and environmental benefits of these approaches, their adoption remains low. The ultimate objective is to help local stakeholders to better understand the benefits and the costs associated with the use of sustainable practices, as they are currently promoted by different actors, and what policies and incentives are needed to support their adoption on a larger scale.

From a holistic perspective, sustainable agriculture should be economically viable, environmentally sustainable, climate resilient, culturally sound and socially just. This concept of sustainability, whilst generally accepted as 'virtuous', is in itself contested and difficult to put into practice, as different actors will emphasise different aspects of sustainability.

In Mozambique, there is strong support for sustainable agriculture across different types of organisations, with approaches such as agroforestry and conservation agriculture (CA) being increasingly promoted throughout the country. When it came to defining 'sustainability', for most stakeholders the environmental dimension prevails, but they generally acknowledge that many different dimensions count. Such a holistic view however is not always reflected in practice, as most initiatives focus on technical solutions that are not tailored to the local socioeconomic and agro-ecological conditions. As a result, even if farmers are aware of the importance of preserving the natural resource base, adopting more sustainable practices may not be a priority: the poorest households see farming as a risky and non-remunerative activity they are not willing to invest in; whereas market-oriented farmers prioritise efforts to overcome structural constraints such as lack of irrigation and poor access to credit.

Indeed, albeit research trials and anecdotal evidence suggest that sustainable approaches help increase yields, are more resilient and economically accessible, uptake among smallholders seems to remain low. Scaling-up is limited by a number of financial, technical and institutional constraints, which need to be analysed in the context of the socioeconomic transformations taking place in rural areas. The scarce policy support is another major limitation. Several policy documents

advocate for environmental stewardship and social inclusion in agriculture. However, political commitment and funding allocated to these objectives are negligible if compared to the support given to agricultural growth and large-scale investments.

In order to overcome these issues, additional resources need to be allocated to research and extension. Agricultural research should address specific technical constraints, taking into account the country's diverse agro-ecologies, and seeking solutions that can best use local innovation skills and resources. In the socio-economic area, studies should assess the profitability and the riskiness of sustainable practices compared with conventional systems. Such analysis is important as labour intensiveness seems to be a major constraint and because no information is available on the number and type of farmers that use sustainable approaches in the long term.

More resources should also be invested to enhance research and extension staff's capacity to focus on sustainable practices, and reach more farmers. Capable trainers are key to the dissemination and uptake of new practices, but most agricultural professionals have been trained in conventional farming. Even in conservation agriculture, which has been widely promoted, learning is at an initial stage. Research and extension staff should be offered more courses on sustainable practices during their training. This should include also more participatory ways to develop and disseminate innovation and continuous learning with farmers. To this aim, links between research and extension also need to be strengthened, and farmers' traditional knowledge and local innovations should be mapped and documented.

In terms of promotion strategy, sustainable practices should not only be appropriate but also attractive to farmers. Creating marketing opportunities can encourage producers to invest time and resources in innovative practices that may involve some risks. Beyond the investments needed to fix structural problems, such as access to water and energy, specific interventions to support sustainable agriculture may include promoting markets for organic inputs and implements for minimum tillage, or advisory services for sustainable water and land management. Support to crop-livestock integration and veterinary services, largely absent in the northern provinces, could help address constraints to the adoption of CA such as lack of animal traction, lack of manure and improved grazing control.

Market incentives should distinguish between farmers. In the longer term, assuming that more competitive farmers may consolidate land and manage relatively larger farms, the promotion of agro-ecology should address the need to sustainably intensify production at different scales. At the moment, the expectation seems to be that the transformation of commercial agriculture in Mozambique will be driven by large-scale investments, as the implementation of the agricultural development strategy (PEDSA) and the Government's commitment to the New Alliance show. These investments are likely to promote monocultures and technological packages which are poorly complementary and even in conflict with sustainable agriculture. A stronger focus on the smallholder sector as the driver of agricultural transformation may thus help approaches such as CA or agro-ecology to be more widely adopted. Allocating additional funds to support this policy shift however may prove challenging, as the agricultural budget, albeit increasing, is still far below the CAADP targets.

There is wide support for sustainable agriculture, and in particular conservation agriculture, across directorates of the MINAG, civil society organisations, farmers' groups and development agencies. Strengthening the capacity of these actors to advocate for sustainable smallholder agriculture as a viable option for the transformation of the agricultural sector can help influence policymakers and bring sustainable agriculture more consistently into the policy agenda. One way to reinforce their role in policy advocacy is by improving and consolidating understanding of the benefits and the costs associated with sustainable practices. Creating exchange and learning opportunities is also important in order to foster synergies and avoid duplication of efforts. This scoping report will inform a workshop and a number of dissemination activities which seek to contribute towards this process.

While suggesting some preliminary conclusions on what could be done to help Mozambique shift towards more sustainable agriculture, this work also raises a number of outstanding questions that need further investigation. One key issue is whether sustainable agriculture is a priority for all smallholder farmers and what are the right incentives to make it a priority for all. A second issue is how to tailor technical and institutional interventions to make sure that sustainable agriculture works well for different types of farmers in different contexts. Finally, when planning and tailoring these interventions, a major question is how to make sure that sustainable agriculture works also in the longer term, assuming that more competitive farmers may consolidate land into larger farms and more family farms may progressively exit the agricultural sector. With this regard, analysis is especially needed to assess how agro-ecology and other sustainable approaches can favour sustainable intensification at different scales.

Background and introduction



This report explores issues surrounding the adoption of sustainable agricultural practices in Mozambique, seeking to understand whether there exists a common understanding of 'sustainable agriculture', how this is reflected in policy and practice, and why, in spite of the evidence about the social and environmental benefits of sustainable farming approaches, their adoption remains low.

Many studies suggest that low-external input, sustainable agriculture can contribute to food security by increasing productivity while at the same time being more climate resilient and environmentally sustainable than high-external input agriculture, especially in marginal environments (Pretty *et al.*, 2011). This view is reflected in many reports by influential international organisations that have recently praised the benefits of agro-ecology and other sustainable practices under multi-functional agriculture and sustainable food systems.¹ It is also the gist of the concept of 'climate-smart agriculture' (CSA), defined as an approach that "integrates the three dimensions of sustainable development (economic, social and environmental) by jointly addressing food security and climate challenges" (FAO, 2013).

From a holistic perspective, sustainable agriculture should be economically viable, environmentally sustainable, climate resilient, culturally sound and socially just. This concept of sustainability, whilst generally accepted as 'virtuous', is in itself contested (Pretty, 1998). Including environmental, social and economic objectives in the definition of sustainability internalises the inherent tensions between 'environment' and 'development'. Different actors will therefore emphasise different aspects of 'sustainable agriculture' – with some stressing the need for an agriculture that meets the food demands of a growing population and provides economic opportunities for all (including youths), some emphasising aspects of social justice, such as food sovereignty and land tenure security, and others focusing more on environmental and conservation issues.

From these alternative perspectives, different practices might be considered appropriate for different socioeconomic, environmental and political contexts. Even so, intrinsic tensions may arise between distinct but equally desirable objectives. In addition, from a technical point of view, sustainable farming cannot rely on a 'one size fits all' model; rather, it is (or should be) a dynamic, persistent, context-specific learning process that makes the best use of the locally available natural, physical and human resources, including scientific as well as traditional knowledge (Pretty, 1998, 1995).

Multiple interpretations suggest that the implementation of sustainable agriculture, at local, national and international levels, requires a shared understanding among the actors in agriculture on what is being sustained, for how long, for whose benefit and at whose costs, over what measured and at what criteria (Pretty, 1998). The underpinning question therefore is not whether a certain set of sustainable practices should be supported in a given location, but what combination of agricultural practices is likely to meet the priorities and reconcile the objectives of the different actors in each context.

The ultimate objective of this report is to help local stakeholders in Mozambique to better understand the benefits and the costs associated with the use of sustainable agricultural practices, as they are currently promoted by different actors, and what policies and incentives are needed to support their adoption on a larger scale.

Mozambique is regarded by many as having great potential to boost commercial agricultural production both through large-scale investment and by increasing the productivity of the smallholder sector. However, large-scale producers still represent a negligible percentage of farmers, whereas productivity gains among smallholders have been slow due to lack of access to credit and to productivity-enhancing technologies. The choice of Mozambique for this case study has been thus inspired by the possibility of contributing to an ongoing debate on how to best exploit its potential, by informing local stakeholders on the opportunities as well as the challenges of promoting more sustainable models of agricultural transformation. These issues are especially relevant in Mozambique, where extreme weather events such as droughts and floods and climate variability repeatedly affect agricultural production and put pressure on the use of land. These pressures are being compounded by large-scale investments in agriculture and other natural resources activities and competition for land in fertile areas along growth corridors.

As a first step of the research process, this scoping study identifies the trends, benefits and constraints involved in the dissemination and the adoption of sustainable agricultural practices in Mozambique. It does so in the context of the opportunities and the challenges offered by rural-urban migrations, the diversification of the rural economy, the increasing number of large-scale agricultural investments and the related changes in land access and use.

¹ These include the work done by the scientific panel of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) and reports by the UN Secretary-General (2013), UNCTAD (2013), UNEP (2012), the UN Special Rapporteur on the Right to Food (De Schutter, 2010), and Action Aid and the International Food Security Network (Wijeratna, 2012)

The report draws largely on a background document prepared by Calisto Bias and Eunice Cavane, which in turn relied on the review of a large number of secondary sources, both published and unpublished, as well as on the information provided by project and programme coordinators at the Faculty of Agronomy at the University Eduardo Mondlane (FAEF-UEM) and the Mozambique Institute of Agricultural Research (IIAM) (see Annex 1 for a full list of names and institutions).

Additional information has been collated through a stakeholder survey which involved 38 individuals from 19 different institutions including Directorates in the Ministry of Agriculture, other government agriculture-related bodies, civil society and development organisations, academia and research institutes (see Table 1; for a full list of names see Annex 2). The stakeholder survey meant to clarify what ‘sustainable agriculture’ means to different actors and how they put it into practice; how, based on their experience, sustainable practices address the needs of smallholder farmers and what are the major constraints to adoption; and what are their perspectives on long-term adoption, within the context of a diversifying rural economy, changes in land access mechanisms and urban growth. Some stakeholders attended the one-hour interview in their personal capacity, others did it as representatives of their respective organisations but added personal insights; so their views, while reflecting the experience gained within their field of work, do not necessarily represent the official position of the institutions they work for.

The first part of this report introduces the main cropping systems in Mozambique, reviews some of the initiatives that have promoted sustainable farming approaches and practices, and illustrates the agricultural and environmental policies that are relevant to sustainable agriculture. The second part investigates opportunities and constraints associated with the adoption of sustainable practices. It explores bottlenecks and the possible solutions according to the view of different stakeholders, leading to a number of recommendations and outstanding issues for further discussion.

These preliminary findings will inform a workshop in Maputo, organised along with the Mozambique Institute of Agricultural Research (IIAM), CARE International and the University Eduardo Mondlane (UEM). The workshop will gather around 30 representatives from key institutions and organisations to discuss how these issues should be tackled by policies and actions, what type of investments and incentives are needed to overcome the constraints, and what different actors can do to pursue the changes needed to scale up sustainable practices. The proceedings of the workshop will be disseminated through existing local networks and forums, with the hope that they can stimulate discussion and raise the proposed actions high on the policymakers’ agenda.

Table 1 List of interviewees, by type of organisation

TYPE OF INSTITUTION	NUMBER OF INSTITUTIONS	NUMBER OF INTERVIEWEES
Government	5	9
International Development / Donor	3	4
International NGO	4	7
National NGO	4	4
Research and academia	2	11
Farmers’ organisation	1	3
Total	19	38

Agriculture in Mozambique

The growth of the agricultural sector in Mozambique is largely due to the expansion of cultivated land, whereas productivity remains low. Large-scale investors and public-private partnerships are now expected to drive a transformation in commercial agriculture, but many technical and institutional constraints remain, especially for small-scale farmers, who account for nearly all producers.



Although agriculture employs 80 per cent of the total workforce and is the main source of income for more than 70 per cent of the population, it contributes only 23 per cent to Mozambique's GDP (gross domestic product) and represents just 20 per cent of the value of its total exports. Growth in the sector is driven largely by the expansion of the area under cultivation, with yields remaining stagnant at between 30 per cent and 60 per cent of their potential (IFAD, 2011). In spite of these limitations, the agricultural sector shows great potential due to the favourable agro-climatic conditions and Mozambique's geographical location. There are high expectations that private investments can lead the commercial transformation of the agricultural sector.

2.1 Sector overview

Mozambique is a vast country located in the south eastern coast of Africa, bounded by Tanzania and the Rovuma River to the north, and by the Mozambique Channel in the Indian Ocean in the east. To the northwest it borders with Malawi and Zambia, to the west with Zimbabwe and to the south and southwest with South Africa and Swaziland. The country has an approximate area of 799,000 km², of which 13,000 km² are inland waters, and its coastline along the Indian Ocean stretches for 2,470 km (MICOA 2007). Estimates indicated a population of 25.8 million in 2013², of which around 70 per cent live in rural areas. The population density is on average low, with 26 inhabitants per km², but substantial variations occur between provinces and regions (MISAU and INE, 2013).

Mozambique is considered one of Africa's strongest economic performers, with an annual average GDP growth of 7.6 per cent for the period 1993–2010 (World Bank, 2012). In the last decade, the economic growth has been driven mainly by inflows of foreign direct investments (FDI) in mining and other natural resources. In 2008 FDI reached an estimated US\$587 million (approximately 6 per cent of GDP) (World Bank, 2012).

Despite its GDP growth, Mozambique still faces many challenges in meeting economic and social development objectives. A significant proportion of population live below the poverty line, with poverty remaining stagnant over the years: the most recent national poverty assessment revealed that the proportion of the population living below the poverty line slightly increased from 54.1 per cent in 2002/03 to 54.7 per cent in 2008/09 (MPD, 2010).

Although there is an indication that the country has reached surplus production of some food items, notably maize and cassava (SETSAN, 2011a, 2011b), food

insecurity is high throughout the country. Rural areas exhibit higher percentages of both chronic and acute food insecure households (27 per cent and 4 per cent respectively) compared with urban areas (18 per cent and 3 per cent respectively) where higher incomes, availability of health services and access to markets make easier to have a richer and more diversified diet (SETSAN, 2014a, 2014b). While still highly vulnerable to weather shocks and emergencies, the status of food security has progressively improved. Conversely, malnutrition is still extremely widespread, with chronic malnutrition for children under 5 years of age being as high as 50 per cent in rural areas and 36 per cent in urban areas (IFAD, 2011). This 'hidden hunger' is now a priority for the Technical Secretariat for Food and Nutrition Security (SETSAN) and for the Ministry of Agriculture and Food Security (MINAG), just renamed after the recent presidential elections in order to stress the ministry's competency over food security.

The stagnation in the incidence of poverty and the low levels of socioeconomic development have been associated with the negligible increases in agricultural productivity. This in fact has a direct impact on food security and on the income of the large portion of the economically active population that depends on farming for its livelihood (more than 80 per cent in rural areas) (Republic of Mozambique, 2011).

Indeed, in spite of the growth of the agricultural sector – between 2000 and 2011 agricultural value-added grew at an average rate of 8.4 per cent per year – the productivity of the main factors of production – land and labour – has stagnated or even declined over time. At the same time, access to credit and to improved technologies and services remains limited (Mogues *et al.*, 2012; ITAD, 2014). Agricultural growth driven largely by land expansion, with very little technical change and marginal productivity increases for farmers, is unlikely to be sustained in the future.

Agriculture in Mozambique is mostly practised by smallholder farmers, who account for 99 per cent of the total number of farming units and farm 96 per cent of the 5.6 million ha of cultivated land (CAP, 2011). The large majority of these farmers practise rain-fed subsistence production on small areas (cultivated land measures on average 1.35 ha) (TIA, 2012), with limited integration into markets and with low use of external inputs, animal traction and mechanical implements (Table 2). Low coverage of extension services, lack of storage infrastructure, high post-harvest losses, poor transport facilities, high transaction costs and difficult access to financial services are among the main constraints on smallholders' productivity (IFAD, 2011).

² Mozambique, UNESCO Institute for Statistics county profiles, www.uis.unesco.org/DataCentre/Pages/country-profile.aspx?code=MOZ®ioncode=40540.

Table 2: Proportion of farm households using improved agricultural technologies in Mozambique (2002–12)

Type of technology	2002	2003	2005	2006	2007	2008	2012
Improved maize seed (%)	–	–	5.6	9.3	10.0	9.9	8.7
Chemical fertilisers (%)	3.8	2.6	3.9	4.7	4.1	4.1	2.8
Pesticides (%)	6.8	5.3	5.6	5.5	4.2	3.8	6.3
Animal traction (%)	11.4	11.3	9.5	12.8	12.0	11.3	7.7
Irrigation (%)	10.9	6.1	6.0	8.4	9.9	8.8	8.1

Source: TIA (2012).

Since 2005, however, the quantity of marketed agricultural products – both for internal and export markets – has more than doubled, largely due to the increasing diversity of market agents, including agribusinesses investors, farmers' associations and traders. Access to extension services is still very limited but is also improving, thanks to additional efforts to strengthen the public extension system as well as the to the advisory services provided by agribusinesses companies and farmers' organisations. The coverage of essential economic infrastructure, including roads, mobile communication network and electricity, has increased too, although substantial investment is still needed (IFAD, 2011).

Large-scale investments in agriculture are becoming more frequent and are expected to grow, driven by the increasing demand for food in the region as well as the global demand for industrial inputs and biofuels and thanks to a series of public-private partnerships that are investing in infrastructural and value chain development along the growth corridors of Zambezi Valley, Nacala and Beira.

2.2 Major cropping systems

Crop production occurs across a wide range of environmental, soil and climate conditions, presenting different agro-climatic challenges. By and large, the climate is subtropical in the southland and tropical in the central and northern regions with two distinct seasons: one rainy and warm season from October/November to April, and one dry and cool season lasting for four to six months, from May to September. In the southern region low-intensity rainfall associated with anticyclones also falls in the cooler periods of the year (MICOA 2007).

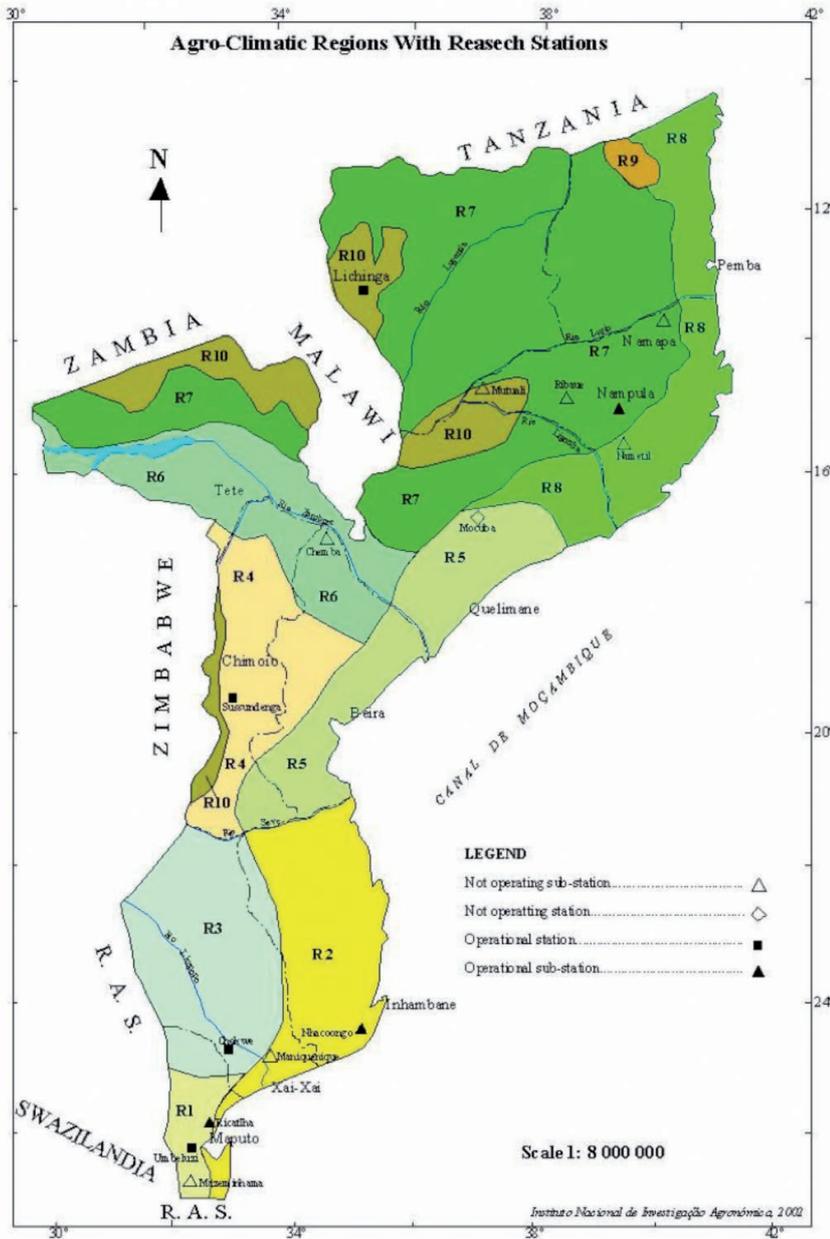
The Mozambique Institute of Agricultural Research (IIAM) has identified 10 different agro-ecological regions, grouped into 3 main categories, largely based on mean rainfall and potential evapotranspiration (ETP) (Table 3 and Figure 1).

The soil classification based on the Food and Agriculture Organization (FAO) system shows a large variety of soils. *Arenosols* (sandy soils) are dominant, representing around 29 per cent of the national territory, particularly in the southern region and along the coastal

Table 3: Environments and characteristics of agro-ecological regions in Mozambique (Sources: INIA 1980; PROAGRI 1996)

Environments/sites	Agro-ecological region	Evapo-transpiration (mm/year)	Mean annual temperature (°C)	Altitude (m)	Mean annual rainfall (mm)
Highland areas: mild weather, high rainfall & low ETP	R3, R9, R10	<1300	<22	> 500	>1000
Medium-altitude zone	R7, R4	1300–1500	22–24	200–1000	900–1500
Low altitude zones: hot, low rainfall & high ETP	R1, R2, R3, R5, R6, R7, R8	> 1500	> 24	<500	<1000

Figure 1: Agro-ecological regions in Mozambique (INIA 1980)



strip. These are coarse textured soils with a sandy layer deeper than 1m, which have poor soil fertility and a low holding water capacity. *Lixissols* – heavily weathered soils with clay accumulation – cover around 23 per cent of the territory. A group of very shallow soils designated as *leptosols*, which limit effective root growth, occupy around 9 per cent of the land. *Acrissols* (high soil acidity and low soil fertility), *Ferralsols* (low soil fertility) and *Luvissols* (low to medium soil fertility) represent respectively 8 per cent, 7 per cent and 5 per cent of the national territory. High fertile alluvial soils (*Fluvisols*) represent only 6 per cent of the land, being present on alluvial and fluvial marine zones along the valleys of the Incomati, Limpopo, Save and Zambezi rivers and their respective tributaries (INIA, 1996).

Across the country, the relative importance of food and cash crops vary mainly depending on the prevailing agro-ecological conditions, but market opportunities and food consumption patterns may also exert some influence on crop distribution. The distribution of traditional food crops in Mozambique is highly correlated with climatic conditions, while differences in soil quality may discriminate against crop performance, determining the size of the output (Carvalho, 1969).

In Mozambique, food crops account for 57 per cent of the total cultivated land (CAP, 2011) and for 90 per cent of the volume of total crop production (MINAG, 2014); they include cereal crops such as maize, rice, sorghum and pearl millet, root and tuber crops (mainly

cassava and sweet potato), and grain legume crops. Horticulture takes up 6.9 per cent of the total cultivated land. Cash crops include cotton, cashew, tobacco, sugar cane, coconut, sesame, soybean and fruit. The main livestock produced are cattle, goats and poultry (CAP, 2011), although different livestock dominate in different regions.

2.2.1 Staple food crops

The most consumed staple foods in Mozambique are maize followed by cassava and rice (Walker *et al.*, 2006; TIA, 2012). Data from TIA (2012) show that maize is widely consumed across the country, particularly in the provinces of Tete, Manica, Niassa and Gaza but much less in Nampula. Consumption of cassava is high in the provinces of Nampula, Zambeze, Cabo Delgado and Inhambane, with no or negligible consumption elsewhere. Consumption of rice, in turn, is mostly concentrated in the south, mainly in Maputo, followed by Inhambane and Gaza, but also important in Sofala and Zambezi.

The prevailing cropping systems for staple crops reflect the trends in consumption.

Maize accounts for about 75 per cent of the total value of smallholder crop production in Mozambique (Kassie *et al.*, 2012), with about half of the total area allocated to maize-based cropping systems. Ninety per cent of production occurs on farms whose average area is under 2 ha, with yields generally low and highly variable. Maize is generally grown under rain-fed conditions, with limited use of purchased inputs such as improved seeds, pesticides and inorganic fertilisers. The use of irrigation is concentrated mostly along the river valleys in the southern part of Mozambique.

Maize is largely grown as a subsistence crop and it is often cultivated as a dominant intercrop alongside grain legumes such as cowpea, beans, groundnuts and pigeon peas. Since 2008, the market for maize has increased and become more stable due to the presence of a new maize mill company (DECA) with a large installed storage and processing capacity, as well as the expansion of the poultry industry in the central and now in northern part of Mozambique (Benfica and Tschirley, 2012). Nonetheless, the share of maize growers who sell their produce is still low, ranging from less than 5 per cent in the southern provinces to 20–30 per cent in some of the central and northern provinces (TIA, 2012).

Cassava ranks as the second most important staple crop after maize; a total of around 2.5 million farms (69 per cent) cultivate the crop, and accounts for around 19 per cent of the land area planted with staple food crops (CAP, 2011), particularly in agro-ecological regions 2, 5 and 7. It is estimated that the value of cassava production has a potential of generating a business volume of about US\$244 million (MIC 2007). Due to the large number of poor farmers involved in the production of cassava, investment in this crop, including into research, are thus likely to have a significant impact on poverty reduction (Walker *et al.*, 2006).

Cassava is grown in all provinces, but it is relatively more important in Nampula, Zambezia, Inhambane and Cabo Delgado where more than 70 per cent of smallholders cultivate the crop (TIA, 2012). In these provinces cassava is a major staple food, and its roots are a major source of calories/carbohydrates for a substantial part of the population, particularly in Nampula (TIA, 2012). Cassava is usually intercropped with cowpea, pigeon pea, groundnut, sweet potato and maize, but it is also grown as sole crop. Cassava leaves are also consumed and are an important source of vitamin A and C, protein and minerals as iron and calcium (TIA, 2012).

Cassava is mostly grown for household consumption, with limited use of purchased inputs (apart from improved planting material distributed by the IIAM) and only a small proportion of cassava production is marketed. However, commercial demand for cassava is now increasing due to new industrial uses, such as in the brewing industry. Through a government initiative to develop the cassava value chain, a consortium of organisations and private firms are now acquiring tubers from smallholder farmers (IIAM 2014). Benfica and Tschirley (2012) show a positive, although marginal, increase of farmers' participation in the cassava market, from 10 per cent to 12 per cent between 2008 and 2011.

Rice ranks as the third most important staple food in Mozambique and is the second most important cereal crop after maize, representing 8.73 per cent of the total area allocated to food crops (CAP, 2011). Small-scale farmers account for 99.5 per cent of rice growers, with an average area dedicated to the crop of around 0.5 ha (CAP, 2011). Rice is mainly grown in a rain-fed lowland ecosystem (Bias and Donovan, 2003) with little use of purchased inputs and heavy reliance on manual cultivation, with a labour-intensive system for land preparation, transplanting seedlings, weeding, harvesting and threshing.

Efforts have been made to increase the area under irrigation for rice production in the central part of the country, specifically in Sofala and in Zambeze provinces. Together with the rehabilitation of some irrigation schemes in the central part of Mozambique, mainly in Zambeze province, there have been efforts to provide rice farmers with technical assistance. One such effort has involved since 2011 a triangular co-operation between Mozambique, Japan and Vietnam to provide technical support to farmers. Technical assistance is complemented by efforts to promote the use of purchased inputs, with emphasis on improved rice varieties.³

In sharp contrast with most environments where rice is grown in Mozambique, a mechanised and irrigated rice system is found in the south, mainly represented by the large-scale public irrigation schemes of Chokwe and Xai-Xai. Under these systems, most farmers, particularly medium- and large-scale farmers, rely heavily on purchased inputs, mainly improved seed varieties and inorganic fertilisers.

Although production has been increasing in recent years, the average annual production of milled rice is only about 125,000 metric tonnes (data from 2009 to 2011), which is far below the average consumption, estimated at 510,000 tonnes for the same period (Index Mundi, 2011). The gap between domestic supply and demand for rice has been increasing, resulting in increasing rice imports.

2.2.2 Cash crops

Traditional cash crops in Mozambique include cotton, sugar cane, horticultural crops and tree crops such as banana and cashew nut. However, new crops are growing in importance in terms of market opportunities, including pigeon pea, soybean and sesame. The development of these crops is largely taking place in the northern and central parts of Mozambique, with vegetable production being important in the south (Benfica and Tschirley 2012).

A total of around 300,000 household farmers are involved in **cotton cultivation**. From 2007 to 2013, the area planted to cotton varied from around 125,000 to 190,000 hectares with an averaged crop yield of 500 kg/ha (IAM, 2013). Cotton production is essentially done by small-scale household farmers, each with an average cotton area lower than 1 ha, under rain-fed conditions. These farms account for more than 90 per cent of overall cotton production.

Cotton is mostly cultivated along the agro-ecological regions 6, 7 and 8, particularly in the northern provinces of Nampula, Cabo Delgado, and Niassa, which

together contribute more than 75 per cent of total cotton production. Growers usually dedicate between 30 and 50 per cent of their cropped area to cotton, reserving the rest for food crops. Within the plot, cotton is usually cultivated as a sole crop, although the use of strip cropping with cereals and leguminous crops has been recommended as a way to reduce pest incidence, decrease risk, and use land and labour more efficiently (Chamuene, 2007; Raimundo *et al.*, 2011; Altieri *et al.*, 2003).

Bananas are an important part of the staple diet as well as an important source of income for rural households. Most smallholder banana producers in Mozambique do not apply pesticides, do not use irrigation and use almost no fertiliser. As a result, yields are low, about 10 kg per bunch for smallholder producers, and fruit quality is poor, whereas modern banana production practices yield 25–30 kg per bunch. Commercial production has increased substantially in Mozambique in recent years with considerable investments by the private sector especially the Maputo, Manica and Nampula Provinces. More than 80 per cent of the bananas produced by commercial farms are exported regionally (especially South Africa), but also to the Middle East and Europe. About 20 per cent of the total production is consumed locally.

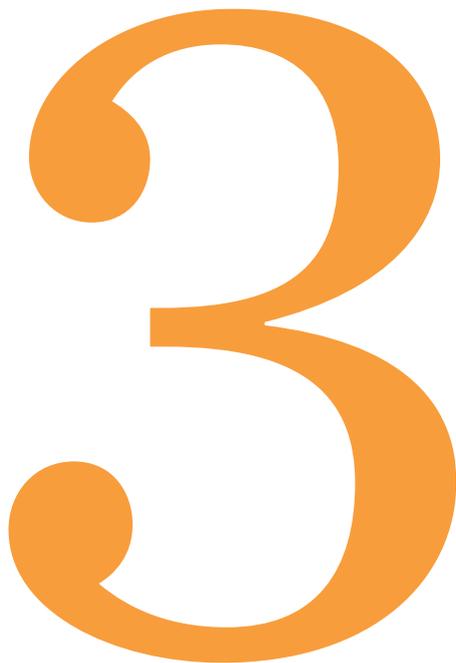
Cashew nuts are mainly produced along the coastal sandy strip, usually in a mixed cropping system involving maize, cassava, cowpea and groundnut. The crop is usually grown with no use of external inputs by smallholder farms, owning on average 28 trees per farm (CAP, 2011). About 1.5 million households (mainly concentrated in the central and northern province) are involved in cashew production in Mozambique (INE, 2007) and total production has showed a substantial increase starting from the 1990s, when a national cashew institute (INCAJU) was created and developed a strategic plan which promoted an integrated cashew management approach (Uaciquete *et al.*, 2013). Initiatives such as planting in blocks and planting in rows were introduced with participation of nongovernmental organisations (NGOs) such as the Adventist Development and Relief Agency (ADRA), World Vision, CARE-International, Helvetas, and others.

Most of the **sugar cane** lands in Mozambique are on flat alluvial plains of the Incomati (Xinavane and Maragra), Pungue, Muda (Mafamabisse) and Zambeze (Marromeu) rivers and the fields generally drain towards the river. Most of the sugar cane grown in Mozambique is under irrigation. There are four sugar mills in Mozambique; each of the mills is surrounded by cane estates predominantly owned by the respective milling companies which rely on intensive production methods.

³ <http://www.mofa.go.jp/policy/oda/white/2012/pdfs/c17.pdf> (PDF)

Sustainable agriculture: an overview of policies and practices

Sustainability in Mozambique is interpreted primarily as environmental sustainability, but aspects of economic viability and social justice are important too. Several initiatives seek to promote approaches such as agroforestry and conservation agriculture. However existing policies, while advocating for environmental stewardship and social inclusion, do not provide effective support to scale-up sustainable practices.



Agriculture in Mozambique could be considered as being organic by default in the sense that hardly any external inputs are used. Indeed, traditional farming systems involve practices such as intercropping of cereals and leguminous crops, agroforestry, especially fruit trees, and crop-livestock integration, depending on the location. Due to low population density, households in most parts of the country can let the land rest during fallow periods, and rotate crops from one year to the next.

The use of inputs such as inorganic fertilisers, herbicides and pesticides is more intensive in large-scale farms and among smallholder producers of commercial crops such as cotton, sugar cane, groundnuts and horticulture, and in irrigated rice schemes. Due to the relatively small importance of these crops compared with staple food production, the environmental impacts of chemical inputs on soil and water sources are estimated to be small in absolute terms. However, in future the extent of such impacts may grow alongside the growth of the commercial sector and a more effective monitoring system may be necessary.

While there is a great deal of uncertainty about the impact of large-scale commercial farms on smallholder producers, for instance in terms of employment, access to land and market participation, the family farming system may also be socially unsustainable in the longer term. Yields are well below potential, and it is very hard for farmers to increase productivity in order to make a profit out of agriculture. In addition, they are highly vulnerable to environmental and climate shocks. All these factors make farming a high-risk and poorly remunerated activity. This lack of opportunity, coupled with the use of labour-intensive technologies, make farming unattractive to many youth, especially considering the transformation happening in the rural economies.

In spite of some elements of sustainability, coupled with a negligible use of chemical inputs, smallholder agriculture cannot be unanimously defined as environmentally sustainable either. In fact many households use practices such as slash-and-burn, removal and burning of crop residues, and deforestation, which affect soil fertility and cause land degradation. In addition, as competition for land increases due to demographic growth, urban expansion, agricultural investments in more fertile areas and natural resource exploration, farmers are forced to cultivate the same plots for longer and to reduce the length of fallows. If this process of intensification is not accompanied by the use of technologies and practices that conserve the soil and replenish the nutrients, it may lead to rapid land degradation and declines in fertility. Soil degradation

due to nutrient depletion and erosion, pests and diseases, coupled with extreme weather events such as droughts and floods, further limit agriculture production and productivity.

Under this scenario, virtually everyone agrees that farmers should adopt improved farming techniques and move to more intensive cropping systems, and everyone is aware that this change must rely on sustainable practices. But how is 'sustainability' defined by local and national actors? And how it is put into practice?

3.1 Defining sustainable agriculture

Government institutions, including the national research institute (IIAM) and the Directorate of extension services (DNEA), and several development organisations such as FAO and CARE, see sustainable agriculture as an opportunity to improve the productivity of smallholder farmers, while promoting sustainable use of available resources and limiting the effects of drought and other climatic vulnerabilities. The majority of the stakeholders interviewed under this research thus see sustainability mainly through an environmental and climate change perspective. However, many of them also stressed socioeconomic aspects such as the need to promote technological and organisational options that are low cost and simple to use.

Although extremely important, the 'appropriateness' of a farming approach does not on its own guarantee sustainability. Sustainable practices should not only be appropriate but also attractive, especially to the younger generation, in order to be adopted in the long term. Such options should give farmers tangible results in the short term and should not expose them to risk and uncertainty. In order to be attractive, sustainable practices should help farmers overcome burdensome operations and, above all, give them market opportunities. Forcing farmers to experiment with something out of their sphere of knowledge without immediate benefits for them is unlikely to be successful in the long term. Instead, attention should be given to the specificities of each agro-ecological zone and to the local traditional knowledge.

The Mozambique Peasants Union (UNAC) identifies sustainability in farming largely as food sovereignty, or the right of local communities to manage and control their natural resources and productive means. This vision does not disregard the role of markets, which instead is stressed as a way through which smallholders should be able to control their food systems without being dependent on external inputs and technologies and large market players.

Finally, some interviewees also made the point that, while technology matters, the debate on sustainable agriculture should first pass through the lens of equality and social justice. In order to exploit the potentials offered by the agricultural sector, significant investments are needed in areas such as infrastructure, market development, post-harvest facilities and irrigation. An important aspect of sustainability is thus the degree to which farmers (and especially women farmers) participate in governance: who takes part in the decisions on investments that affect food and agriculture and how the benefits from these investments are distributed?

While these different interpretations are not necessarily in conflict with each other, interventions that aim at improving sustainability of the agricultural sector very rarely have a holistic approach that take into account all these issues.

3.2 Sustainable agriculture in practice

In the past few years, several initiatives have been implemented to enhance the sustainability of agriculture in Mozambique. Some of them aim to minimise the environmental impacts and increase the social benefits of existing commercial production. Others aim instead to introduce alternative approaches for greater environmental protection and soil and water conservation. Among these, conservation agriculture is by far the most diffused and researched approach. Agroforestry, integrated pest management and, to a lesser extent, biological pest control and sustainable soil fertility management are also being promoted in research and extension projects. Certified organic farming is not very common, with only few private firms having recently started organic production, mainly for export.

3.2.1 Enhancing sustainability in commercial agriculture

As the use of chemicals in horticulture production is expanding rapidly, the Ministry of Agriculture, in partnership with the UEM and ICIPE (International Centre of Insect Physiology and Ecology), have carried out research into the use of biological pest control while the ministry's Directorate of Agriculture Services is in the process of updating the list of banned pesticides.

The Government Cotton Institute (IAM) has promoted several measures to minimise the use of chemical inputs and increase erosion control in cotton fields. Research has been conducted on strip intercropping with encouraging results on integrated pest management, higher cotton yields and more efficient land use for food production (Chamuene *et al.*, 2007).

The IAM has also started an environmental management programme and is promoting conservation agriculture through its own network of extension staff. In addition, it developed a set of sustainability indicators following frameworks from the International Cotton Advisory Committee (ICAC), the Better Cotton Initiative (BCI) and Cotton Made in Africa. So far, several of the largest cotton companies operating in the country have adhered to these standards in order to be certified under the BCI and IAM is committed to make Mozambique the first country to make 100% of its cotton produced as 'Better Cotton'.⁴

Outgrowing schemes can provide farmers with the opportunity to liaise with markets and increase productivity through technical and institutional assistance. For instance Tongaat Hulett, a large agriculture and agro-processing company based in South Africa, has developed an outgrowing scheme which provides legal support to sugar-cane growers to set up formal associations and acquire land titles, delivers technical assistance and inputs to farmers and funds a socioeconomic development programme in partnerships with communities, government, and funding institutions. Under the scheme, the proportion of cane that Tongaat Hulett source from small-scale growers has increased from 3 per cent in 2007/8 to 20 per cent in 2013/14 and is expected to reach 28 per cent by 2015/16. As the factory stretch capacity has not reached its full potential, the company, with funding from the EU and BancABC, has decided to further extend its outgrowing schemes by investing in additional land development, training, legal assistance to farmers and irrigation infrastructure for both cash and food crops.⁵

However, these outgrower schemes do not always work well. While offering farmers the opportunity to market their production, the link to a company and its technological package may also create dependency and increase farmers' vulnerability to food insecurity. Recognising that outgrowing schemes in cotton have not helped increase the productivity of the outgrowers, IAM has developed a matrix of social and environmental indicators for outgrowing schemes that the companies negotiate with the government.⁶

⁴"Mozambique" on the Better Cotton Initiative website (<http://bettercotton.org/about-better-cotton/regions/mozambique/>).

⁵Personal communication with Sancho Cumbi, project manager, Xinavane Sugar Mill.

⁶Source: personal communication with IAM Director, Dr Norberto Mahalambe.

As large-scale investments in agriculture increase, their impacts on smallholders' access to markets are going to be of increasing concern. This is especially relevant as there seem to be expectations by the government that the transformation of the commercial sector in Mozambique will be driven primarily by large-scale investments (as the mandate of CEPAGRI and the large investments in growth corridors show), rather than the smallholder sector, which is instead expected to benefit directly and indirectly from these investments. To this regard, IUCN (the International Union for Conservation of Nature) has recently launched a new initiative, Sustain Africa, with the aim of ensuring that agricultural growth corridors in Mozambique and Tanzania are inclusive, green and resilient.⁷

3.2.2 Conservation agriculture

Conservation agriculture (CA) is based on three principles that aim to enhance biological processes: 1) minimum or no mechanical soil disturbance, 2) permanent organic soil cover, and 3) crop mixing and crop rotations. In the last ten years, the government and several national and international organisations have promoted these principles with different combinations and technological packages. Some of these initiatives are described in detail in Annex 3 and include interventions supported by MINAG, the FAO, the Austrian Development Cooperation, the German Development Agency (GIZ), CARE International in Mozambique and Ajuda de Desenvolvimento de Povo para Povo (ADPP).

Other agricultural development projects / development organisations that have promoted CA in Mozambique include ADRA (Adventist Development and Relief Agency) in Zambezia, Helvetas and the Aga Khan Foundation in Cabo Delgado; the Belgian government in partnership with the Ministry of Agriculture in Manica; the FAO, under the project Up-Scaling CA for Improved Food Security, funded by the Norwegian government; the International Maize and Wheat Improvement Centre (CIMMYT), in collaboration with the International Centre for Tropical Agriculture (CIAT) and IIAM, supported by the International Fund for Agriculture Development (IFAD); and World Vision in Gaza, Tete, and Zambezia.

Most of these interventions have promoted a mix of technical assistance, training – both for farmers and extension staff – and research and experimentation, due to the fact that CA is site-specific, involving a continuous learning process. Some of these, including field work supported by FAO and CARE, used a farmer field school approach. In terms of geographical coverage,

many interventions are concentrated in the province of Manica, although CA projects can be found throughout the country.

In Mozambique the use and availability of tractor or draught power is minimal, so minimal soil disturbance has been promoted largely through the use of manual power – hand hoes for digging basins and hand-drawn implements for ripping or direct planting. Alongside minimum and zero-tillage, practices disseminated under CA include mulching, mainly with crop residues and other sources of biomass, crop mixing and crop rotation. Some of the earlier technical packages relied heavily on herbicide application (Roundup and Ronstar) together with other external inputs, mainly improved seeds and inorganic fertilisers. More recently there have been efforts to promote more accessible practices such as integrated pest and weed management and organic fertilisers, but use of herbicides, inorganic fertilisers and improved varieties are also encouraged.

Overall, results from many of CA intervention showed substantial increases in yields, increased crop diversification and greater efficiency in water use and conservation. The impacts on labour saving are more unclear though. In spite of the positive outcomes, there has not been a widespread adoption of CA by Mozambican farmers. Common lessons learnt include difficulties in changing from conventional methods for land preparation to alternative agricultural practices. There were also difficulties with retaining crop residues in the field due to the traditional practice of free grazing, particularly in areas where large numbers of cattle are raised. In addition, due to the high prices, most farmers lack the resources to purchase external inputs such as inorganic fertilisers, herbicides and specific implements for CA. These potential constraints are addressed in Section 3.4

A variety of organisations are carrying out research in the area of CA in Mozambique. These include the IIAM, higher education institutions such as Eduardo Mondlane University and Michigan State University, and the international agriculture research centres CIMMYT, IITA (the International Institute of Tropical Agriculture), CIAT and ICRISAT (the International Crop Research Institute for the Semi-Arid Tropics). These institutions often work in collaborative projects such as the Sustainable Intensification of Maize-Legume Cropping Systems for Eastern and Southern Africa (SIMLESA) project, funded by the Australian government through the Australian Centre for International Agricultural Research, and the Agro-Ecology Based Aggradation-Conservation (ABACO) project under the Soil Fertility Consortium

⁷ See "Sustainability and Inclusion Strategy for Growth Corridors in Africa (SUSTAIN-Africa)", IUCN website, 5 February 2014 (www.iucn.org/news_homepage/news_by_date/?14396/Sustainability-and-Inclusion-Strategy-for-Growth-Corridors-in-Africa-SUSTAIN-Africa).

for Southern Africa (SOFECSA). Due to the growing importance of CA research and the need to harmonize interventions and develop synergies, a Conservation Agriculture Working Group of Mozambique (CAWGM) was created with financial support of the United States Agency for International Development (USAID). The CAWGM is hosted by the Platform for Agricultural Research and Technological Innovation of Mozambique (PIAIT) and led by the IIAM.

3.2.3 Agroforestry

In Mozambique, agroforestry initiatives gained a new impetus from late 2002 when the International Centre for Research in Agroforestry (ICRAF), now renamed the World Agroforestry Centre, initiated its activities in the country. ICRAF's intervention was built on previous research and experience gathered in other southern Africa countries, notably Malawi, Tanzania, Zambia and Zimbabwe. Early interventions occurred in Tete Province under USAID/TARGET-funded project, aiming to reach 16,000 Chichewa-speaking farmers. The project also covered Chichewa-speaking farmers in Malawi and Zambia. The main focus areas of intervention, as in other areas in the Southern Africa region, addressed the problems of soil fertility, scarcity of wood products, livestock fodder and general environmental degradation (Linyunga *et al.*, 2004). Through the use of low-input technologies, ICRAF aimed to strengthen food security and diversify household incomes. This was done through a step-wise process. The first stage disseminated technologies with a potential effect on farm productivity and the marketing of staple foods, while later stages disseminated advanced agroforestry technologies with the goal of diversifying household incomes (Linyunga *et al.*, 2004).

Mozambique was also part of the Zambezi Basin Agroforestry Project funded by a variety of international donors. In its early stages, the project concentrated its efforts on co-ordinating research and development at the country level through the National Agroforestry Steering Committee (NASCO), consisting of government departments, research institutions, universities and civil society, and at a regional level through Regional Agroforestry Steering Committees (RASC). After the verification of best-bet technologies through on-station and participatory research with farmers, the project scaled up this knowledge and disseminated planting materials (World Agroforestry Centre, 2013).

Since 2013 IIAM and the ministry's Directorate of Rural Extension DNER are implementing an agroforestry initiative, Building a Large EverGreen Agriculture Network for Africa (BLEANSA), in Maputo, Gaza and

Inhambane provinces. EverGreen Agriculture is a form of more intensive farming that integrates trees into crop and livestock production systems at various scales – field, farm and landscape. Practices include the integration of particular tree species into annual food crop systems in order to ensure greater production of food, fodder, fuel and fibre, and enhance carbon storage (World Agroforestry Centre, 2013).

3.2.4 Biological pest control and integrated pest management

Biological pest control seeks to achieve natural suppression of pests with no use of insecticides by using natural enemies, predators, and crop and insect diversification instead. Some basic research on biological pest control has been undertaken by the Faculty of Agronomy of the University Eduardo Mondlane (FAEF-UEM) in partnership with MINAG, the Polytechnic High School of Manica (ISPM) and ICIPE. Although individual research projects provide no information on financial viability, there are indications that biological control can address aspects of economic sustainability in the long run, as showed by a draft report on the impact of biological control on stem borers (1993–2008) implemented in Mozambique, Kenya and Tanzania (ICIPE, 2014).

Integrated pest management (IPM) combines agricultural practices such as biological pest control, intercropping and mulching with the application of pesticides, mainly for the production of cotton, fruit and vegetables. Farmers are trained to switch from calendar (or preventive) spraying to threshold spraying (based on the extent of actual infestation), and learn strategies such as early planting to ensure plants are as strong as possible at key moments of pest pressure. Farmers are also trained in conservation farming, including mulching of various types. Methods include putting weed cuttings between cotton rows and contouring fields with vetiver grass. These methods help prevent soil erosion and run-off when it rains. Experiential learning is essential to the successful adoption of IPM, as this depends crucially on farmers' knowledge and understanding.

Most IPM initiatives in Mozambique are addressed through basic research projects undertaken by the FAEF-UEM (including students' final theses) in partnership with MINAG, IIAM, ISPM, National Cotton Institute, ICIPE and private companies such as DUNAVANT. Most of them are concentrated in the central and northern provinces of Tete, Zambezia, Nampula, Niassa and Cabo Delgado. Ongoing research is trying to address potential training and education strategies to enhance farmers' knowledge and overcome constraints to adoption.

3.2.5 Sustainable soil fertility management

Sustainable soil fertility practices have been promoted through dissemination projects undertaken by several organisations including FAEF-UEM, IIAM, the National Directorate of Agricultural Extension (DNEA), World Vision, Helvetas, FAO, the German Agency for Technical Development (GTZ), Sasakawa Global 2000, and the Austrian Development Cooperation agency. Most projects have been conducted in the districts of the central provinces of Manica, Sofala and Zambezia. Among the soil fertility practices promoted under these initiatives are: composting and application of organic compost; use of lime to correct soil acidity; use of manure, bat guano and cowpea residues; improved fallows using *Gliricidia sepium*, *Sesbania sesban*, *Tephrosia vogeli*, *Tephrosia candida* to improve soil fertility and increase food production; simultaneous intercropping; relay intercropping cover cropping; use of crop residues; productive integration of livestock in integrated cropping systems as sources of manure and power; crop rotations; and cropping systems to manage weed. The practices have been applied mostly in maize-based farming systems.

The type of practices promoted and the point of view of some project co-ordinators indicate a focus on economic sustainability. The projects seek soil fertility-enhancing measures that are locally available at lower costs than inorganic fertilisers, reducing input costs. Nevertheless, none of the materials reviewed provided evidence of financial viability such as cost-benefit analysis, taking labour costs into account.

3.2.6 Organic agriculture

Only a few niche products, including coconut oil, herbs and spices, were produced through organic farming in Mozambique in 2003 (Parrott *et al.*, 2003). Since then, not much has changed. The major constraint to the expansion of organic agriculture is that the local demand for organic produce is negligible (mainly driven by the tourism sector) compared with the demand for uniform, 'nice-looking' products by the growing urban middle-class. The expansion of trade in organic products for export markets is limited by the strict systems of inspection and certification. This is highlighted in a report developed by Vossenaar (2002) summarising the results of a seminar held in Maputo in 2001, organised by the International Trade Centre (a joint agency of the World Trade Organization and the United Nations) in co-operation with the Export Promotion Institute of Mozambique (IPEX).

The report concluded that as Mozambique does not have an agency for certification of organic production, the country should focus on the improvement of economic development in rural areas including the promotion of sustainable agriculture production and improvement in food security. Vossenaar (2002) considered that the country had strong potential for organic agricultural production, identified a range of products that could be promoted and pointed out a local organisation with a focus in the area of organic agriculture, the Association for Biological Agriculture, Biodiversity and Sustainable Development (ABIODES), showing strong interest in the development of local organic standards. Since then however, organic agriculture has not been supported by any government policy and there are only a few examples of organic production.

The African Food Company (TAFC), for instance, claims to be a pioneer in organic banana cultivation. Established in Gaza Province in 2010 with access to the Limpopo River for irrigation, this company has planted 300 hectares of organic Cavendish bananas and has an annual production capacity of 15,000 metric tons of certified organic banana. Its main export market is South Africa, the certification to this end being issued by an authorised German agency (BCS Öko- Garantie).⁸

Private investments in organic sugar-cane production are at very early stage. In the southern province of Maputo, Pure Diets plans to farm and process organic sugar cane for export to Europe and the USA. To date a total of 87 hectares has been planted with seed cane, but the company is expected to expand its operations over 9,000 hectares.⁹ A German company, Ecofarm, plans to produce organic sugar on an area of 2,500 hectares in Sofala province, but this project is only at early stages and depends on funding and institutional arrangements, such as public-private partnership.¹⁰ Organic cashew production is also being considered. In this regard, the Aga Khan Foundation and TechnoServe formed a consortium to run a three year project, the MOZACAJU project. It started in 2014 and runs in the northern part of Mozambique and also promotes intercropping of cashew with other food crops such as maize, cowpeas and peanuts.¹¹

One example of organic farming involving smallholder farmers comes from interventions by World Renew, which has been working in Mozambique since 1993, particularly in Tete province (Mutarara district) and in Niassa province. This organisation, together with its partners, encourages farmers to adopt improved organic techniques, which include minimum and zero tillage, mulching, the application of compost and manure

⁸ www.theafricanfoodcompany.com

⁹ <http://purelifeorganicfoods.com/project.html>

¹⁰ Personal communication with Antonieta Bias and Albano Leite.

¹¹ www.mozacaju.com

rather than chemical fertiliser, the use of locally available nitrogen-fixing legumes, and crop diversification. Producers, however, do not seek any certification, meaning that they do not benefit from a premium price

3.3 Sustainable agriculture in policy

The Ministry of Land, Environment and Rural Development (previously known as Ministry for the Coordination of Environmental Affairs or MICOA) and the Ministry of Agriculture and Food Security (MINAG) play a major role in developing and implementing policies directly and indirectly related to sustainable agriculture.

The Ministry of Land, Environment and Rural Development has developed a number of policy documents relevant to the agricultural sector and its sustainability. The most relevant include the Environmental Law (1997), the Environmental Strategy for Sustainable Development (2007, currently under revision), the Action Plan for Prevention and Control of Soil Erosion (2007), the Action Plan for the Prevention and Control of Uncontrolled Burning (2007), the National Action Plan to Adapt to Climate Change (2007–2010) and, more recently, the National Climate Change Adaptation and Mitigation Strategy (2012) for the period 2013–2025. The ministry is also responsible for approving the environmental impact assessments of the investment plans submitted to the Agriculture Promotion Centre (CEPAGRI) as well as monitoring the environmental impacts of these investments, although many lament that the monitoring and sanctioning capacities are limited by budget constraints.

Under MINAG, two umbrella policy documents provide a guiding framework for agriculture interventions: the first is the Agriculture Policy and its Implementation Strategy (PAEI) approved in 1995 (Resolution nr 11/95) and, more recently, the Strategic Plan for the Agriculture Sector Development (PEDSA) with time span of ten years, from 2011 to 2020.

PEDSA is currently the main guiding framework for agriculture development in Mozambique. It is based on the pillars and principles of the Comprehensive African Agriculture Development Programme (CAADP)¹² and is organised around four pillars: 1) agriculture productivity through increased production, productivity and competitiveness; 2) access to markets through improved infrastructure and services for input and output markets; 3) natural resources through integral and sustainable use of natural resources, namely land, water, forest and wildlife; and 4) institutions through

capacity building and strengthening of agriculture institutions. To achieve these specific objectives, MINAG has recently approved a National Plan for Strategic Investment in Agriculture (PNISA).

Under the first strategic objective, namely “increased production, productivity and competitiveness”, PEDSA envisages growth in agricultural production at a rate of 7 per cent per year through the combination of increased productivity and increases in the cultivated area. The expected results include the adoption of improved technologies through increased access to inputs and services; increased investments in agriculture, including investments in market-related infrastructure; and a stronger support from the research and extension systems. Under the same objective the document also calls for efficient water management; improved control of pests and diseases through IPM, including biological methods; soil fertility improvement through increased use of grain legumes, agroforestry and conservation agriculture; and increased use of inorganic fertilisers and investment in research on soil fertility, including locally available mineral fertilisers and research on inorganic and organic fertilisers and biological nitrogen fixation.

PEDSA suggests several interventions in order to achieve the strategic objective of “sustainable use of land, water forests and wildlife resources”. These interventions mainly aim to enhance the institutional, planning and legal capacities of different stakeholders (MINAG, MICOA and farmers), in order to map and manage the natural resources (land, water, forests and fauna); develop and implement strategies for climate change mitigation; improve the ability of rural communities and extension staff to sustainably manage wild fauna and reduce human-wildlife conflict; and limit detrimental activities such as fires and logging.

While these points show awareness of the importance of preserving the natural resource base, and commitment towards a better planning for natural resource use and management, they also show that the institutions and the policy mechanisms to support these intentions are still under development. For instance, while PNISA establishes a set of priorities for the 21 programmes agreed under the pillars of PEDSA, no indicators, apart from a few growth targets for specific commodities, have been developed to measure progress in delivering the new strategy (MINAG, 2014). In addition, while specific sub-sectorial strategic programmes have been developed for mechanisation and for fertilisers, there is no similar strategic focus for the implementation of other components more relevant to soil and water management and to natural resources.

¹² Established under the auspices of NEPAD (New Partnership for Africa's Development), CAADP is a continent-wide, pro-poor initiative that provides a common strategic and guiding framework for African agriculture development with a goal of promoting investments for agriculture growth, increased food security and reduced poverty.

More importantly, it is not clear whether enough resources are mobilised to achieve these objectives. Under PEDSA and its implementing tool, PNISA, the bulk of the budget – 85 per cent – is going to be allocated to the “Production and Productivity” component, reflecting the prominent government focus on facilitating private investment to foster expansion of the agricultural sector, compared to other strategic pillars (MINAG, 2014). This is especially concerning as public expenditure on agriculture is already low – in 2011 it still represented only 5.3 per cent of the state budget, well below the CAADP target of 10 per cent, and about 75 per cent of this expenditure was on salaries and other transfers including institutional support. Within the agricultural budget, investments in research are extremely low even in comparison with African standards, with the share for R&D being only about 0.6 per cent of agricultural GDP (Mogues *et al.*, 2012).

The Directorate of Agricultural Extension promotes sustainable approaches such as conservation agriculture and agro-ecology, but these are intended to support subsistence production in smallholder farming, thus attracting less interest (including by farmers) and fewer funds – both public and private. In 2013 the Government of Mozambique joined the

New Alliance for Food Security and Nutrition, a shared commitment among the government, the private sector and donors to deliver inclusive agricultural growth. Through the New Alliance, the Government is receiving financial support, contingent to the implementation of 15 policy actions in support of commercial agricultural growth (MINAG, 2014). None of these policy actions, currently at different degrees of implementation, relates directly or indirectly to the use of natural resources or to the environmental impacts of agriculture; whereas socioeconomic issues are addressed only through the facilitation of commercial relationships between local communities and investors.

In summary, while both the MICOA and the MINAG address different aspects of sustainability in their respective policies, there is no organic programme of work to disseminate and scale-up sustainable agriculture. This is partly due to the fact that the responsibility for sustainable agriculture and climate change is shared between the two ministries and, within each ministry, across different directorates. More importantly, however, the policy components which are more relevant to sustainability do not receive as much institutional support (and funds) as those supporting growth and productivity, as the government commitments under PNISA and the New Alliance show.

The shift towards greater sustainability: opportunities and challenges

Research trials and anecdotal evidence suggest that sustainable approaches help increase yields while being more resilient and economically accessible. However adoption rates among farmers remain low. There are financial, technical and institutional constraints to scaling-up, which need to be analysed in the context of the socioeconomic transformations taking place in rural areas.



Studies that compare conservation practices with conventional farming show that the former result in higher yields, higher soil moisture and greater water retention, although yield gains are generally higher in environments with low rainfall or prone to erosion, whereas the differences decrease in high rainfall environments (Nyangumbo *et al.*, 2014; Dias and Nyangumbo, no date). Under our survey, several interviewees acknowledged that converting to conservation practices requires initial investments in knowledge, time and resources. However, they also reported that farmers who continue to apply sustainable principles realise returns in the medium term, as the labour burden progressively decreases, the costs for inputs are reduced, water and land management become more efficient, and there is less pressure on local resources including forests.

In spite of the benefits, uncertainty remains over the actual rates of adoption among Mozambican farmers, which overall seem to be low or take some time to happen (Grabowski *et al.*, 2013). For instance, in order to gain the full potential of CA, all three of its principles should be applied simultaneously, but in Mozambique (as in the rest of sub-Saharan Africa) most farmers do not adopt all the principles due to constraints related to accessibility of resources including land, labour and inputs like herbicides or seeds for cover crops, or due to the need to feed their livestock with crop residues (Giller *et al.* 2009).

In addition, while anecdotal evidence from NGOs such as ADRA, ADPP and CARE show that farmers are generally receptive, and those who adopt consistently the new practices are aware of the benefits, no study has been conducted to assess how many farmers continue to employ the practices learnt under CA or other approaches a few years after the dissemination initiatives ended. As a consequence, no concrete data exist about the medium- and long-term impacts of CA on food security and income and no information is available on the determinants or the deterrents of long-term adoption. The same applies to other types of sustainable farming approaches that have been promoted in the country. On the other hand, it is fair to consider that these questions have arisen relatively recently in Mozambique. The agricultural sector is going through a transformation, with high expectation about the potential, but also uncertainty about the impact of investments on smallholder agriculture, the future role of smallholders, and the links between the two scales.

4.1 Technical and financial constraints

Some of the constraints on the adoption of the sustainable practices described in this report are of a technical and economic nature. Some practices are very knowledge intensive and require time for farmers to learn technical and managerial skills. For instance, producers using biological pest control need to control the agro-ecosystem with high degree of precision. Other practices, such as composting, IPM and minimum tillage, are also more labour intensive, at least in the early stages of adoption. In CA, many farmers lament that digging and maintaining basins and collecting and keeping mulch on the field are especially burdensome. Additional labour may also be required for land preparation, compost production and weeding. The burden of this work, especially for weeding and mulching, often falls more on women than men.

Labour-saving technologies exist. For instance, Brazilian jab planters for manual direct seeding save time and also overcome the difficulty of digging basins in sandy soils that collapse easily, although on the other hand they may be hard to use in heavy soils (Grabowski and Mouzinho, 2013). The use of cover crops can substitute the need to collect mulch material and can also help control soil erosion and (with good pasture management) keep the soil covered in areas where livestock grazing makes it difficult to maintain crop residues. Currently these options are not widely promoted and need to be further assessed. The additional labour burden, not just in CA but also in practices such as composting and IPM, tends to decrease over time, but it can still be a strong deterrent because it occurs before the benefits are appreciable.

Where herbicides and other inputs such as improved seeds and inorganic fertilisers have been promoted as part of CA technical packages, lack of resources to buy these products is another obstacle to adoption. While herbicide has been promoted in the early years of zero tillage, some organisations focus their interventions on alternative ways to suppress weed pressure such as intercropping and crop rotation involving grain legumes, mulching and cover crops. Similarly, there are alternative strategies to reduce the use of inorganic fertilisers, such as cereal-legume intercropping and rotation, promotion of leguminous cover crops and the use of organic fertilisers. However, integrated soil management and biological pest control are approaches that in turn require investment in continuous learning and experimentation by both farmers and extension providers.

4.2 Institutional issues and farmers' choices: 'demand' and 'supply' of sustainable agriculture

Beyond technical constraints, other factors of an institutional, cultural and socioeconomic nature hinder the widespread adoption of sustainable agricultural practices. Some of these factors can be grouped under the 'demand' side, reflecting the fact that pursuing sustainability, especially environmental sustainability, may not be a priority for all farmers. The institutional and technical issues that affect the actual capacity of delivering knowledge and technical assistance in sustainable agriculture, can be grouped under the 'supply' side.

In CA, adoption of mulching and intercropping has been constrained by late land preparation by farmers, farmers not valuing crop residues to cover cultivated soils, and farmers lacking knowledge of the CA approach. This lack of commitment may be due to cultural factors – maybe the local leadership has not been supportive or simply it takes time to change farming practices that have been used for long time – but it can be also be due to risk aversion: some farmers may not want to invest their time and resources in practices whose benefits take time to realise or that have been successful only at a small scale.

In addition, while farmers understand and agree on the need to preserve the natural resource base, they may not be fully motivated to pursue these approaches if other priorities, such as irrigation, access to credit and infrastructure, are more pertinent to them. As the increase in yields may take some time to realise, farmers may not appreciate these benefits against the investments in time and resources that are due upfront. Similarly, unless they are severely affected by any environmental pressure, it is difficult for farmers as individuals to take into consideration the positive externalities, the social benefits that sustainable agriculture brings about for the environment and the society.

On the demand side, there can thus be an issue of 'ownership' by farmers. Some households do not see farming as their primary source of income but mainly as a subsistence activity, and they may not be interested in investing time and resources in it. At the other end of the scale, farmers who want to increase their

productivity are more concerned with accessing water, credit and the market. Without environmental pressure, risk aversion remains high, and even those who realise the importance of preserving the natural resource base may not have a long-term vision of problems such as the unsustainable intensification of the use of land.

Farmers who already use sustainable approaches and are keen to enhance them, may still feel lack of ownership if the learning and dissemination process are not tailored to address their specific needs and do not take into account the characteristics of their local practices. Although many recognise the importance of continuous learning and participatory innovation, lack of knowledge and resources can make difficult for extension staff, researchers and even NGOs to put participatory principles into practice.

On the 'supply' side, institutional constraints to adoption come from the fact that some of the sustainable practices promoted have been found to be unsuitable to certain agro-ecological or soil characteristics or inappropriate given farmers' skills and resources. These practices are often promoted without paying enough attention to the local specificities. Most importantly, they are promoted through a rather top-down, 'transfer-of-technology' model that limits the participation of farmers in developing and adapting the technology (e.g. training of trainers, sporadic field days and demonstration plots). There is little or no research-extension-farmer triangulation that can help address solutions through continuous learning and feedback.

Extension and research staff outreach is surely limited by the lack of resources, but their approach is also the result of the training curricula, which are largely based on conventional farming. More knowledge exists among researchers, both at IIAM and universities, but there are no strong links between research and extension, and the research system itself is not working on a compact programme to push sustainable agriculture.

As mentioned earlier, another element of sustainability is the capacity of households to source an income and create employment beyond securing their food. Experiences such as the ADRA value chain support project, funded by AGRA, show that when the marketing opportunity exists, increasing productivity follows – regardless of the technology adopted.¹³ However, many have promoted sustainable practices in Mozambique by seeking to improve households' crop production for food security, without analysing the local market dynamics and without a value chain approach.

¹³ Personal communication with Mr Armindo Salato, ADRA

Conclusions and recommendations

In Mozambique, there is an increasing support for sustainable agriculture across different types of stakeholders. However, long-term adoption of sustainable practices remains low. Stronger policy advocacy, consistent institutional support and funding for participatory research and innovation are needed to scale-up sustainable practices as a viable option to transform the agricultural sector.



Overall, the stakeholders we interviewed during our research agreed on the need to make agriculture more sustainable, especially in light of the changes likely to happen in the agricultural sector and, more generally, affecting rural economies. This understanding is reflected by their commitment to several field and research projects.

When it came to defining 'sustainability', for most the environmental dimension prevailed, but they generally acknowledged that many different dimensions count. Such a holistic view however is not always reflected in practice, as many initiatives focus on technical solutions that are not tailored to the local socioeconomic and agro-ecological conditions. As a result, even if farmers are aware of the importance of preserving the natural resource base, adopting more sustainable practices may not be a priority for many of them: the poorest households see farming as a risky and non-remunerative activity they are not willing to invest in; whereas market-oriented farmers prioritise efforts to overcome structural constraints such as lack of irrigation and poor access to credit.

Indeed, although precise figures are not available, adoption rates of sustainable practices among smallholder farmers seem to remain low. While it is fair to note that these questions have gained importance in relatively recent times, a number of technical, financial and institutional factors hinder the scaling-up of sustainable approaches and need to be addressed. Drawing on the discussion in Section 4, this section provides a number of recommendations. Some of them are not conclusive findings; rather they flag outstanding issues that need further research and attention.

Cover research gaps

Some gaps have been identified in research. Generally speaking, research needs to address the specific technical constraints to sustainable agriculture in Mozambique, taking into account the country's diverse agro-ecologies, and seeking solutions that can best use local skills and resources. In terms of socioeconomics, the research gaps include studies of profitability and riskiness of CA compared with conventional system, the cost effectiveness and long-term benefits of CA systems, and the characterisation of adopters and non-adopters. The latter is especially important as no information is available on the farmers that continue to use sustainable approaches a few years after the dissemination initiatives end. Estimating the number of 'independent adopters' would be very useful to assess

the impacts of the technology on food security and other dimensions in the long-term.

Focus on the learning and training of agricultural staff

More resources, of course, should be invested to enhance research and extension staff's capacity to focus on sustainable practices, and reach more farmers. Capable trainers are key to the dissemination and uptake of new practices, but most agricultural professionals have been trained in conventional farming. Even in CA, which has been widely promoted, learning is at an initial stage. In Mozambique, research and extension staff should be offered more courses on sustainable agricultural practices during their training. This should include also learning and practising more participatory ways to develop and disseminate innovations with farmers. Some work to reform the extension staff curricula has been done by CARE and FAO but a more systematic approach would be welcome.

Sustainable agriculture should be a consistent part of the curriculum in agricultural colleges. Currently the Faculty of Agronomy does not teach sustainable approaches such as agro-ecology as separate subjects, but mentions them in diverse courses. Only agroforestry has a dedicated course but not all the students take it.

Strengthen the links between research and extension

Strengthening the links between research and extension would be also very useful. These links are rather weak at national level. At provincial level there is more interaction but there is still no system of triangulation between extension, research and farmers in practice. Such a system, if easily accessible by farmers, would help address constraints (such as labour-intensive practices) through continuous learning and feedback. The agricultural development model used by ADPP, for instance, foresees an extension programme whereby an instructor joins a community and works with farmers clubs of 20–25 farmers for a minimum of three years.¹⁴

Value farmers' innovations

Extension and research staff should also map and document farmers' traditional knowledge and local innovations. These can be helpful to adapt sustainable approaches to local contexts, but there does not seem to be much interest in exploiting this potential

¹⁴ ADPP has been promoting the Farmers' Club Programme in several provinces of Mozambique since 2006. The programme has so far benefited over 16,000 farmers in 7 provinces and the beneficiaries have succeeded in increasing crop yields and diversifying production and improving their nutrition (source: personal communication with Ms. Birgit Holm, ADPP Country Director). Building on its experience, ADPP launched a new Farmers' Club programme in November 2014 for the period 2014–2018 with a target of reaching 14,000 small-scale farmers in the provinces of Sofala and Zambezia (source: "Projecto Clubes de Agricultores da SNV e ADPP foi lançado em Sofala e Zambézia", SNV website, 2 December 2014: www.snvworld.org/pt/countries/mozambique/news/projecto-clubes-de-agricultores-da-snv-e-adpp-foi-lancado-em-sofala-e)

as many regard family farming as inefficient. The Prolinnova country platform in Mozambique has in the past documented smallholder innovations and organised events to share these results;¹⁵ however the dissemination of these resources has been minimal and they struggle to implement an organic programme due to lack of funds.

Mundukide, a small foundation, use an interesting model: once they identify the products that have the highest potential in the districts where they work, they scout farmers or farmers' groups elsewhere in the country that are particularly successful in producing those crops. They then hire the successful farmers as trainers for a minimum of 4 months to work intensively with producers. This technical assistance is the only service the producers do not pay for. However, the foundation also helps create the conditions for marketing, by building or improving the local roads and trading the inputs and the implements that are not locally available, at least until there is enough demand for someone else start to supply them.¹⁶ Although not necessarily focused on environmental sustainability, this approach helps identify technologies and practices that are socially appropriate and that are most likely to return an economic profit.

Create the right incentives for the farmers of today...

While it is true that most smallholders produce mainly for their own consumption, this should not discourage the promoters of sustainable practices to consider marketing opportunities. Unless producers are affected by stresses such as severe land degradation or highly unpredictable rainfalls, they may not appreciate the long-term benefits of these practices – both private and for the society – in comparison with the investment required upfront. This is especially true for those households who, seeing farming as synonymous with poverty, are not willing to invest in land improvements and are likely to quit farming as soon as better income opportunities arise.

One way to fill the 'gap' between private costs and social benefits is through targeted subsidies, tied to the use of a certain practices or technologies, or payments for ecosystem services to farmers. However these solutions are highly costly and institutionally complex to implement.

Creating marketing opportunities can help farmers to make investment decisions that may involve some risks. Investments should be made to fix structural problems, such as access to water and energy, availability of rural credit, infrastructure, and post-harvest facilities,

but in a way that addresses primarily the needs of the smallholder sector. More specific interventions to support sustainable agriculture could be done at national level, for instance by promoting marketing of organic inputs and implements for minimum tillage, or by providing advisory services for sustainable water and land management. Support and extension for crop-livestock integration and veterinary services, largely absent in the northern provinces, can also help address some constraints to the adoption of CA such as lack of animal traction, lack of manure and improved grazing control.

At a local level, marketing opportunities should be always assessed to evaluate the potential impact on income and food security of adopting new sustainable approaches for food and cash crops. The opportunity cost of labour should also be factored in, as especially the youth may be attracted by alternative employment opportunities if they consider that the returns and risks of farming do not compensate for the labour involved.

...and the farmers of tomorrow

Market incentives for sustainable agriculture should also distinguish between farmers, and focus on those who are more likely to 'step-up'. In the longer term, assuming that more people will progressively abandon the sector, while more competitive farmers will consolidate and manage relatively larger farms, agro-ecology should be promoted as a way to address sustainable production intensification at different scales.

Implement proactive policies...

Agricultural, environmental and climate change policies address many aspects of sustainability in agriculture, but there is no integrated document¹⁷ or programme of work focusing strategically on the support and the implementation of sustainable practices, beyond minimising the impacts of unsustainable ones. Considering that successful interventions should have a holistic approach and that most benefits are realised in the medium- and long-term, a more co-ordinated effort to promote sustainable agriculture would help achieve a shared understanding of what actions and investments are needed, in the context of the overall sector growth strategy. In addition, agro-ecological farming approaches should be promoted at a landscape scale, whereas the current division of competencies between MINAG and MICOA makes working at landscape level difficult.

It is not clear how policies for smallholders and policies for large-scale investments relate to each other. At the moment the expectation seems to be that the transformation of the commercial sector will be driven

¹⁵ See the Mozambique Country Platform, www.prolinnova.net/mozam.

¹⁶ Source: personal communication with Mr Benat Arzadun, Mundukide.

¹⁷ Strategic documents have been produced instead on the 'Green Revolution for Mozambique', the use of fertilisers and the use of mechanisation

by large-scale investments, as the implementation status of PEDSA and the Government's commitment to the New Alliance show. These investments may promote monocultures and technological packages which are poorly complementary and even in conflict with sustainable agriculture. A stronger focus on the smallholder sector as the driver of agricultural transformation may help sustainable approaches such as CA or agro-ecology to be adopted more widely and consistently (also due to the fact that these approaches work better at a smaller scale) and avoid the environmental hazards associated with large-scale, industrial agricultural production. In order to shift the focus on the smallholder sector, however, the government must support the idea that small- and medium-scale farmers, with the right support, can graduate to economically viable farms, being able to deliver on food security, poverty reduction and employment.

...and back them with adequate investments

Investments are needed also to create the conditions that provide incentives to farmers and other public and private stakeholders to engage in sustainable agriculture. Mozambique is still far below the CAADP target of spending 10 per cent of the national budget on agriculture.

Commitment to funding is extremely important. Some of the benefits of sustainable agriculture manifest in the medium- and the long-term. This requires a significant investment which is consistent over time. More funding is needed to back scientific research (both basic research and applied research), technology development and extension, in order to address the gaps that have been identified in these areas and come up with new solutions. Investments are needed in institutional strengthening for monitoring and implementing policies and regulations and to work across disciplines and ministries.

Influence policymaking

There is wide support for sustainable agriculture, and in particular conservation agriculture, across some directorates of the MINAG, civil society organisations, farmers' groups and development agencies. However, these positions need to be further consolidated over a common understanding of sustainable agriculture which takes holistically into account different aspects of

environmental sustainability, social justice and economic viability. In addition, some of them see sustainable farming as an option for subsistence production only, making it less attractive to policymakers and investors, including some categories of farmers. Strengthening the capacity of these actors to advocate for sustainable smallholder agriculture as a viable option for the transformation of the agricultural sector would help them to influence policymakers and bring sustainable agriculture more consistently into the policy agenda.

Various networks exist on different topics, but none of these apart from the Food Sovereignty Network (Rede das Organizações para Soberania Alimentar or ROSA), which has been recently revitalised, has a direct focus on agro-ecology and other sustainable practices with the objective of influencing policy. Some of the stakeholders interviewed stressed that their interventions are seldom linked to each other and that it would be good to have occasions for mutual learning and to create synergies, not only to reinforce their role in policy advocacy but also to avoid duplication of efforts.

The workshop which IIED is organising alongside UEM, IIAM and CARE, to be held in Maputo in May, can be a first step towards this process. While suggesting some preliminary conclusions on what could be done to help Mozambique shift towards more sustainable agriculture, this scoping report also raises some outstanding questions. One key issue is whether sustainable agriculture is a priority for all smallholder farmers and what are the right incentives to make it a priority for all. A second issue is how to tailor technical and institutional interventions to make sure that sustainable agriculture works well for different types of farmers in different contexts. Finally, when planning and tailoring these interventions, a major question is how to make sure that sustainable agriculture works also in the longer term, assuming that more competitive farmers may consolidate land into larger farms and more family farms may progressively exit the agricultural sector. With this regard, analysis is especially needed to assess how agro-ecology and other sustainable approaches can make sustainable intensification possible at different scales.

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Annex 1

List of informants interviewed during the background research

NAME	INSTITUTION	DETAILS
Prof. Domingo Cugala	FAEF-UEM	Biological Control
Prof. Alfredo Nhatumbo	FAEF-UEM	Soil Fertility
Prof. Amelia Sidumo	FAEF-UEM	Integrated Pest Management
Engo. Eduardo Massingue	IIAM- BLEANSA	Agroforestry
Dr. Ricardo Pequenino	IIAM-BLEANSA	Conservation agriculture and Agroforestry
Eng. Alberto Macucule	IIAM- BLEANSA	Agroforestry
Enga. Carla Cumbe	FAO	Sustainable Agriculture and Farm Field Schools
Prof. Luisa Santos	FAEF-UEM	Biological control and Integrated Pest Management
Eng. Wilson Leonardo	IFDC/IITA Mozambique	Fertilizers
Eng. Bordalo Mouzinho	MSU	Farming systems
Nicholas Dexter	CARE International	Impacts of conservation agriculture

Annex 2

List of interviewees under the stakeholder survey

NAME	POSITION	ORGANISATION	TYPE OF ORGANISATION
Luis Muchanga (Mr)	National Coordinator	UNAC (National peasant union)	Farmers organisation
Bartolomeu António (Mr)	Technical training	UNAC	Farmers organisation
Inácio Maria Manuel	Technical training	UNAC	Farmers organisation
Calisto Bias (Mr)	Coordinator for MINAG	Prosavana	Governmental
Fernanda Simbine (Ms)	Agricultural specialist	Setsan (Technical secretariat for food and nutrition security)	Governmental
Marcela Libombo (Ms)	Executive Secretary	Setsan	Governmental
Ligia J. Mutemba (Ms)	Agricultural specialist	Setsan	Governmental
Danila Cumbane (Ms)	Communication specialist	Setsan	Governmental
Fernando Mavie (Mr)	Director	MINAG – DNEA (Directorate of agricultural extension)	Governmental
Inacio Nhandale (Mr)	Chief of Technical Department	MINAG – DNEA	Governmental
Norberto Mahalambe (Mr)	Director	IAM (Mozambique cotton institute)	Governmental
Lazaro Nhangombe (Mr)	Investment Analyst	Capagri (Centre for the promotion of agricultural investments)	Governmental
Eugénio Macamo (Mr)	Programme Associate	FAO	Donor / International Organisation
José Matsinhe (Mr)	Agronomist	FAO	Donor / International Organisation
Mucavel Custodio (Mr)	Country Representative	IFAD	Donor / International Organisation
Palmira Vicente (Ms)	Rural Development Advisor	Irish Aid	Donor / International Organisation
Armindo Salato (Mr)	Programs Director	ADRA	International NGO
Margarida Graciete Simbine (Ms)	Project Manager	CARE International in Mozambique	International NGO
Eva Comba (Ms)	Research Officer	CARE International in Mozambique	International NGO

NAME	POSITION	ORGANISATION	TYPE OF ORGANISATION
Dan Mullins (Mr)	Director of Research, Learning and Advocacy Unit, Food and Nutrition Security	CARE International in Mozambique	International NGO
Benat Arzadun (Mr)	Programme manager	Mundukide	International NGO
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Annex 3

Examples of major initiatives that have promoted CA in Mozambique

ORGANISATION (INITIATIVE)	GEOGRAPHIC SCOPE	DESCRIPTION	FINDINGS / COMMENTS
Sasakawa Global 2000 in partnership with MINAG – DNEA	Northern and Central provinces	From 1996 to 2007, SG2000 promoted zero-tillage to prevent soil disturbance and to build up soil organic matter through mulching with crop residues and crop rotation, the technical package relying heavily on herbicide application (Roundup and Ronstar) together with other external inputs, mainly improved seeds and inorganic fertilisers. The technical package had a major focus on cereals, especially maize, and to some extent rice	Overall, results from this intervention showed that there were substantial increases in yields and farmers who participated increased their maize yield from an average of 1 ton to 3 ton/ha. However, there has been a relatively low rate of adoption, possibly because most farmers could not afford the inputs included in the technological package (Nhancale et. al. 2006).
MINAG – DNEA together with FAO (technical cooperation project TCP/MOZ/2902)	Countrywide	Initially planned for 18 months, the project was extended from 2003 to 2005. The main goal of this project was to develop skills and increase knowledge of a critical mass of farmers and extension staff in order to facilitate the promotion, spread and incorporation of CA practices into the farming systems.	Analysis carried out by Zandamela <i>et al.</i> (2006) showed that crop diversification within the plot was important to increase production and gross margins in Manica. A sign of the positive impact of the project was the establishment of additional 40 training units in the province of Manica during the cropping season 2004/05. Other lessons learnt included difficulties of changing the attitudes from conventional methods for land preparation to alternative agricultural practices. There were also difficulties to retain crop residues in the field due to the traditional way of free grazing. In addition, due to the high prices, most farmers lack resources to purchase external inputs such as inorganic fertilisers, herbicides and specific implements for CA.

ORGANISATION (INITIATIVE)	GEOGRAPHIC SCOPE	DESCRIPTION	FINDINGS / COMMENTS
Provincial Agriculture Directorate of Sofala with funds from the Austrian Development Cooperation (PROMECC Project)	Sofala	From 2001 to 2008, it promoted zero tillage with emphasis on vegetables like onions, garlic, lettuce and cabbages and to a lesser extent maize and beans through training sessions, field days and demonstration plots. Involving a total of 400 direct beneficiaries, PROMECC's approach include the use of plots/units for testing and validation (UTVs) and promotion of zero tillage, mulching and cover crops, crop rotation and the use of biological processes for integrated pest, disease and weed management and for integrated soil fertility management. The project reported to have reached a total of around 2000 farmers and 30 extension staff.	Several species were tested as cover crops, some of which showed high biomass production, potential to suppress weed infestation and for improving fallows on degraded soils. Overall, through this intervention CA practices showed significant yield increase, reduced labour demand and improvements in soil quality management. ¹⁸ Productivity per hectare increased by about 30%, the frequency of irrigation decreased by about 60%, the number of weeding decreased 90% and the time for land preparation decreased 75%.
GTZ (GIZ), German Development Agency (PRODER programme)	Sofala, Manica and Inhambane Provinces	From 2000 to 2006, it delivered training through several workshops for public and NGOs extension staff and for farmers with the aim to disseminate CA information and knowledge. In addition to this, the project established a total of 53 Units of Testing and Validation (UTVs), some of which showed promising results with regard to mulching and cover crops, increased soil organic matter, control of weed infestation and soil moisture conservation.	Some of the lessons learnt included the need for a wider participation of local leaders and local promoters on the dissemination of CA information and technologies and the need to diversify the number of species of cover crops, especially the dual purpose crop, for soil quality improvement and human consumption.
ADPP (Farmers' Club Programme)	Countrywide	Launched in 2006, the Farmers' Club consist of organised groups of around 25–50 self-supporting smallholder farmers. The members are trained in sustainable conservation farming techniques, in addition to enhancing their access to well managed water resources and improving their access to local and regional markets. Sustainable farming techniques, which are discussed during trainings, are put into practice in demonstration plots. They include issues related to conservation farming, intercropping, water management and irrigation, the use of improved varieties, techniques of integrated pest control and crop rotation to avoid soil fertility depletion. The training also include crosscutting issues namely, health, literacy, gender, human rights and climate change to strengthen member's capacity to adapt and mitigate the effect of climate variability.	<p>The programme has been able to benefit over 16,050 farmers in 7 provinces and the beneficiaries succeeded in increasing crop yields and diversifying production and improving their nutrition. They have access to low cost irrigation and have significantly increased the area of cultivated land and their income.</p> <p>Based on its experience ADPP launched in 2014 a new programme of Farmers' Club for the period 2014–18 with a target of reaching 14,000 small-scale farmers in Sofala and Zambezia. In this initiative, sustainable agricultural techniques include crop rotation, intercropping, crop diversification, use of organic manure, irrigation techniques, improved post-harvest management, planting fruit trees and moringa as natural fencing.</p>

¹⁸Nhancale, pers. com.

ORGANISATION (INITIATIVE)	GEOGRAPHIC SCOPE	DESCRIPTION	FINDINGS / COMMENTS
CARE International in Mozambique	Nampula and Inhambane Provinces	<p>CARE has promoted CA in environments prone to frequent droughts, floods, cyclones and erratic rainfall, combined with sandy and infertile soils. The organisation builds its CA interventions on the principles modelled on tropical forests where soils are permanently covered by dead mulch and biomass production and biodiversity are maximised (Bunch 2014). The project uses farmer field schools (FFSs) as an approach to allow farmers to learn and build their confidence and capacity to experiment. Through FFSs and simple experiments, CARE encourages FFS members to test and observe the effects of CA on water infiltration and retention and soil structure (Bunch 2014) to help farmers to understand and appreciate the processes and mechanisms that operate under CA and thus, facilitating its adoption. The FFSs are also looking for locally available and appropriate green manure and cover crops. These include mucuna, being used for improved fallows, jackbeans and lablab beans. Some of the intercrops include planting jackbeans with cowpeas, which allows to cover the soil all year round, in addition to providing substantial amounts of nitrogen to the soil.¹⁹</p>	<p>Demonstration plots were carried out in one of CARE's interventions, Olima Wo Suka ("conservation agriculture" in the Emakua language from the Northern Province of Nampula), which consisted in promoting mulching, intercropping with grain legume species for soil improvement and improved fallows. Results showed that response of maize to the application of fertiliser was much higher under CA compared with traditional methods, and results compiled from 176 sites in 2004 showed that there was a substantial increase (54%) in grain yield for peanuts (variety Nametil) under CA when compared with traditional methods of peanut cultivation.</p> <p>Reviewing their approach, CARE is looking for alternatives to mulching as this practice often involves intensive labour to cut and carry grass. In addition they found that the mulch degrades rapidly, leaving the soil uncovered. CARE's alternative strategy involves the introduction of green manure and cover crops, with a view of improving soil nitrogen and soil moisture retention, and thus crop productivity, and build resilience to climate change.</p>

¹⁹Source: personal communication with Nicholas Dexter, CARE

Acronyms

ABACO	Agro-Ecology Based Aggradation-Conservation
ABIODES	Association for Biological Agriculture, Biodiversity and Sustainable Development
ADPP	Ajuda de Desenvolvimento de Povo para Povo
ADRA	Adventist Development and Relief Agency
BCI	Better Cotton Initiative
BLEANSA	Building a Large EverGreen Agriculture Network for Africa
CA	conservation agriculture
CAADP	Comprehensive African Agriculture Development Programme
CAWGM	Conservation Agriculture Working Group of Mozambique
CEPAGRI	Agriculture Promotion Centre
CIAT	International Center for Tropical Agriculture
CIMMYT	International Maize and Wheat Improvement Center
CSA	climate-smart agriculture
DNEA	Directorate of Extension Services
ETP	evapotranspiration
FAEF	Faculty of Agronomy (University Eduardo Mondlane)
FDI	foreign direct investment
FFS	farmer field school
GDP	gross domestic product
GIZ	German Development Agency
GTZ	German Agency for Technical Development
IAM	Mozambique Cotton Institute (Instituto de Algodão de Moçambique)
ICAC	International Cotton Advisory Committee
ICIPE	International Centre of Insect Physiology and Ecology
ICRAF	International Centre for Research in Agroforestry
ICRISAT	International Crop Research Institute for the Semi-Arid Tropics
IITA	International Institute of Tropical Agriculture
IFAD	International Fund for Agriculture Development
IIAM	Mozambique Institute of Agricultural Research
INCAJU	National Cashew Institute
IPEX	Export Promotion Institute of Mozambique
IUCN	International Union for Conservation of Nature
MICOA	Ministry for the Coordination of Environmental Affairs
MINAG	Ministry of Agriculture and Food Security

NASCO	National Agroforestry Steering Committee
NEPAD	New Partnership for Africa's Development
NGO	nongovernmental organisation
PAEI	Agriculture Policy and its Implementation Strategy
PEDSA	Strategic Plan for the Agriculture Sector Development
PIAIT	Platform for Agricultural Research and Technological Innovation
PNISA	National Plan for Strategic Investment in Agriculture
R&D	research and development
RASC	Regional Agroforestry Steering Committee
ROSA	Rede das Organizações para Soberania Alimentar (Food Sovereignty Network)
SETSAN	Technical Secretariat for Food and Nutrition Security (Secretariado Técnico de Segurança Alimentar e Nutricional)
SIMLESA	Sustainable Intensification of Maize-Legume Cropping Systems for Eastern and Southern Africa
SOFECSA	Soil Fertility Consortium for Southern Africa
T AFC	The African Food Company
UEM	University Eduardo Mondlane
UNAC	Mozambique Peasants Union
USAID	United States Agency for International Development

Sustainable agricultural approaches such as agro-ecology can help producers increase productivity while protecting the environment and strengthening resilience to climate change. Nonetheless, policymakers rarely support them on a large scale and take-up remains low. This report analyses the factors determining the adoption of sustainable practices in Mozambique, exploring whether a common understanding of 'sustainable agriculture' exists, how this is reflected in policy and practice, and what drives farmers (not) to adopt them. It identifies the technical and institutional constraints and discusses opportunities to overcome them. Further investigation is needed to understand how agro-ecology can make sustainable production intensification happen at different scales.

IIED is a policy and action research organisation. We promote sustainable development to improve livelihoods and protect the environments on which these livelihoods are built. We specialise in linking local priorities to global challenges. IIED is based in London and works in Africa, Asia, Latin America, the Middle East and the Pacific, with some of the world's most vulnerable people. We work with them to strengthen their voice in the decision-making arenas that affect them – from village councils to international conventions.



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