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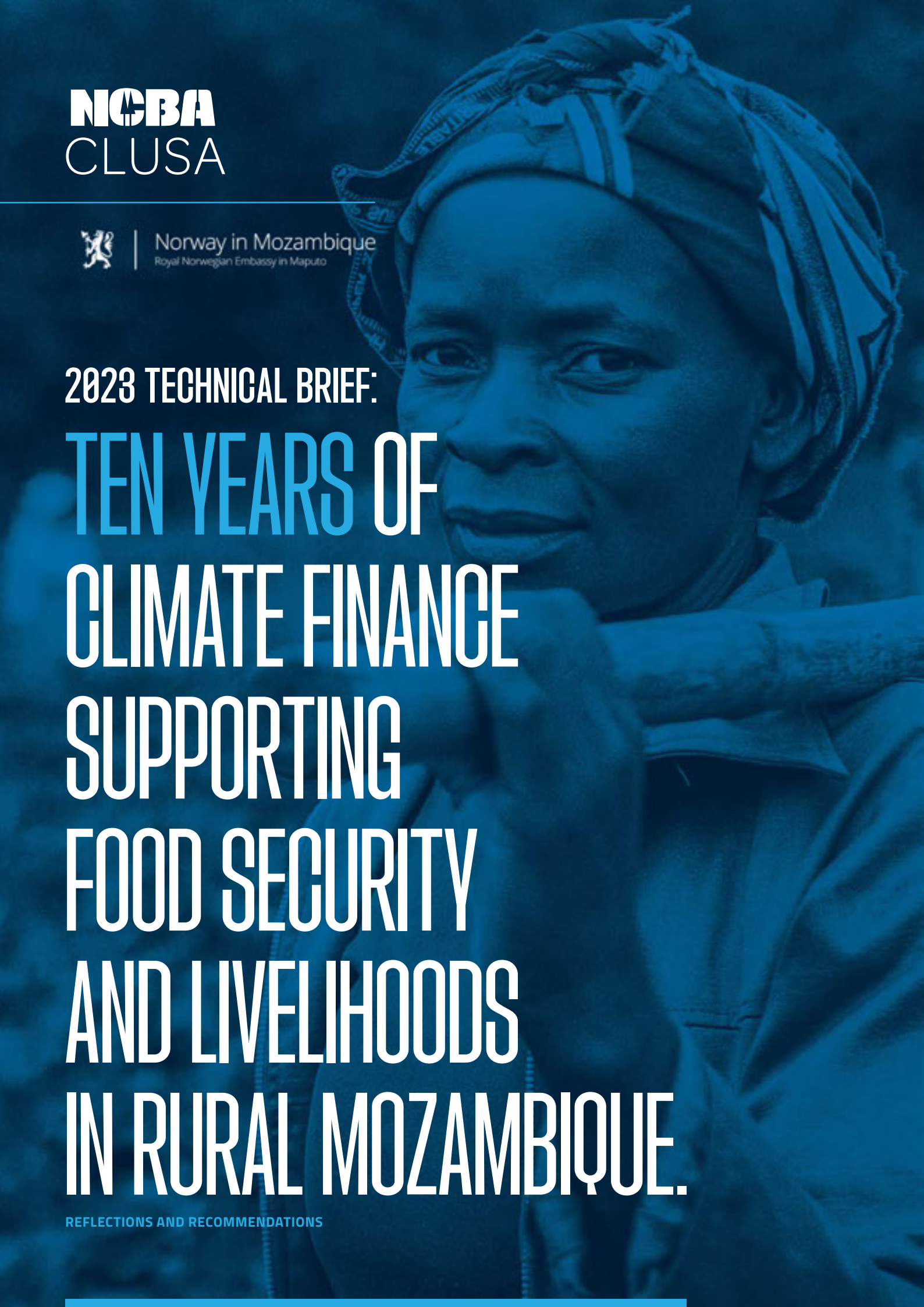

2023 TECHNICAL BRIEF:

TEN YEARS OF CLIMATE FINANCE SUPPORTING FOOD SECURITY AND LIVELIHOODS IN RURAL MOZAMBIQUE.

REFLECTIONS AND RECOMMENDATIONS

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NCBA CLUSA

PUBLISHED IN 2023 JULY

SUMMARY

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REFLECTIONS AND RECOMMENDATIONS

PART 01

CLIMATE CHANGE AND ITS EFFECTS IN RURAL MOZAMBIQUE

Mozambique was recently classified as the most vulnerable country in the world to climate change[1], and the evidence of these changes is indisputable. The frequency of cyclones has increased from two per decade fifty years ago to five per decade between 2010 and 2019 (with five cyclones registered in the first three months of 2022 alone), and cyclone severity shows a similar upward trend[2]. Standing out amongst these was Cyclone Idai, which in May 2019 flooded over 715,000 hectares of cultivated land and left over 433,000 households needing assistance[3]. In addition, the El Niño conditions in 2015–2016 caused the worst drought in 35 years, reducing food availability by 15 percent[4]. From 1996-2015, climatic hazards such as droughts, floods, and cyclones generated economic losses of approximately US$ 790 million[5].

But while severe weather events are the most headline grabbing, it is often the gradual, subtle weather changes that are the most insidious and damaging. Historical climate analysis shows that temperatures are already increasing, and year-to-year rainfall trends are becoming less predictable - with more frequent heavy rainfall events concentrated in already wet periods, and longer and more variable dry spells. These changes can make it impossible for farmers to plan and carry out their activities, and year on year can cause crop losses on just a large a scale as a cyclone or drought.

With 70% of the population living in rural areas, and the vast majority of these people depending on rainfed, climate-sensitive agriculture as their primary source of income and livelihoods, rural households are by far the most vulnerable to these climate shocks and stressors. And these are communities already living on the brink of acute food insecurity, with 14% of smallholders in Sofala, Manica and Zambézia provinces surviving on only one meal per day[6]. It is no coincidence that the most food insecure provinces - Tete, Sofala, Manica, Inhambane and Gaza - are also those with the greatest exposure to drought, floods, and cyclones[7].

BALANCING PROFIT WITH ENVIRONMENT

In recent decades, foreign investment in value chains such as bio-fuels, tobacco, cotton, poultry and animal feeds have enabled a number of agricultural success stories to emerge in Mozambique. Yet while positive for the rural economy, development will heighten smallholders' vulnerability to climate change if it is not managed sustainably. Most of this agricultural growth is being driven by extensification through smallholders' land area expansion instead of through productivity gains via intensification and investment in the long-term productivity of the land - which explains why agriculture is responsible for 27% of Mozambique's greenhouse gas emissions, of which 73% derives from slash and burn agricultural practices[8]. In recent years, developed and developing countries alike are learning that for market-orientated growth to be sustained, it must be coupled with a long-term and climate smart approach to the use of natural resources. Mozambique needs to learn from these lessons now, and ensure that its future growth does not come at the expense of the environment.

ALL PREDICTIONS INDICATE THAT CLIMATE SHOCKS AND STRESSORS WILL CONTINUE TO WORSEN. OVER THE NEXT DECADES WE CAN EXPECT[9]:

INCREASED TEMPERATURES
Temperatures are expected to increase by 1 degree Celsius by 2037, an expected increase in drought and duration of dry spells.

CYCLONES AND HEAVY RAINS
Further increases in frequency and intensity of cyclones and heavy rains.

MORE FLOODS
More floods during rainy seasons.

RAINFALL PATTERNS
Continued change in rainfall patterns (delayed start and earlier end to the rainy season in the north).

INCREASE IN DROUGHTS
Increase in droughts for central and southern regions.

SEA LEVELS
A 13 to 56 cm increase in sea levels by 2090: which would be devastating for coastal, low lying urban areas like Beira city.

THE EFFECTS OF CLIMATE CHANGE ON MOZAMBICAN SMALLHOLDERS

NCBA CLUSA is witnessing first-hand how the changing and more variable climate is already having a tangible effect on smallholders' agricultural production systems, food security, and livelihoods.

For instance, our programs have shown that:

Shifts in growing seasons: rising temperatures and shifting rainfall patterns are causing shifts in growing seasons and a shorter rainy season (particularly in central regions and Zambezi Valley). The rainy season, which used to start mid-October, now starts in around mid-December. The growing season is becoming more unpredictable in terms of start and end dates, with long dry periods and heavy rainfall concentrated over fewer days.

Reduced yields/damage to crops: even in "normal" years, average yields are falling due to variable rainfall and heat stress- particularly for drought-sensitive crops like maize and soy- and an increased incidence of pests such as the Fall Army Worm. Extreme winds and rains cause storm damage to crops, flood low-lying crops and destroy infrastructure. Predictions are that yields of major crops such as cassava, sorghum, soybeans and groundnuts could decrease by 2–4 percent over the next 40 years . The yields of some drought-sensitive, major food crops like maize could fall even further - by 11 percent on average, and up to 45 percent in drier areas like Tete.

Disruption of local markets and livelihoods: These yield reductions impact key value chain crops such as soy, pigeon pea and sesame - disrupting food security, local markets and farmers' income, and potentially resulting in an agricultural GDP loss of 4.5–9.8 percent by 2050.

NCBA CLUSA'S PROMAC PROGRAM: MITIGATING THE EFFECTS OF CLIMATE SHOCKS AND STRESSORS ON SMALLHOLDER FARMERS

Our ten-year (2012-2022) Norwegian Embassy in Mozambique funded Promotion of Conservation Agriculture (PROMAC) program emerged as a response to these challenges. Conservation - or Climate Smart - Agriculture offers a way to manage this balance between environment and profit by improving soil physical structure, soil fertility, land productivity, production efficiency and resilience of the agricultural system to climate change.

By targeting climate smart agriculture investments at the smallholder level, PROMAC aimed to sustainably increase smallholders' production, productivity and food security, while also contributing to the inclusive development of the agriculture sector as a whole. PROMAC focused on three key interventions: 1) access to agricultural services and inputs, 2) market integration through improved access to output markets and 3) access to formal land tenure.

This technical brief summarizes a decade of NCBA CLUSA PROMAC's experience in supporting Mozambican smallholders to prepare themselves to face an uncertain future with more resilience and adaptability ■

PART 02

NCBA CLUSA'S PROMAC PROGRAM - MITIGATING THE EFFECTS OF CLIMATE CHANGE FOR SMALLHOLDER FARMERS

Field day

PROMAC aimed to use climate smart agriculture to sustainably increase smallholders' production, productivity and food security, while also contributing to the inclusive development of the agriculture sector as a whole. Key to this was the transfer of climate smart agriculture technologies and practices, and integration of these within the market system through stimulating both supply and demand.

SERVICE DELIVERY MECHANISM

PROMAC's technology transfer model was centered on groups of around 35 smallholders farmers, led by an entrepreneurial and dynamic Lead Farmer. Lead Farmers are the technology transfer agents for the group, using demonstration plots to showcase climate smart agriculture and traditional agriculture practices side by side, in real time, and under real life conditions. PROMAC project technicians - based at District Services for Economic Activities (SDAE) offices – provided members with services including training in good agricultural practices and climate smart agriculture; monitoring of crop development; and issuing weather and market information/analysis to enable informed decision making.

Technology transfer took place at the demonstration plots through three field days per year (aligned with land preparation, production and harvest periods), continuous

technical assistance provision on farmer's own fields, as well as larger district level field days and events for multi-stakeholders. To ensure sustainability and market integration, Lead Farmers also aggregated members' produce for onward sale and served as last mile retailers of inputs and other goods and services.

PROMAC used this technology transfer model to demonstrate and promote a suite of low-input and cost-effective climate smart agriculture measures, targeted towards two different farmers profiles: 1) subsistence smallholder **S** and 2) semi or fully commercial farmers **SCF**.

These include[10]:

MINIMUM TILLAGE OR SOIL DISTURBANCE (MECHANIZED RIPPING OR MANUALLY PRODUCED PERMANENT BASINS) S+SCF

PROMAC promoted minimum tillage either mechanically (using a ripper as an alternative to the disc and plow - PROMAC imported 24 of these and established a commercial network of service providers) or manually (digging permanent basins, or small holes, in which seeds are planted year on year). These two techniques have the following productivity related advantages:

Increases productivity: Unlike discing and plowing, mechanical ripping only disturbs the soil where seed and fertilizer are placed, reducing erosion and water run-off, and promoting soil fertility and productivity. Permanent basins have the same effect, since they improve soil structure and fertility by enabling nutrients to build up year on year, reduce weeding requirements, guide farmers in correct plant spacing and, after the second year, reduce land preparation time.

Promotes adaptation: in times of drought, minimum tillage enhances water and nutrient retention by capturing rainfall when it occurs; on the other hand, they reduce erosion and flooding when there is excess rainfall. After cyclone Idai, crops planted by PROMAC supported farmers using the mechanized ripper recovered after a week, while fields planted with the plow and disk which were washed away.

Promotes mitigation: ripping requires less tractor time, thus fewer greenhouse gas emissions. Permanent basins require no mechanization at all. Both techniques increase nutrient use efficiency, therefore reducing fertilizer applications.

VEGETAL COVER (CROP RESIDUE AS MULCHING, PREVIOUS CROP STUBBLE AND WEED MANAGEMENT) S+SCF

Increases productivity: ground cover retains water and keeps plants cooler, plus the decomposition of organic matter increases soil health and improves soil structure/aeration. For farmers using mechanization, PROMAC has introduced the "roller knife" – an implement pulled by a tractor prior to land preparation, which controls stubble and weeds.

Promotes adaptation: through improved water conservation and soil health, reduced erosion, and better stubble/weed management.

Promotes mitigation: carbon storage is increased, reducing the use of synthetic fertilizers.

CROP ROTATION S+SCF

Increases productivity: through reduced incidence of pests and diseases and increased soil health.

Promotes adaptation: diversification reduces the risk of total crop failure.

Promotes mitigation: crop rotation increases the soil's organic matter content, especially when nitrogen fixing crops such as legumes are introduced into the rotation mix (which also reduces the need for synthetic fertilizers).

LOCAL SEED SELECTION AND STORAGE S

Increases productivity: seed selected and produced following proper seed selection and multiplication rules (rather than re-using grain from one year to the next), results in higher germination rates and yield per area, and well as better quality product.Especially for locally adapted, drought and disease tolerant varieties.

Promotes adaptation: farmers have their own, affordable seed supply, mitigating the risk of

Farmer preparing land using minimum tillage technology (mechanical ripper) introduced by PROMAC

market shocks and stressors. Drought and disease tolerant varieties enhance water use efficiency, increase resilience to moisture stress and other climate shocks, and reduce the need for synthetic pesticides.

Promotes mitigation: pest/disease tolerant varieties reduce the need for synthetic pesticides (reducing GHG emissions).

ORGANIC FERTILIZERS AND PESTICIDES S

Increases productivity: increased production per unit area, and improved quality.

Promotes adaptation: farmers have affordable, locally available options (e.g., bokashi and compost), reducing the risks related to prices and supply chains. Promotes biodiversity.

Promotes mitigation: reduced GHG emissions by avoiding the use of synthetic pesticides, and reduced detrimental environmental effects.

INTEGRATED PEST MANAGEMENT S+SCF

Increases productivity: through lower production costs and improved quality.

Promotes adaptation: farmers have fewer crop losses - even during drought and other plant stress/pest related conditions. Promotes biodiversity conservation by replacing synthetic chemicals.

Promotes mitigation: by reducing the use of synthetic pesticides and, therefore, greenhouse gas emissions.

COMPOSTING S+SCF

Increases productivity: increased yields and reduced production costs.

Promotes adaptation: increased organic matter content improves soil health, even in degraded soils and for farmers with limited financial resources (they can use what is already available e.g., kitchen and animal waste).

Promotes mitigation: reduced need for synthetic Nitrogen-based fertilizers which produce nitrous oxide emissions. Promotes "circular economy".

CROP ASSOCIATION (INTERCROPPING) S+SCF

Increases productivity: production per unit of land increases because harvests of different crops on the same land can increase yields (via reduced incidence of pests/diseases, increased fertility etc.).

Promotes adaptation: diversifying the production system reduces the risk of total crop failure, and promotes a diversified diet.

Promotes mitigation: through improved soil structure, increased above-ground biomass and reduced need for nitrogen-based fertilizers. Reduced greenhouse gas emissions.

Minimum tillage using mechanical ripper

Field prepared using mechanical ripper

Seed selection and storage

PROMAC KEY RESULTS

WHAT DOES THIS MEAN FOR SMALLHOLDERS AND THEIR VULNERABILTY TO CLIMATE CHANGE?

CSA increases farmers' yields: By adopting climate smart agriculture, PROMAC supported farmers' yields have increased by on average 90%, across all crops. These increased yields are attributed to the improved soil fertility, water retention, increased plant population, and weed control that climate smart agriculture provides.

Farmers trained in/exposed to climate smart agriculture practices via extension network:

125,000

Smallholder farmers adopting climate smart agriculture:

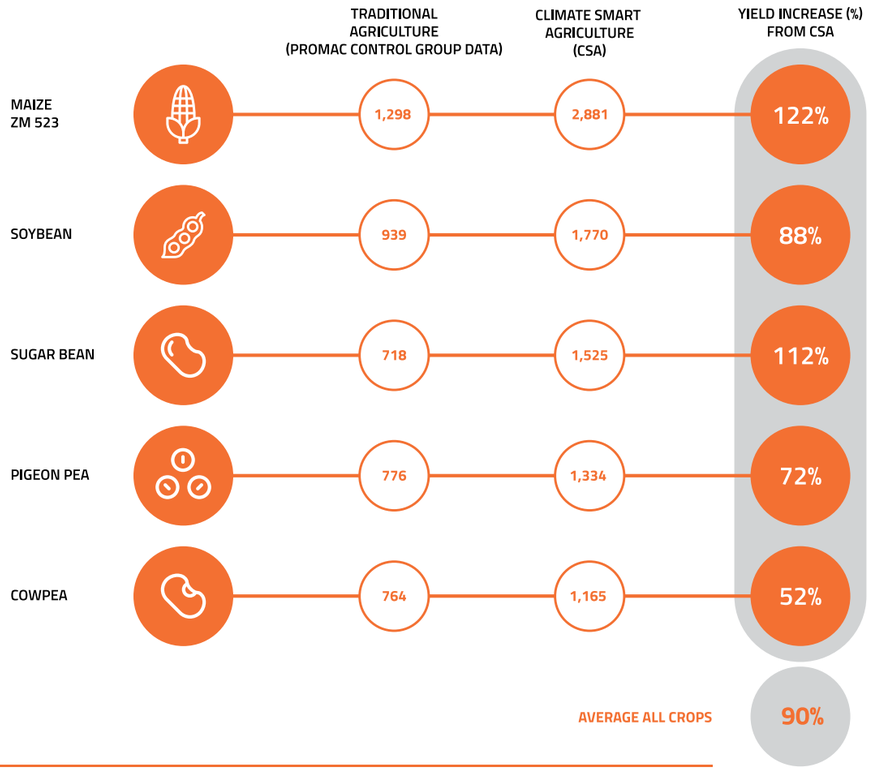
55,000

farmers using mechanical rippers:

299

The graphic below shows average yields in Manica and Zambézia provinces over the past four campaigns:

YIELDS (KG PER HECTARE) ▪ MANICA AND ZAMBÉZIA PROVINCES



NUMBER OF MONTHS OF FOOD SECURITY

SO WHERE DOES THIS PUT FARMERS IN RELATION TO THE MAXIMUM YIELDS THEY CAN REALISTICALLY EXPECT?

In Manica province, farmers using Climate Smart Agriculture for average open pollinated variety (OPV) maize ZM523 had yields of over 3 tons per hectare over the last four years, which is 63% of the four to five tons per hectare that the Food and Agriculture Organization (FAO) considers to be the maximum potential yield for a smallholder who uses the full package of Good Agricultural practices (improved OPV seeds, proper planting techniques, fertilizer application, pest and disease control, and water management). Bearing in mind that the last four campaigns have been characterized by highly erratic rainfall in the PROMAC intervention areas of Manica and Zambézia provinces, including an unprecedented number of extreme rainfall/wind events and the fact that climate smart agriculture results in soil fertility building up year on year, it is highly likely that in future years farmers who use the full climate smart agriculture package could easily reach close to the optimum maize yield of four to five tons per hectare.

CLIMATE SMART AGRICULTURE (CSA) PRACTICES INCREASES FARMERS' FOOD SECURITY

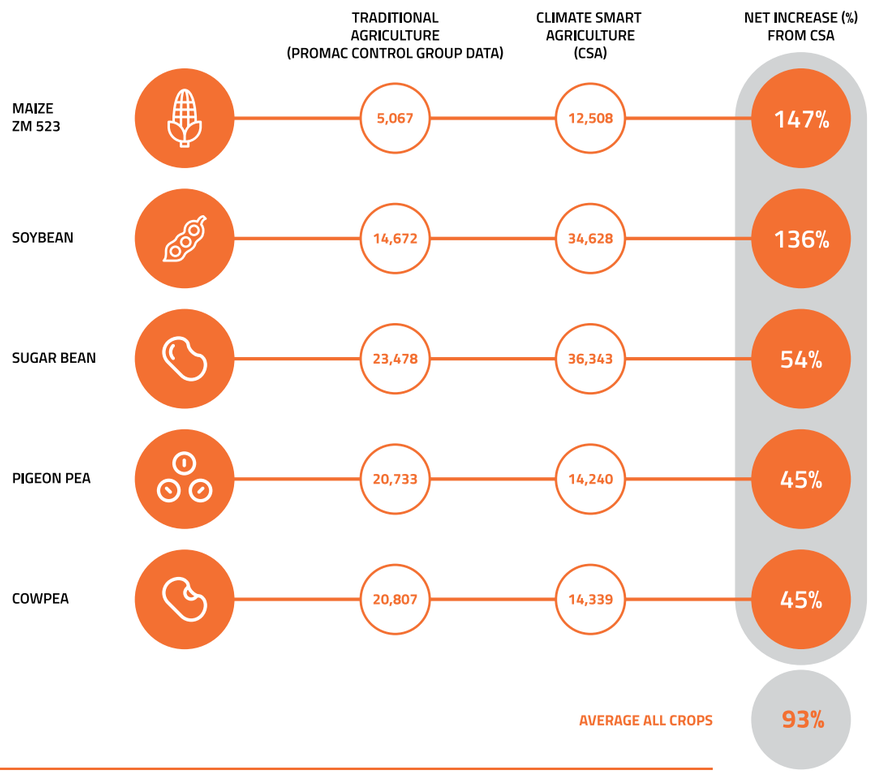
According to Mozambique's Technical Secretariat for Food Security and Nutrition's (SETSAN), the average rural person consumes 0.6 kg of maize per day. This means that by adopting CSA practices on one hectare of maize, a household can increase its food security by double this, from around 8 months to 17 months. 17 months of maize stocks is enough to see the family through the "lean months" and have excess to sell; conversely, 8 months of stocks doesn't even cover the family's own needs, and such a household will typically need to buy in extra maize during the lean months – at several times the cost that they could have produced it themselves. This means that households spend far less on food later in the year when times are tough.

CLIMATE SMART AGRICULTURE INCREASES FARM PROFITABILITY AND FARMERS' NET INCOMES

Smallholders who adopt climate smart agriculture have more profitable farms because their production per unit area (yield) increases. But there are also multiple cost-saving measures that contribute to this increased profitability. These include lower labor costs after the second season of using permanent basins, since the cost of land preparation greatly reduces as farmers reuse the same hole to plant instead of opening new lines each year. The use of properly selected and stored seeds, particularly maize, can also reduce productions costs for farmers who choose local versus certified seeds. The need for fertilizers - while still ideal - is greatly reduced as soil fertility and crop development is supported by both soil cover crops and crop rotation. Weeding - one of the costliest production operations for farmers - is also greatly reduced because of both the soil cover and crop rotation. And lastly, smallholder farmers who adopt climate smart agriculture can, if they choose to, reduce their investment in costly inputs such as chemical fertilizers, herbicides, and pesticides, and instead rely on the locally available nature-based solutions promoted by PROMAC. This combination of increases in yield per unit area together with increased efficiency explains the massive increase in smallholders' net incomes through adopting climate smart agriculture: in other words, farmers are not only producing more but they are producing it more efficiently.

farmers saw their profits, after taking account of production costs like inputs, increase by on average 93%, depending on the crop. This means more income available for household expenses, asset accumulation and to re-invest in the farm.

NET INCOME (MZN PER HECTARE)



Permanent basis:
a minimum tillage technique
for manual land preparation

LESSONS LEARNED AND RECOMENDATIONS

THE ADOPTION OF CSA IS A BEHAVIOR CHANGE ISSUE

For technologies and practices to take off, they need to be transformed from the niche to the standard practice. Behavior change begins with extension staff who engage with smallholders on a day-to-day basis and extends through to peer to peer farmer demonstrations and field days, influential agribusinesses who showcase their commitment to CSA, private sector marketing campaigns, and targeted, multi-channel, media campaigns. Fundamentally, we argue that smallholder appropriate CSA technologies should be massified and marketed in a way that excites and attracts their target audience, much like other product or service aimed at this target group.

CLIMATE SMART AGRICULTURE TECHNOLOGIES NEED TO BE TAILORED TO DIFFERENT PROFILES OF FAMERS

What works for a subsistence farmer producing manually won't work for an agribusiness, or even a semi commercial farmer. This is why PROMAC produced different technical assistance packages for different farmer types.

NEW TECHNOLOGIES MORE ACCESSIBLE AND AFFORDABLE

Smart, time bound subsidies targeted at private sector and smallholder clients can strengthen market systems and help to simultaneously stimulate supply and demand - making new technologies more accessible, affordable and in demand. They can help to kick start new technologies, until they gain critical mass and become more affordable. Demonstrations, marketing, and behavior change interventions, support to the private sector to bring down the risk in investing, as well as discounts on the purchase cost (e.g., our own Green Discount voucher scheme), have all helped PROMAC to take new innovations - like mechanical ripping, **weather index insurance** and **drone monitoring** - to scale in rural communities.

ABOVE ALL, FARMERS NEED ACCESS TO MARKETS.

Not only that, but they need fair prices, and inclusive business arrangements that see them partnering with buyers and processors for mutual profit rather than pitted against each other for short-term gain. This is why NCBA CLUSA's Agribusiness Unit linked PROMAC's 900 smallholder groups with off-take markets to sell 43,000 tons of produce (worth around $14,000,000); issued a weekly **Price and Markets bulletin**; linked farmers and MSMEs to inclusive finance using our annual **Financial Products Database** and, in partnership with the University of Eduardo Mondlane and Boston Carroll School of Business, conducted primary research into the commodity market in Mozambique - such as our **2020 Intermediary Study** and **research into market timing for smallholders**.

INVESTING IN DATA COLLECTION AND EVIDENCE-BASED DECISION MAKING WILL HELP SCALE UP CSA THROUGHOUT THE COUNTRY

The Government of Mozambique has made clear its commitment to CSA by ratifying climate-related international agreements and developing national strategies and plans, such as Mozambique's National Adaptation Program of Action, the PEDSA, PNISA and the National Strategy for Adaptation and Mitigation of Climate Change 2013–2025. To ensure that CSA continues to receive priority in national agriculture budget allocations, there must be an investment in assessing and showcasing its cost-benefit advantages, especially faced with the potential economic costs of inaction. This should include increasing the capacity and reach of extension services, strengthening information systems for evidence-based decision-making, and establishing national coordination mechanisms like the regional CSA platform for the center of Mozambique, led by the FAO in partnership with the Ministry of Agriculture and Rural Development to support knowledge sharing, avoid duplication, and target investments.

Above, all, do not to lose momentum: in addition to the **55,000 smallholders making the switch to climate smart agriculture** as a result of PROMAC, there are multiple commercial farmers, NGOs, national and regional platforms and government agencies dedicated to driving the movement forwards. What is needed is a concerted effort to scale up and massify these efforts, integrate climate smart technologies into private actors' business models, collaborate and promote dialogue between agencies and stakeholders, and combine forces with neighboring countries to take climate smart agriculture to the forefront of agricultural practice. With increasingly severe climate shocks and stressors set to become the norm rather than the exception, the future of Mozambique's agriculture sector rests in the hands of these stakeholders, and their commitment and ability to make this happen ■

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