Using flock simulations for modern goat market systems in Central Mozambique

Photo: Sabine Homann-Kee Tui

How visualizing future scenarios is motivating goat farmers in Tete Province to network for business

Sabine Homann-Kee Tui, Givious Sisito, Carlos Quembo, Claudio Sixpence

ICRISAT INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS
IIAM
CGIAR RESEARCH PROGRAM ON Water, Land and Ecosystems
Austrian Development Agency
MOREP II

Summary

In marginal and high-risk farming areas like Marara District in Central Mozambique, goats are a quick investment pathway for smallholder farmers and can enhance the benefits from agriculture.

The current goat value chain involving sales at the *feira* (informal goat sales venues), with unscrupulous intermediaries, does not enhance the development of smallholder farmers. Those with small flocks cannot participate in goat markets while those with large flocks are not motivated to use their flocks more productively. As a result, the entire community operates below potential. Goat farmers and buyers are far apart, both geographically and in terms of understanding and co-operation.

Enhancing communities' capacity to organize and manage decentralized goat markets can benefit smallholder farmers immensely. Volumes and quality of goat sales can be increased by addressing the needs and interests of owners of larger and smaller flocks alike within the same community.

A community-based goat market system builds social responsibility and helps communities to manage risk. The private sector has also expressed an interest to invest for enhancing communities' technical capacity.

The uptake of improved technologies becomes easier through farmer-to-farmer learning within the context of functional goat markets. Farmers with both small and large flocks learn, from demonstrations and engagement with the private sector, how to prevent losses from mortality and rejected goat meat at the market, rebuild flocks faster after sales using the fertility inherent in goat flocks and upgrade meat quality for market-oriented sales. The market place becomes a site for social learning and for promoting the uptake of agricultural technologies.

Simulation modeling of inflow and outflow of goats in a flock helped to inform and stimulate dialog between farmer organizations, business people and public extension services. The discussions about current and improved market systems elucidated farmers' existing knowledge, motivating factors and strategies to reach their goals. They brought deep insights on how farmers could benefit from improved market systems and how private sector and extension services could work more cost effectively. The feedback created confidence in farmers and enhanced their willingness to change the current market system into a decentralized one.

Key messages

- For smallholder farmers to benefit from real opportunities, perspectives and paradigms need to change in a process that includes farmers, the government, extension services, the private sector and researchers. This is particularly valid where challenges lie in external institutional and policy structures that are difficult to visualize and immediately implement.
- Co-learning supported by simulation modeling methods helps to relay what a future reality can look like, while continuous feedback from agricultural experiments and sales negotiations can hasten decision processes. This is the case of the goat market system in Marara District.
- Changing just a few processes in the goat market system can have strong positive repercussions, stimulated by positive feedback and creating a ripple effect.

Background

The MOREP II project on Nudging Sustainability Transitions Using Innovation Platforms and Market-Oriented Development in Mozambique has worked (2015-2018) through a farmer association, AAPACHIMA, with 60 farmers (representing different levels of resilience) in six villages in Marara District, Central Mozambique about 80 km from Tete city, Mozambique. It involved government departments for crop and livestock extension at district and provincial levels and a number of private abattoirs, traders and input suppliers.

ICRISAT*, BOKU/CDR# and IIAM§ worked together with the Government of Mozambique to understand and facilitate locally conceived change processes which could have significant impact for the farmers. The project was funded by the Austrian Development Agency and supported by the CGIAR Research Program – Water Land and Ecosystems.

Context: Goats offer farmers strong returns on investment

Communities in drylands like Marara subsist on agriculture and livestock. Goats, in particular, represent a primary source of income and a means for asset building, currency account and investment where no formal banking systems exist. Goats help farmers balance the effects of grain harvest deficits. In Marara District, severe food shortages were experienced during the El Nino drought of 2015/16, followed by grain losses due to Fall Armyworm, locust and other pest infestations in 2016/17, and below-average harvests again in 2017/18. Under these fragile conditions of severely constrained crop production, raising goats becomes even more important.

*International Crops Research Institute for the Semi-Arid Tropics
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An increasing demand for goats is boosting prices. Large private sector meat processing facilities are seeking relations with farmers.

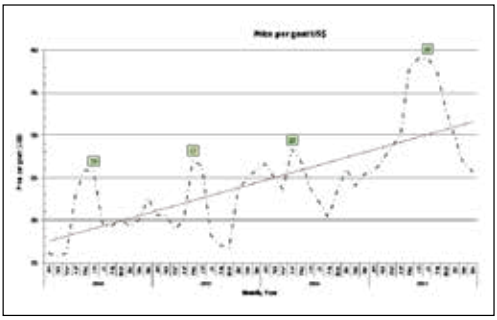

Figure 1. Goat price trends in Marara District (own assessment).

Despite obvious opportunities, the goat subsector remains poorly recognized and goat market development underfunded. Vulnerable farmers with small flocks, driven by factors that force them towards distress sales, lose out when goat prices drop due to mass sales. Meanwhile those with large flocks are not motivated to upgrade their agricultural enterprises. Other challenges abound:

- **High mortality rate** of goats, leading to direct loss of household income
- **Poor meat quality** denies farmers a good price for their goats
- **Distress sales** of goats to purchase food leads to an oversupply of poor-quality livestock and, consequently, low prices.
- **Livestock theft** organized by cartels undermines the social fabric of communities.
- **Weak disease control**, such as the foot-and-mouth disease outbreaks hinder goat sales.

Opportunities through an Innovation Platform

Photos: Sabine Homann-Kee Tui

Goat sales are used to buy staples such as maize.

Informal transactions support food security.

The MOREP II project was designed to build technical capacity and empower farmers in Marara District while strengthening social networks with important stakeholders in agricultural value chains.

An open Innovation Platform (IP) approach was chosen, providing farmers, business people, researchers and extension workers a space for diagnostics, discovery and learning (Figure 1). Farmers, through the IP activities, gained capacity in goat production to markets.

The project introduced DynMod, a simple diagnostic simulation tool to explore the potential for increasing goat production and market offtake for Marara District. This is how it worked:

- DynMod parameters were generated from communities' knowledge and management practices, flock distribution and structure.
- DynMod illustrated impacts of different interventions, improved goat management, cross breeding and market incentives for entire communities, rather than for individual farmers alone.
- IP discussions helped elaborate an alternative market system with the involvement of farmers.

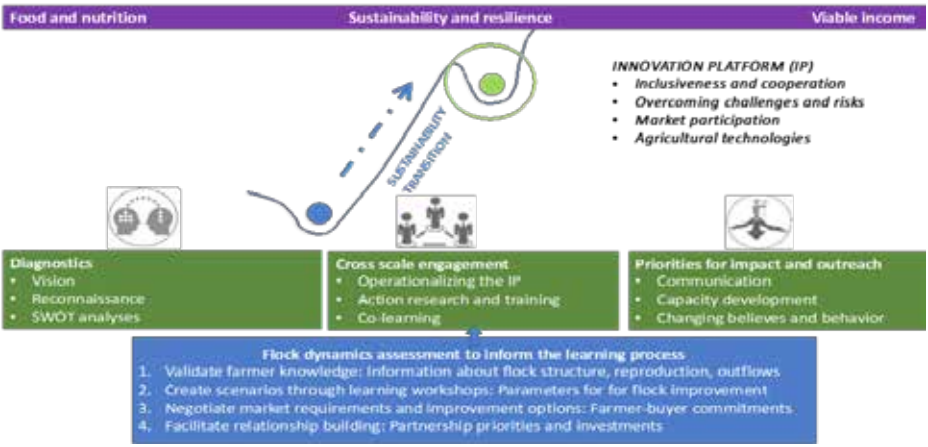

Figure 2. Using goat flock dynamic simulations to inform and design an alternative market system.

Diagnostics: Preconditions for market-oriented development

Community vision: Pathways towards resilience and profitability

The IP helped farmers visualize how better structured agricultural enterprises would look in the future (see photo below). Market-oriented goat production was defined as critical for providing opportunities for farmers.

The IP then worked on the most important mechanisms to support these pathways, (i) establishing a farmer association for long-term security and commitment (ii) creating social networks based on trust, knowledgeability and proactive planning and (iii) promoting technical training and capacity development.

Community self-evaluation three years later showed that farmers saw themselves better placed to harness opportunities along the goat development pathway. They had developed better cooperation within communities and built new networks with other stakeholders. They had better integration of crop and livestock technologies. Yet, developing the goat markets was still seen as lagging behind.

Farmer's vision illustrated at the inception workshop (2015)

Farmers' self-evaluation of IP progress (2015).

Reconnaissance: Designing an alternative market system

Decentralized satellite sale points were defined as alternatives for improving the goat market system, offering closer access to goat markets for all farmers, not just those within the IP.

Three pilot sale points were located, farmers for coordinating goat sales identified and initial sales were mobilized. However, sales did not take off because of the following factors:

- Price distortions through cross-border trade with Zimbabwe: Buyers from Zimbabwe paid higher prices. Hence local farmers opted to sell directly to them.
- Political disturbances: Political conflicts temporarily cut off MozAgri, a prominent buyer based in Chimoio.

The stage has been set for decentralized sales; however, it requires long-term strategic support and investment in market organization and infrastructure development.

SWOT: Farmers' aspirations are not the same

Farmers with disparate resource endowments have different priorities when participating in goat markets. During a SWOT analysis workshop in 2016, farmers offered important insights on local market development:

- **Low-resilience farmers:** For extremely vulnerable farmers (<10 goats), external threats and weaknesses influenced decision-making. Unavailability of markets was the most serious threat impeding livelihood improvements, while inclusiveness in market development was seen as a vital opportunity to avoid stress sales and build livestock assets. Making extension services more relevant and accessible was also important to them, particularly as they felt poorly informed.
- **High-resilience farmers:** With larger goat flocks and more agricultural land, these farmers were more optimistic and confident. Access to the right knowledge and technologies would help them address climate-associated feed shortages – a major threat in the regions. Supporting linkages between these farmers, private sector and extension services would be critical to unleashing market potential and attracting investment.

Cross-scale engagement: Flock dynamics simulations for an alternative goat marketing system

Information sharing and learning around the simulations of flock dynamics – inflows and outflows in goat flocks illustrating productivity and flock performance levels – helped farmers participate in an alternative market system in Marara District by:

1. Identifying goat ownership patterns

Flock dynamics simulations helped identify two kinds of goat ownership, which influenced behavior of sales flows (Figure 2).

- **Low-resilience farmers**: Most farmers own very few goats. They struggle due to lack of alternatives for income. They typically sell during years of poor rainfall, when they need staple foods. When all farmers sell simultaneously, prices plummet, while grain prices rise.
- **High-resilience farmers**: Only a few farmers have large flocks of goats. Having other means and resources at their disposal, they can afford to wait for the right time to sell their goats, independent of their household needs. Yet, though they can tap into better market channels, their role is not more prominent than those whose selling pattern is needs-driven.

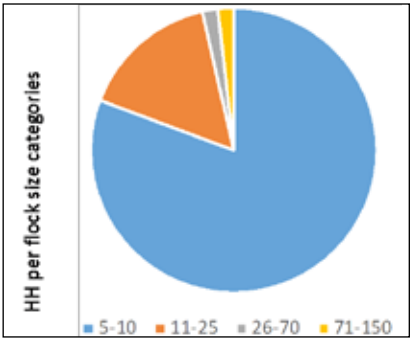

Figure 3. Average household's (HH) goat ownership in Marara District by flock size category (farmer estimates).

2. Appraising farmer knowledge and skills

The flock dynamic simulations gave insights on current and improved sales flows. They provided entry points for enhancing flock performance based on farmers' existing knowledge and for improving farmers' capacity to make best use of improved management packages.

3. Speeding up flock renewal and growth

To improve flock performance, agriculture extension and development programs should encourage activities such as improving reproduction, maintenance, buck management and selection of productive females. Farmers managed goat flocks for high productivity, supporting quick rebuilding of flocks after sales and losses as a way of managing high risk that is typical of Marara District. They maximized reproduction through high rates of females and the genetic potential for twinning. Early culling of males allowed females to grow. However, many farmers with small flocks rely on communal bucks while those with large flocks have few bucks per female. This reduced the genetic potential due to inbreeding, as well as contributes to low conception rates; a flock with few bucks is not effective and reduces the efforts of breed improvement.

4. Preventing goat mortality

Another entry point for promoting higher productivity, faster recovery after droughts and more goats for sale is in management packages that address goat mortality. Losses were primarily through dry season feed deficits, insufficient feed for pregnant/lactating does and kid mortality. Support services and the private sector play a critical role in enabling farmers with technologies in feeding, health and housing, as well as in strengthening farmer-to-farmer knowledge sharing and technology dissemination pathways.

5. Enhancing goat offtake

Although offtake rates were already high, the price per goat remains a bone of contention. Negotiation workshops are therefore essential to bring farmers and buyers back to the table.

Low-resilience farmers prioritized flock building over sales, and therefore retained females and sold only bucks. Moreover, due to distant markets the need for transportation put them at risk of exploitation by intermediaries.

Farmers with larger stocks can afford to experiment. As larger flock sizes were typically affected by low parturition and high mortality rates, restricting flock sizes, improving management and introducing improved breeds could improve quality, sales and income for these farmers.

Visualizing potential for higher productivity

In order to encourage farmers it is important to illustrate to them their potential and what they are capable of. Scenarios were developed based on farmers with different resilience levels, for the community, as well as for low- and high-rainfall years.

The packages:

Impacts of improved management packages: Integrating nutrition, health, housing and flock management helped to maximize the prolific potential of goats, with farmers increasing offtakes while maintaining the same flock size.

Impacts of improved goat quality on income: While productivity of current goat breeds can be enhanced through improved management, introduction of improved breeds can further raise the quality. The combined effects of increased weight, quality and offtake improved the overall sales value of the flock.

- **Farmers with small flock sizes (25 goats):** With improved management these farmers can reduce losses from mortality, and will thereby be able to sell more animals and be better cushioned in years of poor rainfall. They sold goats to the value of US$167 in high-rainfall years and US$346 in low-rainfall years; with improved management their revenue increased to US$205 and US$413 respectively.
- **Farms with medium flock sizes (50 goats):** Improved management can increase the annual revenue for these farmers from US$363 to US$449 in high-rainfall years, and from US$670 to US$804 in low rainfall years. They demonstrated an eagerness to improve feed management and participate in better organized markets. Coupled with market incentives this can substantially increase returns for these farmers.
- **Farmers with large flocks (100 goats):** These farmers can increase offtake by up to 20%, without reducing flock size. They often face climate-associated feed

shortages. Improved management would reduce loss of goats and enhance offtakes by 20%, helping these farms to raise revenue from US$618 to US$753 in high-rainfall years, and from US$366 to US$676 in low-rainfall years. The greatest benefits were from selling higher quality goats during high-rainfall years, capturing the effects of healthy body condition and the resultant increased prices.

- **Farmers with very large flocks (150 goats):** These farmers can benefit from terminal cross-breeding of Kalahari Reds crossed with selected indigenous females regularly replaced through the community. They would produce terminal F1 cross breeds from a restricted flock size of 100-150 goats and a high offtake of quality F1. Farmers could make an annual revenue of up to US$1500-3000 per year, as compared to farmers who maintained current flock management and lower meat quality (US$493-569 per year). The increased revenue stemmed from the combined effect of increased F1 body weight by 100%, increased offtake by 5-8% and increased price by 12%.
- **Extrapolation of community offtake:** Upscaling the potential benefits at village level, comparison of goat ownership and total numbers of goats likely to enter village markets, created important insights for planning improved goat sales:
  - The largest volumes of goats sold stem from small flock owners, who sell their goats driven by need, during bad years and dry periods. Market access for these farmers needs to improve urgently.
  - Owners of large flocks can engage with poorer farmers to provide them livestock feed, quality breeding stock and stock for fattening, while experiencing the community-wide benefits from higher volumes of quality goats to markets.

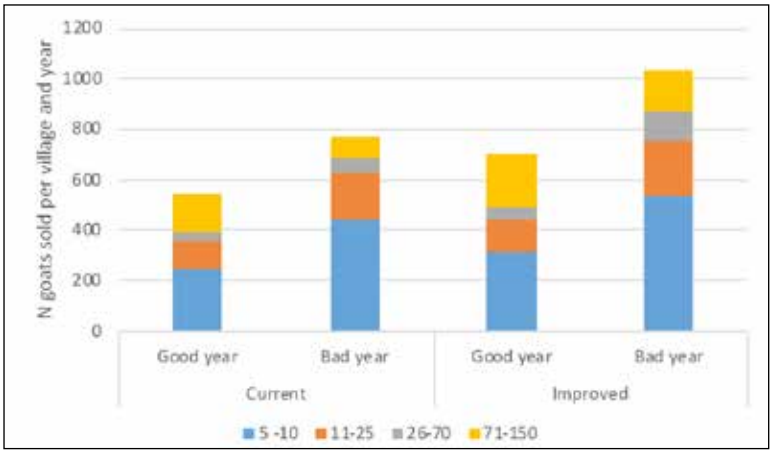

Figure 4. Village-level potential to increase total number of goat sales in Marara District, for different years and farm types, based on farmer estimations.

Analyzing flock ownership at the larger scale, the implication is that without changing the market system, poor quality distress-driven sales, rather than market-oriented sales, will continue to dominate.

Community-wide market improvement is, therefore, crucial for farmers and buyers to harvest more from goat sales.

New community-oriented market system

The flock dynamic simulations and related discussions created confidence in the decentralized satellite sales market system. Buyers expressed a willingness to engage in more cost-effective sales to increase the value of the goat meat. The community-oriented market system is a way to establish better market linkages for more efficient sales, and an improved environment for farmers to invest in improving goat flock levels. The private sector has already started investing in this market development, generating a positive feedback with farmers.

Farmers: The local farmer association requires empowerment to coordinate goat sales at nearby satellite sales points, including price verification and negotiation with buyers. Farmers with large flocks, though few in number, are critical for testing improved feed and health technologies, sourcing high-quality indigenous female goats from the community and building strong linkages with buyers. They become local decentralized market outlets for poor farmers to trade with, and easier for large buyers to reach. The very poor with small flocks benefit from closeness to markets (inputs and outputs), more transparent prices and knowledge transfer within the community.

From price negotiation to the first investment in communities, AAPACHIMA farmers and MozAgri building relations, mediated by Tete Provincial government.

Private sector: Large buyers can catalyze investments in farmer-led goat enterprises, promoting transparent sales procedures and injecting innovation. Buyers are ready to collaborate with farmers if they are able to source larger numbers of quality goats cost-effectively. This makes buyers more willing to invest in technology dissemination, e.g. feed and health inputs and demonstrations. MozAgri, which participated in the IP, has already provided an improved breed buck for rotation through farmer associations.

Government research, extension and support services: Partners from government research and support services found this approach promising, not only for Tete Province but for other areas too. Extension services foster knowledge exchange and learning within the community, following locally defined priorities. Sourcing funds for infrastructure development and establishing price differentiation are crucial changes to be made to maximize potential. Innovative investment in inclusive and sustainable options, through corporate social responsibility or social protection programs, will allow poor farmers to participate in real opportunities.

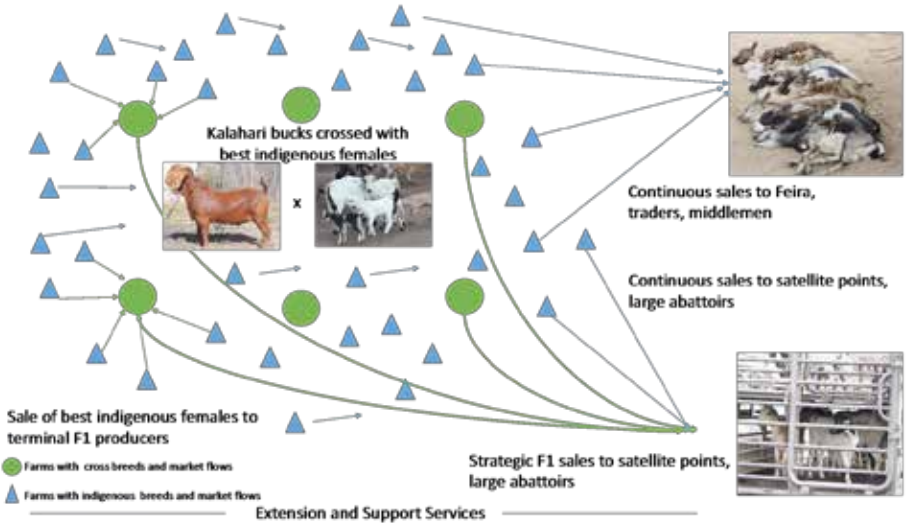

Figure 5. Community-oriented goats-to-market system.

Conclusions and recommendations

After studying feedback emerging from research, we claim that flock dynamic simulations deepen the analyses of agricultural and market systems, helping to shift the situation of smallholder farmers locked in a state of vulnerability and poverty as in Marara District. The following lessons were generated, grounded in the MOREP II research project:

The buck stops here

We need to stop ignoring the real issues. The potential success for improving smallholder lives depends on deeper institutional and social change in the agricultural set up, not on technological change alone. In Mozambique, investment in agriculture has been by-passing the interests of smallholder farmers, driven, instead, by politically motivated large-scale commercial investment and focusing on high potential areas. Goat markets did not feature as a mechanism for wealth creation under appropriate approaches, and therefore were neglected and underfunded, as compared to projects for subsistence agriculture. This needs to change.

Build on what is already there

Spread awareness that goat markets in Marara District, beyond providing fair trade opportunities, are a mechanism for rural development, a great asset and a catalyst for capacity building. To exploit this, new investments are needed that help to build goat flocks as a profitable enterprise, while supporting maintenance and improvement of the indigenous breeds. Simultaneously, the feed value of available biomass will be enhanced, resulting in higher quality of goats and agricultural practices adapting to the seasonality in goat sales.

Expect failure

The farmers' journey in areas like Marara District is prone to setbacks. Accept that distress-driven livestock production and extractive resource use has locked the farmers in a state of poverty. Being aware of these realities, employing socially inclusive approaches, carefully identifying development pathways and seeking out unique opportunities such as goat raising can help vulnerable farmers regain confidence to participate.

Communicate positive feedback

Guided discussions illustrated that changing flock structure and management is a way to upgrade volumes and sales of goats. This extends the benefits to vulnerable farmers as well as to more affluent and the private sector. Facilitating collaboration beyond a project's lifespan remains critical for large-scale impact, as well as being able to elaborate on the various requirements and roles of farmers, private sector and government extension.

One step at a time

Complexity and finding the right entry point for changing the market system can be overwhelming. Problem analyses, activities that address root causes and flexibility in implementation all reset resonance. In this project, understanding the effects of goat ownership on sales behavior was among the most critical results, underpinning the need for community-based marketing approaches, rather than targeting individual farmers, to enhance market participation and offtake.

Statements on changes needed in the market system

Carlos Quembo, IIAM head of Central Zone: *The MOREP II project has illustrated that transforming farming in Marara District is all about improving relationships among stakeholders: Farmers are already open to change towards a more structured system in agriculture; they are keen to pass on their knowledge to other farmers. We must integrate technology and market development with building farmer capacity and thereby allow them to adjust and negotiate options themselves, in their own dynamic contexts. This will allow an improvement in the quality of the goats to markets. The private sector must invest in communities if they want to buy goats in the long term. Improving trusting relations and engaging in price negotiations are the most important entry points for change.*

Chris Serfontein, MozAgri: *Our vision is to make buying of goats more cost-effective. Our challenge for the next 10 years is to streamline the market system. Buying and transport will be faster at decentralized selling points. We are willing to assist at the selling points. Farmers are already very committed. We have started to provide improved breeds, the Kalahari Red, for farmers to rotate within their association, as a way to increase carcass weight at large scale. If farmers control animal health, together with reducing losses from rejections at the abattoir, there will be more money for the farmer.*

Carlos Njanje, farmer and President of the AAPACHIMA farmer association: *We farmers in Marara District before and after MOREP II are not the same. Cultivating one ha of land was not enough to nourish our family. With MOREP II we are able to produce more biomass on less land to feed our families and produce higher quality feed for our animals. We will continue to improve the quality of produce sold to markets, be it livestock or vegetables.*

Matheus Ferrau, farmer, beneficiary of goat restocking and pass on: *We can produce goats, but we need help to access better markets. Market opportunities are there, but as long as we sell individually we will not solve our problems. The quality of our lives will remain low as long as we don't have access to profitable markets.*

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Front cover photo: *Sabine Homann-Kee Tui, ICRISAT*

Caption: *Goat kids at a farmer's homestead in Marara District, Central Mozambique.*

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ICRISAT-India (Headquarters)
Patancheru, Telangana, India
icrisat@cgiar.org

ICRISAT-India Liaison Office
New Delhi, India

ICRISAT-Mali (Regional hub WCA)
Bamako, Mali
icrisat-w-mali@cgiar.org

ICRISAT-Niger
Niamey, Niger
icrisatsc@cgiar.org

ICRISAT-Nigeria
Kano, Nigeria
icrisat-kano@cgiar.org

ICRISAT-Kenya (Regional hub ESA)
Nairobi, Kenya
icrisat-nairobi@cgiar.org

ICRISAT-Ethiopia
Addis Ababa, Ethiopia
icrisat-addis@cgiar.org

ICRISAT-Malawi
Lilongwe, Malawi
icrisat-malawi@cgiar.org

ICRISAT-Mozambique
Maputo, Mozambique
icrisatmoz@panintra.com

ICRISAT-Zimbabwe
Bulawayo, Zimbabwe
icrisatzw@cgiar.org

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