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DYNAMICS OF TECHNOLOGICAL INNOVATION OF SMALLHOLDER FARMERS IN MOZAMBIQUE - THE CASE OF SOYA PRODUCTION IN GURUÉ, ALTA ZAMBÉZIA

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RESUMO

Este estudo identifica a forma como a tecnologia foi disseminada no cultivo da soja na pequena agricultura familiar na região da Alta Zambézia, em Moçambique. Foi observado o itinerário técnico de 128 pequenos produtores e analisada a forma como o capital circulante tem ganho posição nesses sistemas de produção. Foram constituídos quatro grupos de produtores diferenciados relativamente à intensidade de uso capital. Cada um destes grupos foi analisado do ponto de vista da tecnologia utilizada, com base num Indicador Global Tecnológico, e analisadas as características sociológicas dos produtores e os níveis de rendimento gerado. As relações entre capital e trabalho deixam antever o interesse na progressão tecnológica da soja. A introdução de tecnologia requer acesso a capital circulante que a generalidade dos produtores tem dificuldade de mobilizar. A progressão verificada na aquisição de serviços de máquinas em momentos-chave do cultivo é mais evidente do que a verificada no uso de agro-químicos. A prática de inoculação de semente é generalizada.

Palavras-chave: inovação tecnológica, pequeno agricultor familiar, produção de soja, Moçambique

ABSTRACT

This study identifies how the technology was disseminated in the cultivation of soya in small family farms in the Alta Zambézia region of Mozambique. The technical itinerary of 128 small producers was observed and the way in which working capital has gained position in these production systems was analysed. Four groups of small farmers were identified regarding the capital intensity. Each of these groups was analysed from the point of view of the technology used, using a Global Technology Indicator, and the sociological characteristics, and the levels of income generated as well. The relationships between capital and labour may suggest the interest in the technological progression in soya production. The gradual introduction of technology requires access to working capital that most producers find difficult to mobilize. The progression verified in the acquisition of machine services in key moments of cultivation is more evident than the one verified use of agrochemicals. The practice of seed inoculation is widespread.

Key words: technological innovation, small family farming, soya production, Mozambique

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Rui Rosário, Yara Nova e Naldo Horta[1]

1. INTRODUCTION

The present study was prepared within the framework of a research project promoted by the Observatório do Meio Rural (OMR) in 2019, whose main objective was to contribute to the debate on the political strategies adopted for the development of small family farming in Mozambique, assuming that such a process constitutes a determining pillar of the country's development.

The case of the soya production in Alta Zambézia was selected because, in the last two decades, there has been a notable investment by various international funders, public and private, in support programs with a direct impact on the family sector of agriculture in the region. The amounts allocated were made by a number of foreign NGOs contracted by various donors for this purpose. The Mozambican Government and Administration have always supported these initiatives, in a more prominent manner and with greater involvement in some cases, and more discreetly in others.

During this period, different programs applied different models of action, seeking to meet similar and strategic objectives for the development of family farming. Essentially, there has been coherence between these programs, generating new approaches over this period of about 20 years, when and where the previous ones fell short of the defined objectives and policy guidelines. It should be noted that part of this process was the expansion and development of economic activities downstream of production, particularly poultry farming, which was essential to induce an increased demand for soya that generated favourable market conditions, from the producers' perspective. Upstream, several initiatives created conditions for the supply of inputs essential for crop´s technological development.

Thus, it is possible to say that the promotion of soya cultivation in the Alta Zambézia Region over the last two decades was a consistent, multifaceted, and generally coherent process that led to the introduction of a new cash crop on the farms of family farmers, implementing the first steps in a process of technological development that should gradually expand if the organisational conditions of production and market conditions make it possible.

According to the 2009-2010 Agricultural Census (INE, 2011), the number of soya producers in Zambézia was 2,422. These producers cultivated about 2,000 ha of soya, which corresponded to about 10% of the area occupied with cash crops in the province, and 0.2% of the entire area cultivated there. These figures contrast significantly with the today´s figures. Although, for methodological reasons, the figures are not directly comparable, several estimates point to a current number of producers 30

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times higher, with more than 60,000 small and medium soya producers in the province (MADER/DPP, Inquérito Agrário Integrado, IAI 2020). This expansion has a strong concentration in the Alta Zambézia. According to this source, the area cultivated with soya in Zambézia Province was 33,949 hectares in that work´s reference campaign.

Increasing the number of producers of a "new" crop about 30 times in 10 years is a development that deserves to be studied in depth. The development of favourable market conditions, recognized by most producers - easy marketing and compensatory price level - created the background for the good farmers´ receptiveness to soya cultivation. This crop fits easily into the traditional farming systems of the region and is considered less demanding than those that directly compete with it, namely maize. The price level of soya has remained favourable throughout this period, both in absolute terms and the prices of competing crops, such as maize, pigeon peas, tobacco, cotton, or sesame.

The expansion of soya cultivation in Alta Zambézia involved necessarily differences amongst producers, particularly disparities in the technology level. Although much progress has been made over the past 20 years, there is still a long way to go, even for those who today produce in a more technologically advanced way. Continuing the technological progress already verified, developing the product quality and differentiation , expanding the use of environmentally friendly technologies, and promoting the diversification and multiplication of outlets are elements that require the attention of political leaders and economic agents already installed. Accepting this perspective, as happened in the recent past, many of the determinants of the progress of this crop and of the living conditions of those who promote it lie downstream of production. However, the improvement of production conditions requires the possibility of access to capital and the technical capacity building of producers.

It has been proven that if such conditions are met, the small producer responds to market incentives as well as to market disincentives, and these are very dependent on the greater or lesser success of promoted upstream and downstream production initiatives.

Mozambique will likely reinforce the domestic supply of soya, responding to increased demand. This will certainly continue to grow, in response to the need for increased demand for animal protein arising from the strong increase in population and improved income levels. Simultaneously, the country may seek to position itself in the international soya market, which is extremely dynamic, innovative, strongly competitive, multifaceted, controlled by large economic interests and by national political strategies of countries of high economic power. The first steps towards soya exports have already been taken, with the Indian market and neighbouring countries as the main destination. This trend may continue and possibly strengthen in the coming years.

It is therefore interesting to analyse the way the family production segment integrated in this process, trying to understand the diversity of realities it contains, particularly at technological, social, and economic levels. It is also of interest to identify the ways in which the already verified technological progress was spread to small family farmers, trying to find out the blockages or constraints to which they are subjected, as well as the impacts on family income, food security, among other relevant elements of this type of process.

This knowledge may serve as a foundation for the definition and improvement of policies directed at the various family farming segments, especially for the implementation of the SUSTENTA program, which recently extended to the entire national territory a policy leading to the emergence of small and medium-sized commercial producers.

The first chapter of this study describes the process of soya crop promotion in Alta Zambézia in the last decades, seeking to systematize the main factors that led to the process of expansion of this crop in the region. It provides information on the succession of supports to family producers over time, as well as the different stages that the process contained. The second chapter presents the main methodological options of this study, and the third chapter presents the main results. The paper ends with a discussion of these results and the identification and systematisation of policy measures to support the continuation of the small family farming development process in Mozambique.

2. TWENTY YEARS OF SOYA PROMOTION IN ALTA ZAMBÉZIA [2]

Soya cultivation has a long history in Mozambique, namely in Gurué District, dating back to the colonial period. After independence, this crop was reintroduced in Mozambique in the state company "Complexo Agrícola de Lioma" (CAPEL), in the District of Gurué, with Brazilian technical assistance. This company's activities were interrupted as a result of the 16-year War.

After the end of hostilities in the region, this crop was promoted by the non-governmental organisation (NGO) World Vison among family farmers, with financial support from the Department for International Development (DFID) of the United Kingdom. The Zambézia Agricultural Development Project (ZADP), with activities focused on the Districts of Gurué, Nicoadala and Namacurra, had two distinct stages: the first stage (from 1994 to 1998), focused mainly on agricultural activities, in a top-down logic. In the next phase, from 1998 to 2003, it extended its scope, covering not only agriculture, but also land use rights and microfinance, in a bottom-up logic. Despite the difficulties experienced in managing this project, in the second stage several relevant activities were developed in partnership with other entities, namely with the Cooperative League of USA (CLUSA), in the field of associativism, and the Organização Rural da Ajuda Mútua (ORAM) (Rural Mutual Aid Association) in the land use rights component. The microfinance component was integrated in the Zambezia Microfinance Project (PROMIZA)/KARELA. The multinational company CARGILL assumed a relevant position in the supply of inputs under this project (Pequenino, 2003).

The introduction and promotion of agricultural production within the framework of this project had as its main objective the improvement of nutritional conditions and food security of the communities that had been severely affected by the civil war. This project included the diversification of farms´ activities, namely livestock production. The introduction of soya cultivation among small and medium

[2] Annex I "*Chronology of supports to family farmers and the promotion of soya cultivation in the region*" systematises, in chronological order, the various programs supporting family farming in the region. It specifies the intervening organisations and funders, scope of action of the programs and objectives of action and, in general, the main results achieved. Besides this information, other information on the context of this process is also included. The information systematised in the annex, on the basis of which this point was drawn up, was compiled from the sources indicated therein.

producers took place with encouraging results, according to the promoters of the program. Some of these producers were producing in unused areas of the extinct state company CAPEL, in Lioma, with active support from the official services. Several partnerships were established with agribusinesses in the region. New varieties of soya were tested and introduced with the support of the International Institute for Tropical Agriculture (IITA) and seed multiplication fields were established. IITA's approach differed in that they introduced technological packages with interesting economic results (Hanlon & Smart, 2013, Di Matteo & Schoneveld, 2016b).

The promotion of local associations, such as the formation of savings groups and the promotion of the introduction of soya in food (soya bread, soya milk and soya baby food) among women, are still present in the region, albeit its reduced expression. Soya-based foods have been disseminated in various schools, seeking to improve children´s nutritional conditions. Another relevant aspect of this programme was the support to land demarcation and formalisation of DUATs of plots exploited by family producers and communities. The results of this action are not known precisely.

In this programme, CLUSA was involved in the creation of the Federação dos Produtores do Gurué (FEPROG) (Federation of Producers of Gurué) and about 127 local associations of small farmers, organised in about 11 local forums, which bring together about 5,200 family producers. This organisational structure of producers has a relevant position in the region still today.

This Federation was the pivotal centre for the dissemination of soya cultivation in the region at that time. At that time, contract production was promoted and a Seed Bank was created, with seeds produced by producers in the region, giving seeds to the producers, and the latter remained contractually responsible for delivering double that amount to feed the Seed Bank. The sale of this grain generated an income that allowed the purchase of quality seeds and agro-chemicals, namely fertilisers.

CLUSA also supported land demarcation and DUAT formalisation. Demonstration fields were set up and capacity building actions were carried out for family farmers. This organisation supported the preparation of around 300 hectares of the former state company CAPEL for soya cultivation by family farmers.

The strengthening of market mechanisms was promoted through the intervention of the Federation of Producers with the "big buyers" of soya, namely with large poultry producers in Manica (Abílio Antunes) and Nampula (Frango King) to supply compound feed factories.

The expansion of the poultry market was the main driver of the growth of soya production in Mozambique. Due to its high protein content, soya is highly valued in the production of compound animal feed, together with the energy component that maize grain provides. Most of the domestic soya production supplies the poultry sector, namely to companies such as Frango King, Abílio Antunes, Higest, Mr. Chicken and Novos Horizontes, which ensure a domestic market with a remarkable size, relatively stable and competitive, with a growth tendency (Hanlon & Smart, 2013, Smart & Hanlon, 2014).

Between 2004 and 2010, through a programme managed by TECHNOSERVE with funding from USAID, the Mozambican poultry industry grew more than fourfold, with annual production reaching over 23,000 tonnes of chicken meat in 2009. This trend has continued and total production of compound poultry feed, essentially composed of maize and soya, grew after this period from a total 93,893 tonnes in 2010 to 573,000 tonnes in 2014 (FAO, 2013, Bah e Galigo, 2019). The poultry promotion programme, had the following components:

- Promotion and upgrading of equipment, the expansion of production capacity and quality with about 11 poultry producers, in various Provinces, and the strengthening of links with small producers in an integrated regime;
- Organising and boosting the poultry value chain, through the Associação Moçambicana de Avicultura (Mozambican Poultry Association), and launching a national campaign to promote the consumption of domestically produced poultry products, with the strong involvement of the public veterinary services
- Conditioning the massive imports from Brazil, via the Middle East, South Africa and Zimbabwe, often of poor-quality products, in order to protect domestic production
- Regulation of biosecurity standards by the State, in collaboration with Cargill and two American universities (Bah e Galigo, 2019).

In a few years the domestic chicken production reached a degree of self-supply of about 85%, with emphasis on the creation of vertical integration systems of large size and advanced technology, with own production and the integration of small producers (Bah e Galigo, 2019). Mozambique now has a considerable concentration of production in Manica (Empresa Avícola Abílio Antunes) and Nampula (Novos Horizontes).

Simultaneously, in the period 2009-2012, large-scale commercial production, resulting from the entry of foreign capital associated with Mozambican economic interests, experienced strong expansion, as had happened in other parts of Africa (Cochrane, 2016, Deininger et al, 2014). As a result of the quantity and quality of the grain produced, the national production of soya produced in large companies became a decisive element in the supply of raw material for the compound animal feed production sector, alongside the pulverised production and differentiated quality coming from the family sector in the region.

The race for concessions on large portions of land, usually thousands of hectares of high quality land, usually in a favourable location, is known as land-grabbing. This process has given rise to a large body of literature demonstrating that most of these investments do not materialise the desired positive effects for rural economies (Hanlon & Smart, 2013 Smart &Hanlon, 2014, Di Matteo & Schoneveld, 2016a, Baumert et al., 2019, Dadá & Nova, 2018, Deininger & Xia, 2016, Bleyer, 2016, Aabø & Kring, 2012, Nova 2021).

In Mozambique, the most emblematic programme of this type of policy was ProSAVANA, launched in 2009, constituted by a trilateral public-private partnership between Japan, Brazil, and Mozambique, launched in the framework of the so-called South-South Cooperation. Through this programme, geographically centred on the Nacala Corridor (South of Nampula and Niassa provinces and North of Zambézia), the intention was to transform 14.5 million hectares of land to produce mainly soya, maize, and sugar cane. Initial estimates indicated that the project would reach about 500,000 people living in the programme's area of influence (UNAC & Grain, 2015). However, the project was blocked due to strong opposition from local farmers' movements and civil society´s coordinated action in the three countries (Funada-Classen, 2019, Baumert et al., 2019), notably in Japan, which was funding the project.

The fundamental idea of ProSAVANA was to incorporate Mozambican agriculture into global value chains by supporting smallholder farmers through the creation of Special Economic Zones (SEZ) under out-grower contract production regimes. The main beneficiaries of these investments are foreign investors, some elements of the national elite and local government officials politically well-placed in this process (Chichava et al., 2013, Okada, 2015) as well as the downstream sectors, which thereby secure considerable quantities of raw materials for processing.

As a way of appeasing the conflict over the above issues, companies usually choose to include social responsibility components. Such initiatives are usually apparent, always insipient, and of limited social reach (Bruna, 2017, Baumert et al., 2019, Sitoe & Lisboa, 2020). These are unable to promote the development of the surrounding area where these investments were installed. Essentially, these companies reproduce the labour relations characteristic of the large-scale production of the colonial period, exercising strong pressure for the process of peasants´ proletarianization.

In Gurué District, large areas were granted concessions for the establishment of several large enterprises dedicated to agricultural production (Joala et.al., 2016 and UNAC & Grain, 2015). Together, these enterprises obtained concessions for about 32,200 hectares of the best land in the region, which together forced the resettlement of about 1,084 families. Many of these families worked on former state-owned company land, a process that benefited from the active support of the district authorities in previous years. The local authorities began to act in the opposite direction, following instructions from the Central Government, which was very involved and interested in this process. Thus, the efforts made with family production in the Lioma area were neglected, supporting the entry into the region of interests that were alien to it, with a view to establish very large production units, similar to what had happened, years before, in the Brazilian cerrado (Cabral et al., 2016, Glover et al., 2018, Hanlon et al., 2011, Norfolk et al., 2012, Rosário, 2019, Thaler, 2013, The Oakland Institute, 2011, Wrangham, 2004).

In addition to the concession of about 202,000 hectares of land in Zambézia for the exploitation of fast-growing forestry species to 4 foreign owned companies, in particular from Portugal and Norway (Bruna, 2017), the new agricultural enterprises thus created are the following:

- AGROMOZ (locality of Lioma): Amorim Group (Portugal) and INTELEC Holdings (Mozambique) with management by the Brazilian company PINESSO; concession of 9,000 ha in 2012; resettlement of around 96 families;
- Hoyo-Hoyo Agribsiness (locality of Ruace): enterprise linked to the BXR Agro group (Netherlands), initially promoted by the Quifel Natural Resourses group (Portugal); concession of 10,000 ha, awarded in 2009, with DUAT of 3,000 ha. In the process, 838 families who worked about 1,945 ha of farms of the former state company CAPEL were resettled; in 2019 this company employed about 150 workers in the low season and about 400 in the high season;
- Rei do Agro (locality of Lioma): ASLAM group (USA) with Zimbabwean management. 10,000 ha under concession. Own and contract production; 2,500 ha not yet cleared, 1,500 ha arable land; 700 ha in the 2012/2013 campaign; very selective in the choice of producers (objective

of 500 ha contracted in 2012/2013); number of resettled families unknown; irrigation project supported by USAID; enterprise currently in expectant stage, with close connection to Hoyo-Hoyo;

- Murrimo Macadâmia (locality of Gurué): South African group Crookes Brothers Limited; concession of 3,200 ha in 2012. Company specialised in the production of macadamia nuts for export (China); secondary production of maize under irrigation; resettlement of around 150 families.

The information available on these developments is not only scattered, but also very scarce, and the practical results and social and economic scope of the concessions granted are unknown. However, some permanent level of conflict between the communities of the surrounding areas and the administrations of these enterprises is known.

In the second decade of the 21st century, crucial steps were taken for the current soya production configuration by family farmers in Alta Zambézia. In addition to the multiplication of agents promoting contract farming, the introduction of the family farming development model on a commercial basis was reinforced and technologically supported. This new policy was based on reinforcing the position of medium-sized family farmers in the sector, generically referred to as "Pequeno Agricultor Comercial" (PAC) (Small Commercial Farmer). They were the vehicle for disseminating technological progress in contract farming solutions to small producers in their areas of influence. Thus, a market for machinery services was created and the production of certified seed was contracted. Later, conservation agriculture techniques were introduced and encouraged, and the role of the State in the development process was increased, namely within the framework of the first phase of implementation of the SUSTENTA Programme.

The "Pequeno Agricultor Comercial" (PAC) PACmodel was developed in the period 2012-2018 by TECHNOSERVE (TNS) with financial support from the Netherlands. This model sought to transform some selected producers into agricultural entrepreneurs based on a combination of several criteria. The central idea resided in the attempt to integrate these producers into the soya value chain, which at that time already had strong dynamism in the region, through direct support to mechanisation and to the introduction of technological innovations, so that they could promote an upgrade of their farms (TECHNOSERVE, 2018a, TECHNOSERVE, 2018b). One of the strengths of this action was the introduction of mechanisation in some of the main operations of the crop and, simultaneously, the production of certified seed.

The PACPAC were local farmers and entrepreneurs who, from the outset, were recognised for their ability to adopt and mobilise improved agricultural techniques and technologies and, subsequently and by extension, the surrounding community. The PACPAC were selected based on their agricultural history, behavioural characteristics that demonstrated entrepreneurial capacity, and compliance with the commitments assumed with the project administration, being holders of DUATs and having sufficient capital available to invest and develop the new economic model in their companies.

In this model, the PAC provide multi-services and assistance to the Pequenos Agricultores Familiares (PAF) (Small Family Farmers). On the one hand, the former sell (on credit) mechanisation services and inputs (mainly improved seeds) and transfer knowledge on best agricultural practices to the PAF. On the other hand, they play a role in aggregating production by repurchasing the produce from the PAFs (TECHNOSERVE 2018 a, TECHNOSERVE, 2018 b).

The model was applied in the districts of Gurué and Alto Mulócué, where TECHNOSERVE (TNS) identified and trained 31 PAC, over six years, benefiting around 3,531 PAF at the end of the programme (TECHNOSERVE, 2019).

Under this programme, in 2014 the Cooperativa de Produtores Agricolas de Alta Zambézia (COPAZA was created), which aggregated the 24 PAC in Gurué District and 2 in Alto Mulócué District. Together, these producers cultivated about 800 hectares of soya, in addition to other cash crops. These producers currently ensure the production of certified seed.

The promotion of the basic level of mechanization consisted in supporting the purchase of 32 tractors and various implements (31 ploughs, 19 seeders, 29 disc harrows, 15 threshers, 30 trailers and 10 irrigation systems). The finance scheme of this support was based on the subsidy allocated by the programme of about 50% of the amount of the equipment, being 40% of that amount financed through the contracting of bank loans (BCI, BIM and GAPI), for a period of five years, with an interest rate between 14% and 17.25% and, finally, 10% of the investment amount financed with own capital (TECHNOSERVE, 2014).

In the period 2016-2018 the programme supported the creation and acquisition of the equipment for the Sociedade de Beneficiação de Sementes (SBS) company in the District of Gurué, resulting from investment by the COPAZA cooperative and capital from the Mozambican Txopela Investments S.A. SBS promotes the selection, classification and storage of certified seed produced by associated producers.

In this phase, some agro-dealers have emerged and consolidated their activity in the region. Contract production was strengthened but has always found it very difficult to establish itself at a general level. Production distribution channels were multiplied and soya exports to nearer Asian markets began. New stakeholders started to intervene in the marketing of soya in the region and, for the first time, in 2017/2018, according to unofficial sources, Mozambique exported soya to India through Nacala.

Among the "agro-dealers" of importance in the region, the following stand out[3]:

- Sociedade de Beneficiação de Sementes (SBS): Contracts the production of seed certified by the Seed Authority (about seven varieties, second and third generation) from 27 producers of the COPAZA group - 307 hectares of production, corresponding to about 411 tons of seed in 2018/2019 (income of 1.33 Ton/ha); industrial unit with seed processing equipment (cleaning, calibration, cooling, packaging, and storage) acquired in Brazil, in operation from 2019. Processing capacity of 2,500 tons of seed.
- African Century Agriculture (ACA), ex-GETT (established in 2011, South Africa, with support from Norway): production of chicken meat and supply of feed to poultry farming in Nampula (King Frango); major promoter of soya production by contract (in 2011, about 844

[3] Partial information obtained by combining several sources.

producers/1,250 hectares), with initial support from Swiss Cooperation (InovAgro); about 1,000 hectares under concession; activity also in Niassa;

- ALIF Química (Mozambique): contract farming system with producers who cultivated land under concession before the start of the war; 155 producers on 300 hectares in the 2011/2012 campaign;
- Lozane Farms (Mozambique and Zimbabwe): company with own production and production under contract. Distribution of about 70 tons of soya seed to about 1,000 producers who cultivated an area of 1,400 hectares; marketed about 1,700 tons of soya (2018/2019);
- Cooperativa AGRA (Alto Molecule) which, among other production services, provides members with mechanisation services (especially in the land preparation, sowing and threshing phase) and supply of inputs. This Cooperative works with about 700 producers, 90% of whom have an area of less than 5 ha.
- MIRUCU, a consortium between the Associação Nacional de Extensão Rural (AENA), which provides technical assistance to some 1,200 soya and maize producers, and MURERELO, which promotes the link between these producers and the market;
- Phoenix Seeds (2002, Zimbabwe): sell about 30 tons of seed (2011);
- ETG - imports seed from Tanzania, distributed to about 400/500 producers (Swiss/INOVAGRO support);
- LUSOSEM (2017, Portugal): imports seed from Zimbabwe

In the year this research was carried out, the NGO Solidariedade assumed a relevant role in the district, continuing the work developed by the TNS project, supporting the first phase of the SUSTENTA program. According to this NGO, it was working with 350 "farmer leaders", each one working, on average, with 30 small producers from the surrounding area (about 30% of these are women), making a total of 10,500 producers.

The support given, in addition to conservation farming techniques, use of improved seeds, includes other areas such as, through the Gender and Youth Department of the organisation, nutritional aspects linked to the use of soya beans in food, equity issues, domestic violence, entrepreneurship and climate change.

Halon & Smart (2013) consider the Pequeno Agricultor Comercial (Small Commercial Farmer) model a success story, but question whether it can be replicated in other provinces and other activities. The doubts lie in the fact that this success was due to specific reasons, namely the concentration on a single crop with a favourable market, the high level of adaptation of the crop to various levels of mechanisation and the continued support of different organisations in providing technological packages accompanied by advice on production and marketing. In addition to these success factors, the growth of soya production occurred in PAC's relatively large farms and with the entry of the private sector into soya production through contract farming solutions with proven profitability.

The authors warn, however, that the process of transition from a traditional farmer to an agricultural entrepreneur is not simple. It involves three aspects simultaneously: the existence of a guaranteed market, continued technical assistance and credit programmes, and the capacity of producers to make a cultural change that involves the ability to plan, save and reinvest. It should be noted that this process was based on a private partnership established between NGOs and foreign financiers who supported most of the costs of the operation.

These authors consider that there are four crops with potential for the development of the soya model, namely: (1) maize and rice, which have low prices but become profitable from accessible productivity levels (above three tons per hectare); (2) groundnut, which has a market in South Africa, is suitable for mechanisation and emerging farmers, but requires an effort to improve production quality; and (3) sunflower.

These limitations to the replication of the model contrast with the extension to the whole territory of this type of intervention. Mosca (2014) warns that although these models generate significant increases in production, they can generate negative environmental effects arising from monocropping, the intensive use of agro-chemicals, deforestation to expand the worked areas and soil depletion.

However, according to Baumert et al. (2019), small-scale agricultural models can generate higher incomes without compromising food security. These create greater employment opportunities, greater dynamics in local value chains and multiplier effects on the local economy, compared to large-scale production models. The introduction of agricultural systems or models adapted to the local context better serves poverty reduction objectives, according to Dawson et al., 2016.

Despite improvements in poverty conditions, inequalities increase mainly in households with low literacy levels and those with very small areas. Thus, many authors conclude that small-scale agricultural productivity growth has substantial potential for poverty reduction (Hazell, 2010, Imai & Gaiha, 2016), while attention should be paid to the increase in social inequality that may be generated (Baumert et al., 2019, Sitko et al., 2014).
The results of the model developed by TNS should therefore be analysed in detail, as this same policy model is being implemented extensively in the SUSTENTA Programme.

Identifying the ways in which soya crop technology has been disseminated among family farmers in Mozambique's main production zone and the associated technological development (mechanization, use of improved seeds and other inputs) represents an insight of great interest for assessing the goodness of current public policies aimed at the agricultural sector.

3. METHODOLOGY

3.1 Sampling Strategy

In order to investigate how soya farming technology has been disseminated in Alta Zambézia and to know the impact generated on the economy of small family farmers, in April 2019 it was decided to carry out a survey among small family farmers in the region. The objective was to identify how the technology was disseminated in this agricultural segment and to understand, from different perspectives, the impacts of this process.

The time period to carry out the work was very short, with the survey planned to be carried out between the end of the soya crop campaign (April/May), ensuring that producers would have relevant data in memory for the survey, and the beginning of the pre-election campaign period of the October

2019 elections, which could interfere with producers' provision of information. In addition to a restricted timeframe, financial means were limited as the project would only draw on financial resources left over from other OMR research projects.

After carrying out a mission to the districts of Gurué, Alto Molócué and Ile to conduct interviews with the main stakeholders linked to agriculture and the production and commercialization of soya in Alta Zambézia (Rosário e Horta, 2019), the following strategy was defined:

- The lack of a useable sampling frame for the design of a random sample of producers led to the option of basing the work on a (non-random) sampling directed to small soya producers;
- It was decided to base the work on a sample of no less than 100 observations, concentrated in the localities of the District of Gurué in which soya production is of greatest importance: Magige, Tetéte, Ruace and Lioma; the size of the sample was established so as to ensure the formation of 3 to 4 groups of producers with distinct technological levels, ensuring a number of observations (between 20 and 30 observations in each group) in order to guarantee sufficient conditions for analysis;
- The representation of each location would be, at first, uniform, with 25 observations in each location. It was defined, however, that in the course of the survey, depending on the different dissemination of soya cultivation in each location, the uniformity of representation of each location could be modified, prioritizing the reinforcement of smaller farms;
- The sample would be made up of small producers selected on the basis of a set of criteria drawn up in collaboration with the Federation of the Association of Farmers of the district of Gurué, namely being soya producers, ensuring representation of three classes of total area of the farms (up to 5 ha; from 5 to 20 ha and more than 20 ha), favouring small sizes, and ensuring the technological differentiation of the crop and the gender diversity of the producers;
- The level of representation of each of the area classes should be differentiated according to the size of the farms and not according to the area of soya cultivation since the importance of this crop in the farm business plan was one of the intended results.

A team of six surveyors was formed, selected by the Federation, with a high level of education (grade 12), knowledge of the local language, some experience in conducting surveys and knowledge of agriculture, particularly soya cultivation.

The survey was conducted over four days (one day per location) after a full day of intensive training. The surveyed producers were concentrated in a pre-defined location in the locality where they lived, and where the survey was carried out. Right after the survey, the form was immediately checked by the survey coordinator for missing information and the most obvious inconsistencies, according to a primary quality control grid. This method allowed the quality of the responses to be improved from the outset by correcting defects detected during questioning, agent by agent and producer by producer. The data was processed in the Statistical Package for Social Sciences (SPSS).

A strategy of this type does not guarantee the representation of the agriculture of the district, so the results should not be interpreted in that perspective. However, it is believed that it created good conditions for the research objective to be fulfilled, capturing sufficiently well the way in which the promoted technologies were disseminated among small producers, respecting the temporal and financial constraints of the research.

The final result of this survey by location, after validation, can be seen in Table 1. There is a higher incidence of producers in the locality of Lioma, with approximately one third of the observations, where this crop is very important. The locality of Magige is the one with the lowest incidence, with only 22 observations (17.20% of the total). In the remaining localities the number of observations is identical, each one with 25.00% of the total number of observations of the sample.

Table 1 – Distribution of the observations of the sample per locality

Locality	**Number of observations**	**Frequency (%)**
Magige	22	17,20
Tetéte	32	25,00
Ruace	32	25,00
Lioma	42	32,80
Total	128	100,00

The distribution by total area class obtained at the end of the operation was as follows:

Producers with farms up to 5 hectares: 72 (56.30%).
Farmers with farms between 5 and 20 hectares: 41 (32.00%)
Farmers with farms over 20 hectares: 15 (11.70%)

A strong presence of small producers was ensured; whose farms have a total area of up to 5 hectares (56.30% of observations). The class between 5 and 20 hectares includes 41 observations (32.00% of the total) and, finally, 15 observations are made up of producers who operate farms with a total area of more than 20 hectares (11.70% of the total sample). This distribution favours the presence of medium and large producers compared to the distribution of producers in the entire district, which is a favourable result for the objective of the study.

Table 2 - Distribution of observations by soya area class

Soya area class	**Number of observations**	**Frequency (%)**
Up to 1 ha	35	27,30
1 - 2 ha	34	26,60
2 - 4 ha	30	23,40
4 - 8 ha	13	10,20
8 - 12 ha	9	7,00
+ 12 ha	7	5,50
Total	128	100,00

With regard to the area cultivated with soya, the distribution of observations presented in Table 2 shows that the focus on small farming was met, with thirty or more observations at each of the three smallest levels. From 4 hectares onwards the number of observations decreases as the soya cultivation area increases. Above 4 hectares of soya the sample contains 29 observations.

3.2 Information collected - survey form

The Survey Form was designed based on open and closed questions, with a view to characterising, from a technological and economic point of view, the technical course of the crop in the campaign beginning in October/November 2018 and ending in May/June 2019. In addition to this information, a set of questions was included to characterize the farm as a whole, as well as others of a sociological nature that would allow to know various characteristics of the producers and households (see Annex II - Survey Form).

The data collected in the survey was spread over 246 items, demanding just over 30 minutes of questioning on average.

The data collected was structured according to the following chapters:

- Characteristics of the producer and his social background;
- Household characterisation and composition;
- Pluriactivity and non-agricultural income;
- Food diversity and food acquisition;
- Land occupation, land use and land tenure;
- Production and commercialisation of soya (background and perspectives);
- Technological pathway of soya cultivation: land preparation, sowing, use of seed, fertilizers and crop protection products, weeding, harvesting, threshing, transport, sale, and financing.

The technical path of soya cultivation included qualitative and quantitative information, the latter seeking to identify the use of production factors: labour (family and paid) and working capital (machinery service, common (self-used and purchased) or certified seed, fertilisers, and crop protection products, specifying quantities and costs (with the exception of family labour and self-used seed). We sought to know the quantities of grain stored for use as seed in the following campaign.

The technical itinerary of soya cultivation included the following steps, in relation to which correspond the technological aspects that are analysed in this research:

Regarding mechanisation, the following six items were considered:

- Use of own tractor;
- Ploughing/preparation of the land;
- Sowing;
- Weeding;
- Harvesting;
- Threshing.

Regarding the use of inputs, information was collected on the following six items:

- Certified seed;
- Inoculated seed;
- Herbicides;

- Fungicides;
- Insecticides;
- Fertilisers.

For each of these item*s*, relevant information was collected for each operation, namely time spent on the operation, quantities of inputs used, expenses incurred, among other aspects.

3.3 Identification of technological development levels

In order to identify the levels of use of technological items observed for soya cultivation, a methodology was developed to quantify the different realities contained in the sample. The aim was also to develop a methodology that was not very demanding in terms of basic information and that could be applied to the study of other socioeconomic realities and other agricultural crops.

The first step consists in identifying the technological level of each producer interviewed. In the second step, homogeneous groups of producers are formed with respect to the intensity of use of the technological items considered. Once these groups were formed, an attempt was made to develop a method that would make it possible to quantify the most prominent aspects of soya production technology for each of them.

For the first step, qualitative information regarding the production process was used. The survey allowed to know the cultural practices performed at each stage of the technical itinerary of the crop of each producer, from the process of land preparation to the sale of the production. For each of the technological items considered in the survey, the use or non-use of each item was specified through a mute variable (0 or 1). If a given item had not been used, the value "0" was entered; otherwise, the value "1" was entered. Since six items relating to mechanization were defined, by adding these responses we obtain, for each producer, a discrete variable, with intire values within a range of [0, 6], expressing the degree of use of mechanization on the crop. The same type of procedure was applied to the use of inputs.

By adding the values thus obtained for mechanization and inputs, a quantified perception of the overall technological development level of each producer is obtained, expressed through a discrete variable with intire values contained within the range [0, 12]. Since the survey focuses on soya cultivation, it may be admitted, however, that the technological development obtained is identical to that of the other agricultural activities practiced by the producer. Accepting this premise, the technological level observed for soya cultivation reflects the technological level of each individual producer.

The surveyed producers were distributed into four technological level groups:

- **Level 1 "No Technology"**[4] " - Level of technological development with zero value, i.e., situations in which all operations are carried out manually, without recourse to any of the considered technological items;
- **Level 2 "Low Technology"** - Level of technological development with a value of 1 or 2, representing incipient levels of recourse to the considered technological items;
- **Level 3 "Medium Technology"** - Level of technological development with a value of 3 or 4, with more extensive use of the considered technological items;
- **Level 4 "High Technology**" - Level of technological development with 5 or more technological items, corresponding to the most advanced technological development levels observed in the sample.

The second step consisted on the analysis the distribution of the values of this last variable and, from there, grouping the producers into homogeneous classes with regard to the technological level. Once these groups had been formed, it became possible to analyse their characteristics, both at the technological level and in other aspects observed in relation to the producers and their households, income formation, land use and tenure, nutritional aspects, and others.

With regard to the technology used in soya cultivation, the criteria used, group by group, consisted on determining, for each technological item, the relative frequency of use of a given item by the producers in the group, that is, the quotient between the number of producers in a given technological group that used a given technological item, in relation to the number of producers of that same technological level.

By adding these values associated, for example, with mechanisation, we obtain a quantified indication of its importance in each group, as well as the relative importance of each of the items that compose it within the whole group of producers. Note that the adoption of a given technological item by producers does not necessarily follow a rigid pattern from group to group. For the purpose of this work, these aspects represent a central element.

The same procedure described above for mechanisation was applied to each item that comprises the inputs.

Thus, the Technological Indicators (TI) associated with mechanisation (TImec) and inputs (TIinp) are obtained for each of the different technological levels created.

By adding the values of these two indicators, we obtain the value of the Global Technological Indicator (GTI) for each group. In other words,

$$GTI = TI_{mec} + TI_{inp}$$

[4] The fact that the level has been designated "No Technology" does not mean the absence of technology. In these cases, traditional technologies are applied, with all operations being carried out manually with the support of small tools. In these cases, the technological item*s* considered in this research are not used.

where TI_{mec} represents the degree of technological development observed in the field of mechanisation for each group, and TI_{inp} represents the technological level regarding the use of inputs. The GTI expresses numerically the intensity of use of a set of surveyed technological items.

If all the producers in a given group use all the technological items considered for mechanisation (value of 1.00 in each item), the value of the TI_{mec} would be 6.00. The same would be true for inputs. Consequently, under these circumstances, the GTI can reach the maximum value of 12,00.

With this method it is also possible to quantify how distant the value observed is from the maximum possible value in each of the producers´ group. The interest of this result lies in the possibility of obtaining a quantified indication of the effort that will be necessary to make, group by group, in order to reach the maximum possible value.

At the same time, it becomes possible to identify which technological items contribute to a certain level of current technological development of each of the groups formed, as well as those that need to be promoted for a given group of producers to progress technologically towards the maximum value.

In addition, given that the whole set of groups of producers is formed starting from increasing levels of technological level, it is also possible to make a pseudo-temporal reading of the technological development process. The characteristics that were observed in a sequence of increasing technological level, somehow they give an indication of how, over the last years, technology has been adopted by small producers and has been installed in soya production in the region.

Since this process is necessarily long, it makes sense to conduct a second survey of this set of producers in the future in order to identify, on a real time basis, how the situation evolved and try to understand in detail the timing of this type of process. This timeframe is of great importance for guiding the timing-consistency of policy programmes to promote technological development among small family farmers.

3.4 Family farmers´ income levels in soya cultivation

To determine the level of income obtained at each technological level, the formation of net operating income was used (Gross Income minus Variable Costs), that is, the Gross Margin of the activity. Given the predominant type of producer in the sample, this level of income, which does not consider fixed costs, is the most relevant result, given that structural costs are usually very low or zero.

Given that the degree of monetarisation of the economy of these farm units is quite diverse, Variable (operating) Costs were broken down into two fundamental categories: "cash" costs, whose values were obtained in the survey, and "non-cash" costs , consisting of the value attributed to non-wage labour (family or other), valued by the average value of wages paid in the region in that season, and the value attributed to the seed produced, valued by the average sale price of soya beans in that year. Schematically we have:

Gross Production

minus "cash" Variable costs

= Gross Margin I

minus "non-cash" Variable costs

= Gross Margin II

By definition, family labour represents a Fixed Cost from the perspective of the production unit as a whole. However, as the amount of family labour was recorded, operation by operation, in the soya crop, it was considered as a variable factor, for convenience and ease of analysis.

The rationality of allocating family labour time among the various activities carried out throughout the year on the farm (agricultural or non-agricultural activities, work devoted to the production of each of the food crops and in cash crops) allows the family labour engaged in a particular activity, in this case soya production, to be considered as a variable factor, reinforcing the choice made.

3.5 Relationship between Labour and Capital

To analyse the levels of economic efficiency of production, a production function was estimated, allowing the verification of the relationship between production and the use of the production factors Working Capital and Labour. For this purpose, we used the Cobb-Douglas function, which is widely used in empirical studies of this nature. This function has the advantages of becoming linear in logarithmic form, allowing the adjustment of a function in multiple linear form, where the coefficients of each factor of production represent, simultaneously, the (partial) elasticities of output with respect to a given factor. Finally, this algebraic form allows the direct analysis of the return to scale of production by adding the partial elasticities (Strassburg et al., 2014; Dharmasiri et al., 2011). Return to scale is the technical feature of the production function that measures changes in production due to changes in factors of production simultaneously.

The Cobb-Douglas production function is given by:

$$Y = AK^{\alpha}L^{\beta}$$

Where Y represents the value of production, L is labour and K is capital. Logarithimizing, one has:

$$LnY = A + \alpha LnK + \beta LnL$$

This algebraic form provides indication about the returns to scale of production, namely:

- If $\alpha + \beta = 1$, returns to scale are constant;
- If $\alpha + \beta < 1$, returns to scale are diminishing;
- If $\alpha + \beta > 1$, returns to scale are increasing.

The Cobb-Douglas production function used in this study is as follows:

$$LnY = \beta_0 + \beta_1 LnWorkingCapital_i + \beta_2 Labour_i + \varepsilon_i$$

Where:

- *LnY* is the natural logarithm of the value of soya production;
- *LnWorking Capital* is the natural logarithm of the value of total purchased inputs (seeds and agro-chemicals) and machinery services used in the soya crop;
- *LnLabour* is the natural logarithm of the value of (wage and non-wage) labour used in soya production;
- β_0 is the independent parameter (coefficient) of the function;
- β_1 is the parameter (coefficient) that is associated with the explanatory variable Working Capital;
- β_2 is the parameter (coefficient) that is associated with the explanatory variable Labour;
- ε_i is the difference between the predicted and observed value of LnY_i, i.e. it is the residual variable resulting from econometric estimation).

Two limitations in the use of these models are recognised in the analysis of the data from this survey. Firstly, given that the sample is not random, the basic condition for the use of econometric models, which require the random selection of observations, is not met. Secondly, in Microeconomic Theory the production function assumes that economic units are managed so as to maximise profit. This hypothesis does not apply in this case, since, among the objective of the respondents, the household food supply is a priority objective, of which soya is either not part or has very little expression. The monetary income obtained by selling local surplus food crops and technologically poor cash crop production is an objective that competes with the former in the agricultural use of available resources (land, labour and capital).

However, considering these concerns, the results of this analysis are useful for obtaining indications on a microeconomic level about the current relationship established between the fundamental magnitudes of the productive process analysed in this research: Production, Labour, and Working Capital.

4. RESULTS[5]

4.1 General characteristics of the sample

The 128 observations cover around 795 individuals, given that the household observed is composed, on average, of 6.21 elements. The sample is composed of producers with an average age of 42 years. Just over a third of the respondents (39.10%) are female. Around two thirds of the respondents (64.80%) can read and write.

[5] This chapter follows closely on the dissertation "*The role of smallholder farmers in agricultural policy options in Mozambique*" presented by Yara Nova for her master's degree from the Lisbon School of Economics and Management in 2021 (Nova, 2021).

Half of the sampled producers (50.78%) dedicate themselves full-time to agricultural production, with the sale of agricultural products being the main source of household income (Table 3). Rural wage earning (*ganho-ganho*) and the sale of beverages (juices and alcoholic drinks) and food (usually bread and cakes) constitute the non-agricultural activities with relevance in 39.07% of the observations, especially in producers with smaller farms.

Table 3. Pluriactivity of the sampled producers

Pluriactivity	Number of observations	Relative frequency (%)
Full-time farming	65	50,78
Provision of agricultural services (*ganho-ganho*)	23	17.97
Food trade	21	16.41
Non-food trade	6	4.69
Wage labour (State, companies, NGOs)	6	4.69
Civil construction	4	3.13
Provision of other services	2	1.56
Provision of agricultural machinery services	1	0.77
Total	**128**	**100,00**

The total area of the sample set of observations is 2,017 ha (15.8 ha on average). Out of this area, 1,534 ha (76.05%) are cultivated. The difference between these two areas (23.95% of the total area) corresponds to forest and fallow areas which are relatively common as farm size increases.

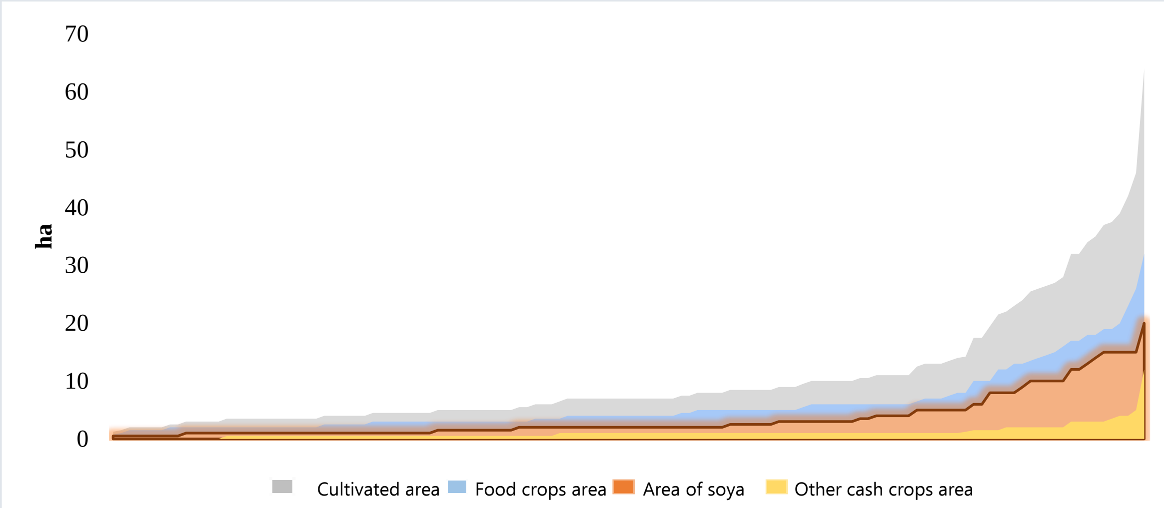
The sample includes 458 ha cultivated with soya, which represents the average of about 30% of the agricultural area of each farm. On average, each producer cultivates about 3.58 ha of soya. In the remaining area food crops and other cash crops are grown.

Only four producers (3%) own a tractor and cultivate a total of 39.5 ha of soya (8% of the soya area of the sample). However, in 328 ha of soya (69% of the total) observed in the sample belonging to 50 producers (39%), the land is almost always prepared by purchasing machinery services.

Soya cultivation occupies a total of 98 days of work per ha, with 48 days/ha of family labour and 50 days/ha of paid labour. Only 14% of the annual amount of family labour provided by the producer and his household is dedicated to soya cultivation.

The average level of daily expenditure with food purchases in this sample is 9.50 MZM/day/person (around 0.15 US$/day/person) which is a value that well demonstrates the importance that food production has for these families.

Chart1. Composition of cultivated area according to the physical dimension of the surveyed units



Note: Area under cultivation refers to the sum of the area of cash crops and food crops. On the x-axis, survey observations are ordered by increasing size of UAA (ha).

Chart 1 shows the evolution of the composition of the area under cultivation in increasing order of physical size (hectares) of the observed farms. This sample contains observations of very variable sizes, with a minimum cultivated area of 0.5 ha and a maximum of 64 ha. The average value is 10.60 ha and the modal value 7.00 ha.

The structure of land use is fairly homogeneous in the sample, covering all sizes. There is always an important portion of area devoted to food crops (on average 56% of the cultivated area), usually for the production of cereals (in almost all cases maize and sorghum and, in sporadic cases, rice), legumes (various types of beans) and less frequently tubers (cassava). These crops are often grown in association on the same plot close to the house. These production systems are characteristic of small farming, which guarantee the household's food supply in basic dietary products, combined with the production of cash crops. Part of the production is stored and used as seed in the following season. This logic of land occupation, typical of small family farming, persists in all aspects. Cash crops tend to become more important as the size of the farm increases. The frequent presence of maize crops, either as a food crop or as a cash crop in the larger farms, interferes with the land use structure that this chart intends to characterise.

This survey sought to identify how the producer considers the agricultural area currently available, asking about the intention, or not, to increase it in the future.

Table 4 - Intention of increasing the farm area

Intention to increase the size of the farm	Number of observations	Relative frequency (%)
No intention to increase the area	44	34.40
Increase through land "market"	42	32.80
Increase through use of available, uncultivated area	26	20.30
Passive attitude to increase area	16	12.50
Total	128	100.00

Around one third of the producers declared no intention of increasing the area. However, the remaining two thirds declared their intention to increase the cultivated area. Around one third of the respondents (32.80%) intend to increase the available area by resorting to the land "market" that, in practice, exists (renting and purchase)[6] or by using available unused areas (20.30% of the respondents). Finally, 16 producers recognise an interest in increasing the current area, intending to do so by requesting support to some entity, usually the Community or the Government.

Given this set of characteristics, it can be assumed that the sample is composed of a group of producers that brings together a diversity of situations adjusted to reality, fulfilling the objectives of this study, with the different segments of family farming in the region being sufficiently represented.

4.2 Technological levels in soya production

According to the methodology described above, 44 producers in the sample (34.38%) are at the "No Technology" level. The core groups are made up of 36 and 37 observations each, respectively, each representing about 28% of the observations in the sample.

With the exception of the higher technology level, which does not have a number of observations that ensures safe conditions for analysis as it contains only 11 observations (8.59% of the total sample), the other levels are sufficiently extensive to allow safe conclusions to be drawn.

Along with this reserve, contrary to the other three groups, the latter group is heterogeneous in its composition, since it contains producers who own their own tractor (4.7% of producers) and some who are engaged in the production of certified soya seed (3.9% of producers), which is technologically more demanding. Therefore, information regarding this group is considered in the analysis only as an indication. It should be noted, however, that the number of family farmers with tractor in Gurué District was, at the time of the survey, very small, possibly about 27 producers. The number of producers of certified seed was of the same magnitude. In these circumstances, the sampling rate in this group is certainly higher than in the others. For this reason, with the appropriate reservations, the corresponding figures are commented on throughout the text.

Table 5 shows the figures corresponding to the technology used by producers in each of these four groups. The figures in the table correspond to the quotient between the number of producers of a given technological level (column) that used a given technological factor (row) relative to the number of producers of that same technological level, that is, the proportion of producers in each group that

[6] Although the Mozambican Land Law (Law no. 19/97) is very explicit in the principle that land is the property of the State and that it cannot be sold, in reality, the sale of land represents a practice that is strongly present in some places and is nowadays considered one of the fastest ways to access land in urban and rural areas (Mandamule & Manhicane, 2019).

used a given technological item. The figures presented for mechanisation, inputs, and the set of items (the GTI) correspond to the sum of the figures indicated for each component.

In all groups it can be seen that technological adoption is more evident in the mechanisation component than in the input component. In other words, the investment made in mechanisation is more widespread among the producers surveyed than the consumption of inputs.

Table 5. Technological levels of soya production in Gurué District (2018/2019 campaign)

	Technological factors	**Level 1 - "No Technology" (0 factors)**	**Level 2 - "Low Technology" (1 to 2 factors)**	**Level 3 - "Medium Technology" (3 to 4 factors)**	**Level 4 - "Higher Technology" (5 factors or more)**
	Number of observations (sample)	**44**	**36**	**37**	***11***
Mechanisation	Ploughing/land preparation	0,00	0,31	0,76	*0,91*
	Own tractor	0,00	0,00	0,00	*0,55*
	Sowing	0,00	0,06	0,22	*0,91*
	Weeding	0,00	0,00	0,00	*0,00*
	Harvesting	0,00	0,11	0,08	*0,00*
	Threshing	0,00	0,36	0,68	*0,82*
	Subtotal Mechanisation (1)	**0,00**	**0,84**	**1,74**	***3,19***
Working Capital (Inputs)	Herbicides	0,00	0,00	0,00	*0,00*
	Certified seed	0,00	0,00	0,00	*0,45*
	Inoculated seed	0,00	0,31	0,76	*1,00*
	Fungicide	0,00	0,08	0,22	*0,55*
	Insecticide	0,00	0,08	0,41	*0,36*
	Fertilizer	0,00	0,08	0,27	*0,45*
	Subtotal Inputs (2)	**0,00**	**0,55**	**1,66**	***2,81***
	GTI (1) + (2)	**0,00**	**1,39**	**3,40**	***6,00***
	GTI maximum value	***12***			
	Distance to go for maximum TI level	**12,00**	**10,60**	**8,60**	***6,00***

Note. The values in the right-hand column are presented in italics due to the restrictions placed on their analysis.

The " No Technology" group represents what is statistically called the "witness" or "base group", that is, a set of 44 observations whose reality does not have the direct influence of the process (adoption of technology) that we intend to analyse. This group corresponds to a larger part of small family farming.

In this group, the option to grow this crop will result from favourable market conditions in the region and as a result of opportunities created by support programmes for producers through the supply of seeds during a given period. These producers replicate the production in subsequent campaigns, sowing the part of the part of previous campaign production stored for this purpose.

The use of part of the produce as seed in the following season is a common solution in all technological level groups, even at the higher level, because of the high price of quality seed. In this group, as in the others, soya started to occupy areas previously used for maize production. The characteristics observed in the core groups (low and medium technology levels) somehow reflect how technology was introduced into small family agriculture through the PAC model. Producers increasingly resort to using the machine services provided by PACs, reducing the time spent on a given operation, replacing the traditional technology of using labour to carry it out. This development is generating increases in labour productivity.

The use of mechanical traction is most evident in the phase of land preparation for crop installation. Mechanical threshing, usually carried out through the rental of mobile equipment not coupled to a tractor, is the second phase of the technical path of the crop in which mechanisation is more widespread. The frequency of use of mechanisation in these two phases more than doubles in the transition from low to medium technology producers. At the higher level, 91% of producers mechanically prepare the land for crop establishment and 82% thresh mechanically.

Only at the higher technology level are mechanical sowing processes used, which is a result of the presence of certified seed producers in this group. Weeding (two or three times a year) is done manually in all groups[7]

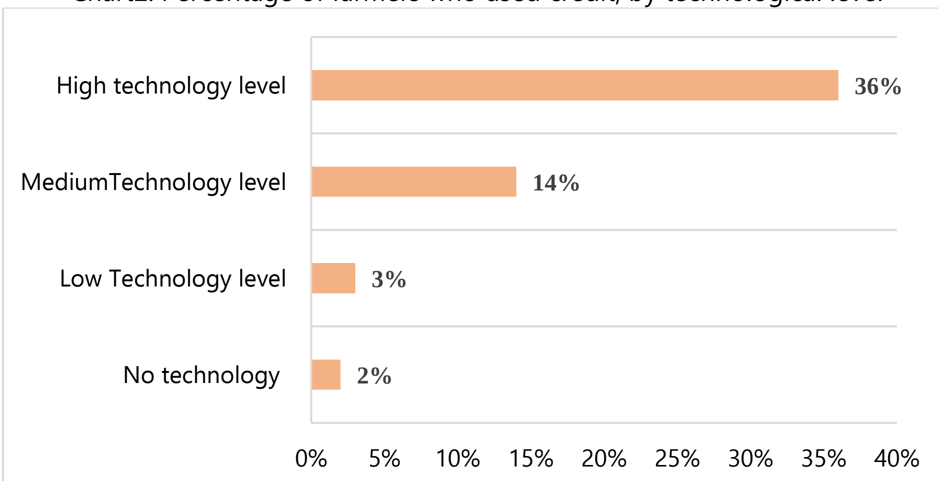
The quality of the seed is a determining factor in production yield. There is a growing tendency to use inoculated seed with increasing technological levels. The technique of inoculating seed (associating a microorganism (rhizobium) to seed right before sowing), which improves the productive capacity of the plants, is used by about one-third of low-technology producers (31%) and is already a common practice at the medium level (71% of producers in this group). In the higher group, inoculation of seed is a widespread practice. The dissemination of this technology represents a very striking result of the success of the different programmes supporting soya cultivation in the region. It should be noted that only in this latter group are producers buying certified seed, usually associated with the production of certified seed.

A relevant aspect of this scenario is the very low use of fertilisers and plant protection products. As a whole, the use of these factors ensures better crop productivity conditions and safeguards the crop's quality and the maintenance of soil fertility conditions (not to exhaust the soil). A generalised panorama of this type reflects a situation of strong dependence on climatic conditions and susceptibility to the propagation of organisms that are harmful to plants, and undermines the sustainability of crops (Goldman, 1995).

[7] In December 2019 the first implement had been acquired to carry out mechanical weeding in the region, for experimental use, which at that time had not yet been carried out because it required planting the crop in the field (sowing in rows), which is still unusual in the district.

The systematic use of fertilizers and crop protection products (insecticides, fungicides, and others) varies but is always low. Even at the high technology level, only 55% of producers use fungicides and 36% apply insecticides. This picture suggests a general situation of low productivity in this crop and reduced quality of production, as well as a reinforced dependence on weather conditions and some phenomena associated with them (rainfall and damage caused by harmful organisms) that can be reduced through the rational usage of agrochemicals (Nicolopoulos et al., 2016, Parliament Europeu, 2021).

Chart2. Percentage of farmers who used credit, by technological level



In general, there are constraints on the use of working capital (machinery services and inputs), indicating the great producers´ difficulty to access credit, particularly short-term (seasonal credit). Since the inputs are imported and, consequently, subject to exchange rate variations, their price level is usually high.

Only one third (36%) of the producers at the higher technology level used financing (Chart 2). The use of credit in the remaining groups is not very significant and decreases sharply as the levels of technological development of producers decreases.

Given that this type of producer has strong capital limitations, access to credit, namely seasonal credit, is a key element for improving production conditions.

The results of this survey clearly highlight the general picture of difficulty in accessing working capital, whether for the purchase of machinery services or inputs. Contract farming solutions are one way around this obstacle. However, the degree of success of this solution is usually limited, and the adherence of small producers is below its potential, possibly due to the multiplicity of production outlet channels already existing in the region.

In this sample, 80 producers (62.50% of the total) that make up the two lower levels of technological development practically did not use credit. The few that did, resorted to informal schemes. This scenario should develop, with policy makers seeking the most appropriate channels (micro-credit or others) to unblock this situation.

The effort to be made to disseminate technological progress is still remarkable. A measure of this effort can be seen in Table 5 by the distance of the GTI value of each technological group to the maximum value that this indicator can reach (see lower line in that table). The group corresponding to the higher technological level will be halfway to reaching the maximum possible value. The two central groups are situated at 25.83% and 11.67% of the maximum value of the GTI. Regarding the No Technology group the first steps in the introduction of technological progress in soya cultivation are still have to be taken.

4.3 Characteristics of producers and technological level

In order to know the characteristics of the producers that integrate the groups of the technological levels formed, it was sought to identify the profiles of producers in each group that showed to be more evident in the sample: literacy level, years of soya cultivation, and socio-political and professional relevance, and their technical capacity building, developed by the relations established with the rural extension services.

Chart 3 shows a strong, almost direct association between the literacy level and the technological level, indicating that the higher the literacy level, the greater the capacity to adopt technological innovations.

Chart 4 shows that, with some variability, there is a higher concentration of producers who stareted recently to produce soya (less than 10 years). This time of experience in soya farming coincides with the period of strong expansion of poultry production.

It should be noted, however, that there is a decreasing trend in the group of producers who have been producing soya for less than 10 years, which represent 72% in the No Technology group, reducing their expression to 69%, 70% and 63% as one moves towards higher levels of technology. The values in Chart 4 suggest that the adoption of this crop is relatively recent, even at the highest level of technological development. In other words, the higher technology levels are not the result of an individual, gradual process developed over the years, but rather the exogenous way in which opportunities for technological progress have presented themselves to producers through the support programmes.

Chart 3. Producer´s literacy level, by technological level

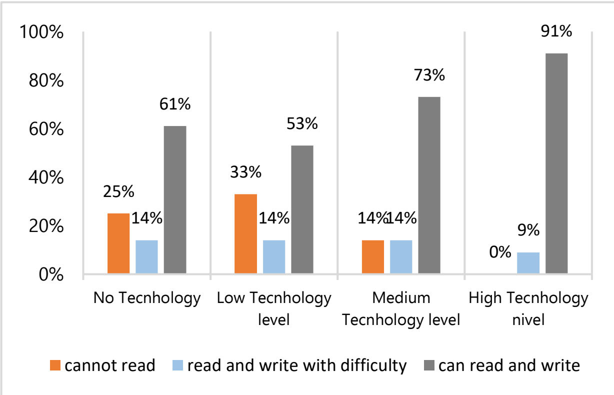
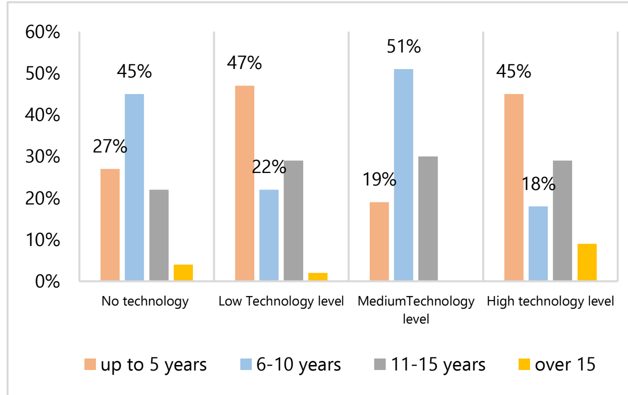


Chart 4. Years of soya cultivation, by technological Level



As the process of technological development is exogenously promoted, it is important to verify the social status of the producers that adopted it. For this purpose, we used a set of data on the social position of each producer. The data used refer to the family status and their insertion in the decision-making organisation of the community to which they belong, and to their current or past work in political power structures.

An Indicator of Socio-professional Relevance of the producer was constructed, consisting of four criteria, namely: (1) being or having been a member of an association; (2) being or having been in management positions in associations; (3) belonging to a religious association; and (4) being, or not, member of the School Council.

Chart 5. Socio-political relevance of producers, by technological level

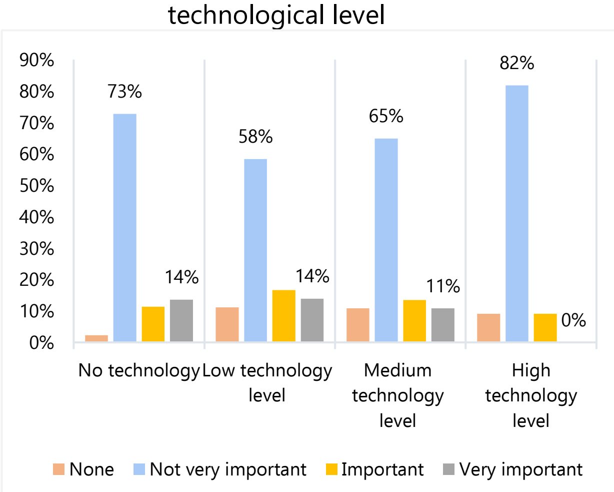
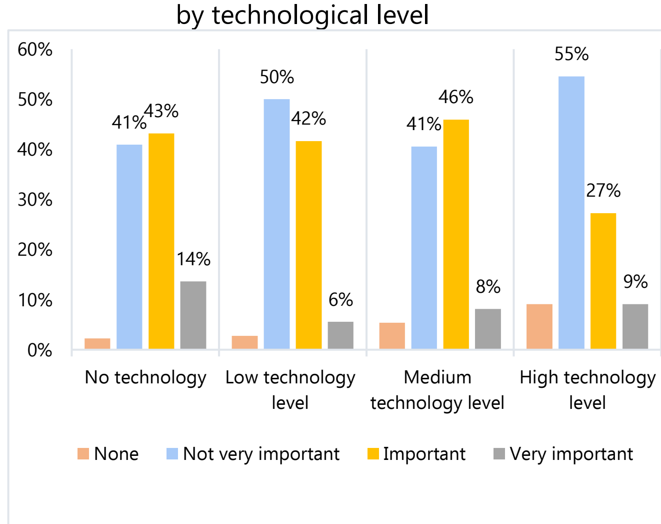


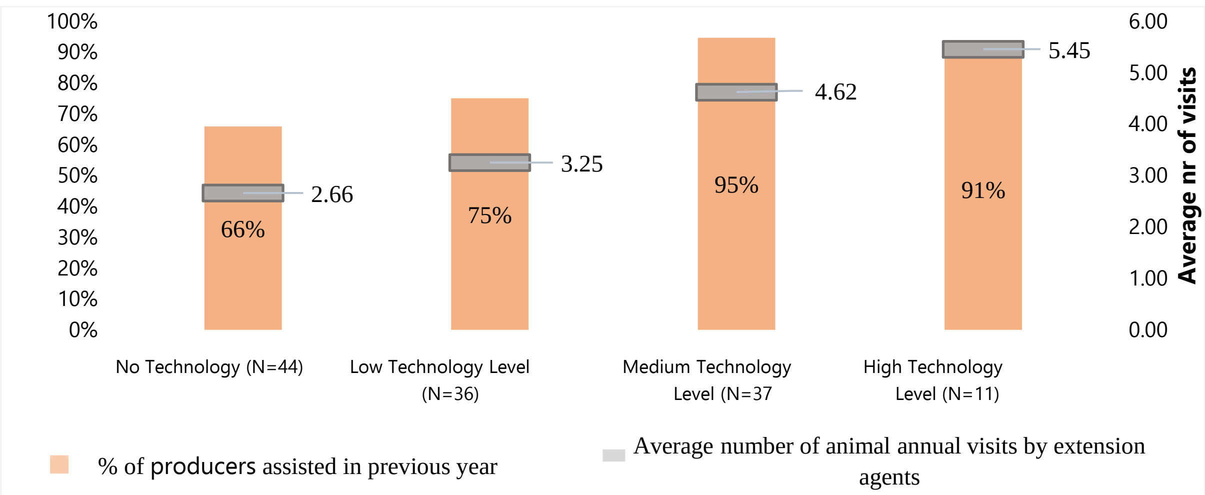
Chart 6. Socio-professional relevance of producers, by technological level



In parallel, an indicator was created based on five criteria that express the socio-political relevance of the producer, namely: (1) being a community leader; (2) having a close family relationship with the community leader; (3) being or having been a Neighbourhood Secretary; (4) having participated in the District Consultative Council; and (5) being a member of a political party.

In Charts 5 and 6 above, it is observed that, in general, respondent producers have more socio-professional than socio-political relevance. In terms of political relevance, in all the technological levels of the sample there is a predominance of producers with relevance classified as "not very important", a characteristic which, curiously, assumes the maximum value in the higher technology level (82% of the producers). The levels of relevance "not very important" and "important" predominate in all groups. This aspect is highly relevant for the debate on this type of public policy in Mozambique, demonstrating that it is possible to conduct this support in a way that is not associated with the social or political relevance of its beneficiaries.

Chart 7. Technical assistance offered to producers by rural extension services



Note: In order to improve the visualisation of the chart, the values of the average number of annual visits were placed on a second scale.

The producer associations play an important role in the communities, namely in the transmission of information, technical advice, and political representation. Usually, belonging to a certain association constitutes, in addition, an open door to access support programmes for small-scale agriculture. Perhaps because of this, 90.6% of the producers in the sample are integrated in some association (usually local) and 54.7% hold, or have held, the position of association leader. The extent of this characteristic of the respondent producers logically derives from the strategy followed for selection of observations.

Technical support plays a fundamental role in the operationalisation of public policies and dissemination of technical knowledge. Chart 7 clearly shows that the percentage of assisted producers and the intensity of assistance increase according to the technology level of the producer.

The percentage of producers assisted at the two highest levels is very high - over 90% in both cases. In the two lower groups, this type of support is less significant, specifically 66% of cases at the No Technology level and 75% of producers at the Low Technology level. However, the frequency of visits is lower, with three visits per year on average.

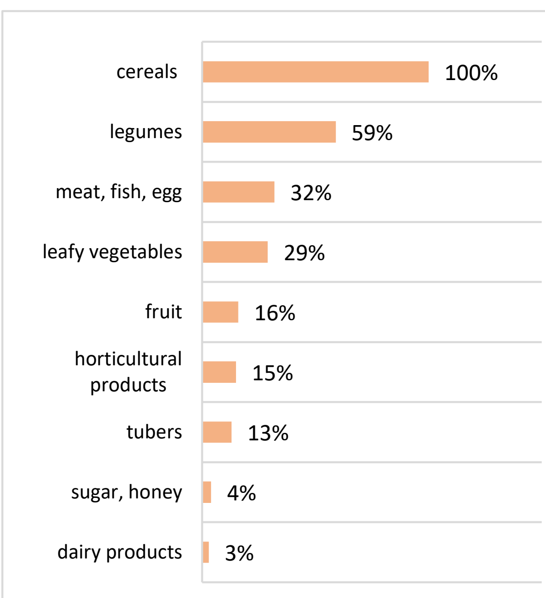
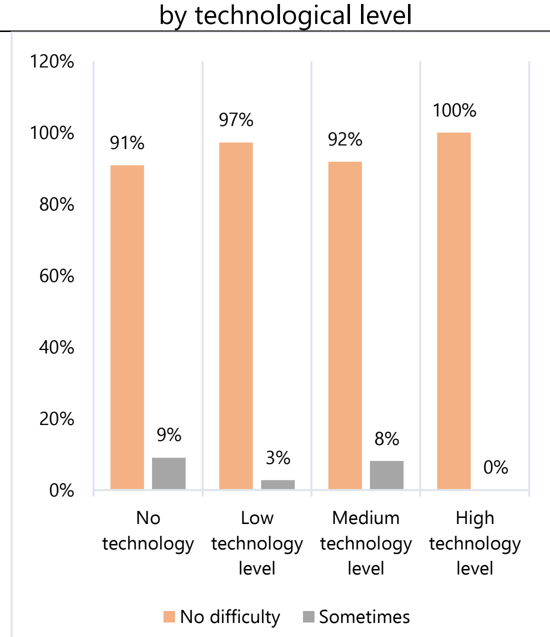
This result demonstrates the existence of a direct relationship between the intensity of technical assistance support and the technological development level of the crop, confirming the crucial role played by rural extension services in this context. The need to increase the effectiveness of rural extension services is thus demonstrated.

4.4 Technological levels and food diversification of households

In the diet of producers in this region the weight of cereals and legumes, mostly produced on the farm, is evident (see Chart 8).

When questioning producers about the frequency and cases in which there were difficulties in obtaining food for the household (Chart 9), it can be observed that, with the exception of producers of higher technology level, there were cases in which the producer acknowledged having had situations of insufficient food at some point in the previous year.

However, for the vast majority of producers in the sample, the non-availability of food does not represent a restrictive factor for family life, despite the existence of reduced levels of food diversification.

Chart 8. Food items included in the family meal the day before the survey	Chart 9. Difficulty in food supply, by technological level
	

The Food Diversity Indicator was developed based on the different types of food products consumed by the household the day before the survey was carried out. This index is only an approximation to households´ dietary diversity and was created in order to analyse the relationship between technological progress and the diet of producers.

This Food Diversity Indicator was calculated based on a total of nine types of food items that make up the typical diet in the region, namely: (1) Cereals (maize, sorghum, and rice); (2) Tubers (cassava, yam, and potato); (3) Legumes (beans, groundnuts, others); (4) Leafy vegetables (kale, cabbage, others); (5) Vegetables (onion, tomato, okra, garlic, others; (6) Fruits; (7) Animal proteins (meat, fish and eggs); (8) Dairy products (milk and butter); (9) Sugar and honey.

To observe food diversity, it is important to consider the seasons of the year to which the information is related with, given the variation in the availability of food throughout the season. In other words, in the periods where production occurs there may be less food availability; in the post-harvest season there is greater abundance and diversity of food items.

Chart 10: Food diversity indicator, by technological level

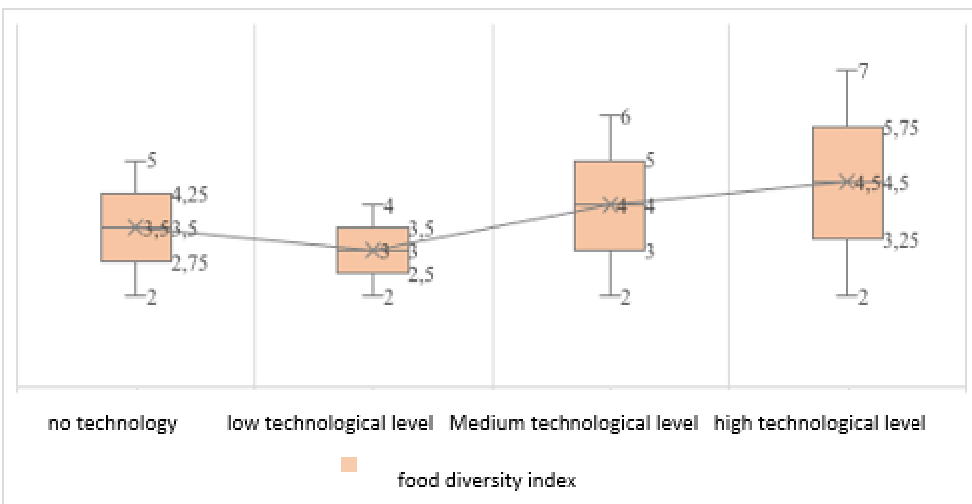


Chart 10 suggests that an increase in the technological level is associated with a higher level of food diversification. However, this trend is not clear and has a reduced amplitude. In fact, the No Technology group has an average value even higher than the Low Technology group, with an average value of 3.5 in this indicator compared to 3.0 in the next group. In addition, the maximum value of the diversity indicator in both groups points to the direction of a reduction from the former to the latter. The data collected from the survey does not allow us to find a justification for this result, which may be the result of some anomalous, undetected situation.

However, when considering the three groups that use the considered technological items (low, medium, and high) the tendency to increase is clear, increasing the value of the index from 3 to 4.5. The maximum values of the indicator are more expressive, rising from 4 to 6 types of food iems used the previous day in the two central groups, reaching a value of 7 in the higher technology level.

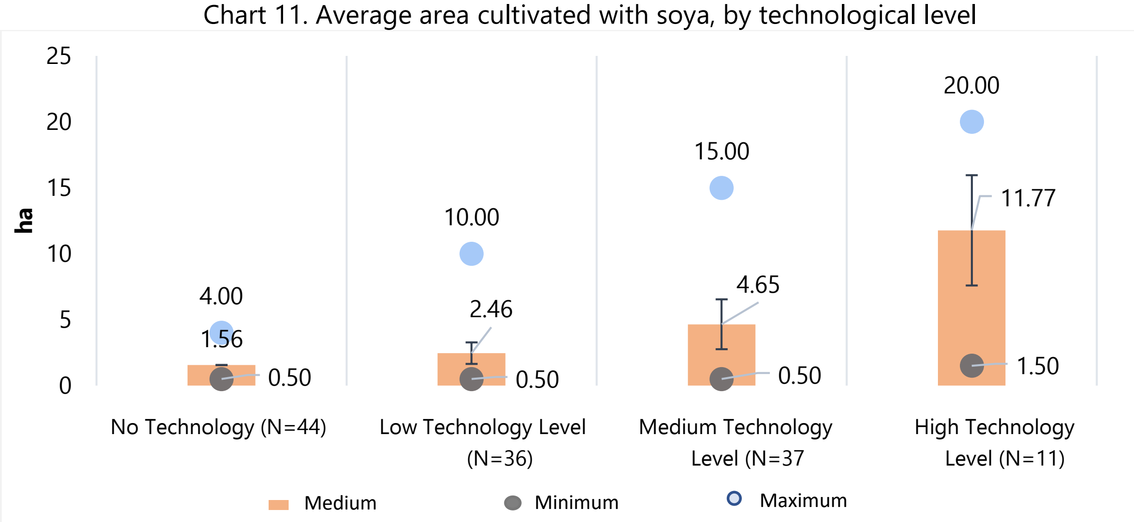
Note that at all technology levels there are observations with a minimum value of only 2 items (usually maize and beans), which corresponds to the pattern of the traditional meal in this region.

4.5 Production, productivity, and income in soya production

The groups formed present important differences in the size of the production area. According to the information in Chart 11, the average area of soya crop per producer increases significantly with the increase in technological level, going from 1.56 ha in the No Technology group to 11.77 ha at the Higher Level.

With the exception of the group of producers at the high technology level, who have a minimum area of 1.50 ha, all other groups always include units with small areas (minimum observed value of 0.50 ha). Although there are very different sizes within each group, there is evidence of a direct relationship between the technology level and the physical size of the soya cultivation area, verified in both the average and maximum area values observed.

Chart 11. Average area cultivated with soya, by technological level

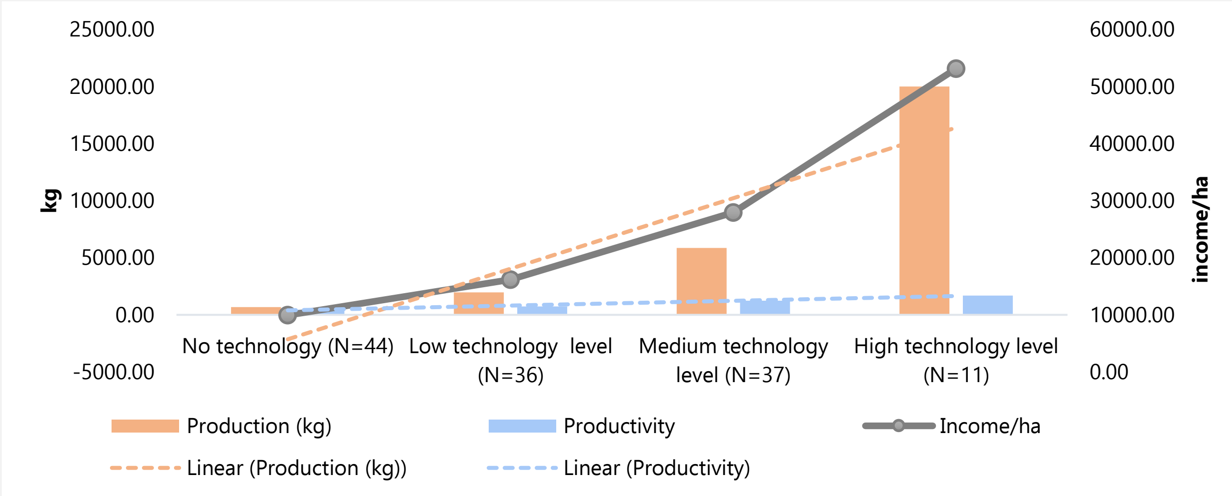


Note: The black lines in the middle of the bars represent the standard deviation (dispersion around the average).

The differentiation in the technological levels used for soya clearly determines a differentiation in the level of productivity, as is evident in Chart 12.

Productivity increases as the technological level increases. It can be noted that between the group of producers with No Technology and the low and medium technology levels, average productivity increases 2.7 times, rising from 450kg/ha to 1,230kg/ha, respectively. At the higher technology level, taking into account the reserves to which the information should be subjected, productivity stands at 1,680 kg/ha, a value considered acceptable for rainfed soya production.

Chart 12. Production, productivity, and average income/hectare of the soya crop, by technological level



Note: To improve the visualisation of the graph, the values corresponding to the income in meticais (MZM) per hectare were placed on a second scale.

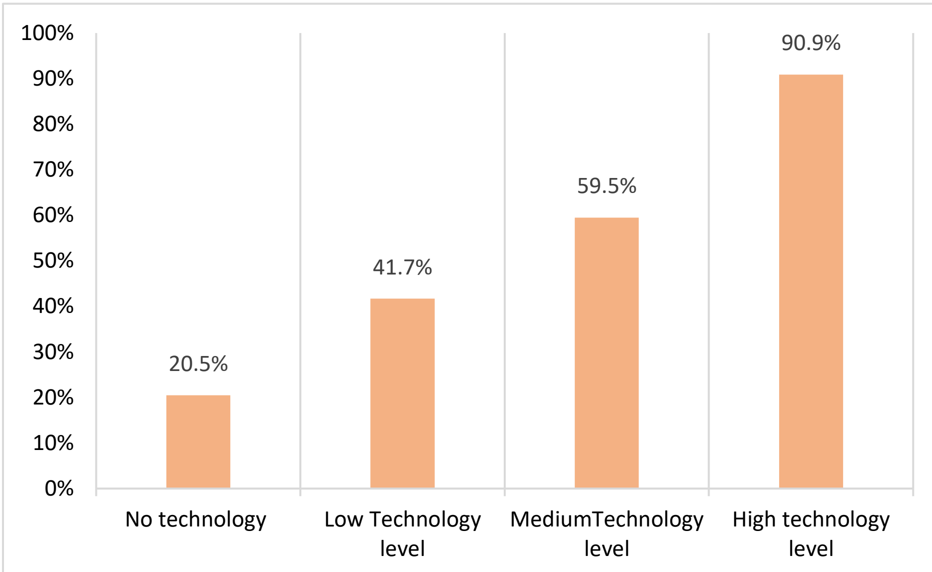
Associating the increase in area and productivity, which accompanies the increase in the technology level of the crop, results in a significant increase in production and, consequently, in yield per hectare of soya.

Another important issue has to do with the ownership of land use. In Mozambique, land is owned by the State, and producers and companies can be assigned a right to use it for an extended period, called Direito de Uso e Aproveitamento da Terra (DUAT). This right gives its beneficiaries a medium and long-term perspective of land use, which is a condition that favours investment.

Chart 13 shows that the percentage of producers with DUAT awarded always increases with the increase in technology level.

At the No Technology level only one fifth of the producers had the officially assured continued use of the land. In other words, around 80% of them were producing on land that was unofficially allocated to them. Land use normally derives from traditional rules that constitute customary law, usually by inheritance. In some cases, the producer declared having access to the land he cultivates through purchase, a situation not always compatible with positive (constitutional) law.

Chart 13. Percentage of producers who own DUAT, by technology level



The percentage of producers with DUAT increases to 42% and 60% in the intermediate technology level groups, this percentage being 91% at the higher level.

4.6 Use of labour and technology levels

A relevant aspect of the operation of these production systems concerns the use of family labour and paid labour. In these cases, family labour represents the availability of labour to carry out the various operations linked to the domestic life of the family, the production of food and the generation of monetary income, through the cultivation of cash crops or the promotion of non-agricultural activities.

This availability of non-wage labour - whether family or mutual aid - is complemented by wage labour, usually contracted on an operation-by-operation basis. In this case, in the region, there is no wage level on a time basis, whether daily, weekly, or monthly. Wage labour is contracted to fulfil a certain defined operation in a certain area. This reality requires a conversion calculation of the labour units involved in each operation (number of people x number of days) and, from the values thus determined, to convert the result into a common unit that expresses labour consumption.

For this purpose, the conversion of work into Annual Work Units (AWU) was made, which expresses the amount of work that a person is capable of doing in a year. We did not differentiate by age or gender, as is sometimes practiced. The reason for this is that the organisation of agricultural operations takes into account the characteristics and work capacity of the different elements that make up the workforce. Similarly, no attention was paid to the differentiation between family labour, which is normally more productive, and wage labour. This differentiation constitutes a limitation of the methodology used.

In this way, it is possible to convert the different types of labour used in soya cultivation into Annual Family Work Units (AFWU) and into a value for the wage labour, the Wage Annual Work Units (WAWU). Adding these two quantities of work gives the total amount of work done in soya cultivation.

Attention is drawn to the fact that soya cultivation is carried out in about six months, during the rainy season. Expressing the amount of work in an annual reference unit of 321 days per year (working 6 days per week and 52 weeks in the year) naturally results in low AWU values for this crop (see Table 6).

Table 6 - Amount of work used in the soya crop

	No Technology	Low Technology	Medium Technology	High Technology
Number of Annual Family Work Units (AFWU)	0,37	0,39	0,34	0,36
Number of Wage Annual Work Units (WAWU)	0,26	0,60	0,66	2,01
Total number of Annual Work Units (AWU)	0,63	0,99	1,00	2,37
Potential Family Work (AFWU)	4,18	4,83	5,21	4,47
Share of AFWU in soya in the potential AFWU	8,85%	8,07%	6,53%	8,05
Number of soya hectares/ AWU	2,46	2,60	4,91	4,94

Note: Values obtained by converting working time into AWU, using the following calculation: Σ (number of days in a given operation x number of people involved in it) / 321.

The amount of labour used in soya cultivation varies from 0.63 AWU in the group of No Technology producers to 2.37 AWU in the most technologically developed group. This increase results from the increase in the area of the farms in each of the groups analysed above. The middle groups absorb around 1.00 AWU in both cases.

As the technology level and the area of this crop increase, the relationship between family work and wage labour changes significantly. The dedication of family labour to soya cultivation is similar in all groups, on average around 0.37 AWU. The number of WAWU increases strongly when considering successively higher technology levels and increasing areas with the crop, increasing from 0.26 WAWU to 2.01 WAWU.

In other words, the increase in the area of this crop, despite being accompanied by an increase in the use of working capital, implies, under current technological conditions, an increasing use of labour. This evolution results from the fact that many of the cultivation operations are performed manually.

These figures reflect the important impact on employment that family farming is capable of generating.

Another relevant aspect contained in Table 6 concerns the allocation of family labour to this crop in relation to the potential amount of work represented by the family, that is, considering the amount of work of all family members working on the farm. This allocation to soya cultivation is, in all groups, around 8% of available time, with a maximum percentage in the group of No Technology (8.85%) and a minimum value of 6.53% in the medium technology level.

The number of hectares of soya worked per AWU is 2.46 ha and 2.60 in the No Technology and Low Technology groups. This ratio almost doubles in the two higher groups, reaching in both the value of 4.9 ha/AWU. Since labour indicators do not follow this evolution, this result suggests that the farm starts to reach labour productivity levels acceptable in the regional scenario from 5 ha of soya upwards.

4.7 Income Formation

The information contained in Table 7 allows us to observe how income is generated in each producers´ group. The figures correspond to the average values per producer.

A first aspect that emerges from this table is the fact that the selling price of soya increases according to the level of technology. The value observed in the No Technology group was 21.98 MZM per kg, progressively increasing to 23.40 MZM per kg in the higher technology group. The selling price of certified seed observed was 40.00 MZM per kg which, to a large extent, justifies the high value of the Gross Income observed at the higher technology level. Besides this specific situation, the price increase may be associated with the quality of the product and/or the marketing channels used, a relationship that the data collected does not clearly demonstrate.

Table 7. Formation of producers' operating income, by technology level

Values in Meticais

	Level 1 - "No Technology".	**Level 2 - "Low Technology**	**Level 3 - "Medium Technology**	**Level 4 - "Higher Technology**
Average Soya Price	21,95	22,22	22,65	*31,63*
GROSS INCOME (production x price)	**15 305,16**	**44 017,41**	**136 623,33**	***676 043,89***
VARIABLE COSTS I *(cash)*:				
Wage Labour	5 673,87	15 238,35	33 029,02	*80 478,88*
Working Capital (inputs)	688,70	2 398,06	20 989,58	*63 080,00*
Mechanization	-	7 277,78	33 308,33	*83 920,00*
Total cash costs	6 362,57	24 914,19	87 326,93	*227 478,88*
GROSS MARGIN I (on cash costs)	**8 942,59**	**19 103,22**	**49 296,40**	***448 565,01***
VARIABLE COSTS II (non-cash):				
Own seed	1 927,78	2 898,31	6 435,28	*6 482,50*
Family labour (non-salaried)	13 666,43	17 389,28	22 150,31	*41 299,93*
Total non-cash costs	15 594,21	20 287,59	28 585,59	*47 782,43*
Total variable costs (cash and non-cash)	21 956,78	45 201,78	115 912,52	*275 261,31*
GROSS MARGIN II (on cash and non-cash costs)	**- 6 651,62**	**- 1 184,37**	**20 710,81**	***400 782,58***

Note: Values in the right column are presented in italics due to the restrictions to the analysis of this group, previously mentioned.

The cash variable cost structure changes strongly with the increase in technological level: if wages represent, on average, 89% of the total variable costs in the No Technology group (the remainder is spent on the acquisition of common seed). This percentage reduces significantly with increasing technology level, dropping to 61%, 38% and finally to just over a third of the total (35%) in the more technologically more advanced group. The remaining variable costs (mechanization and inputs) evolve inversely, going from a combined value of 11% in the No Technology group to 39% in the Low Technology group, and increasing to 62% and 65% in the two following groups.

The partial substitution of salaried labour by technology, namely mechanisation, whose percentage of variable costs rises from 29% to 38% in the intermediate groups, associated with an increase in the use of inputs (which percentages of variable costs rise from 10% to 24%) justifies this evolution.

The value of Total Variable Costs (cash and non-cash) is higher than the Gross Income in the first two levels. The ratio between these two values is 1.43 in the No Technology group and 1.02 at the next level. Only in the medium technology group is this ratio inverted, being lower than one. In other words, it is only from that level onwards that a positive operating result is obtained, 15% of the Gross Income value at the medium technology level and 59% at the higher level. This last value is apparently high and cannot be directly compared with the previous ones.

In this case, the Gross Margin II value represents 66% of the value of production. As this group of observations contains producers with motorized equipment, this analysis is not applicable, as variable costs that are relevant for these cases were not included. This is the case of costs with fuel and lubricants, and with conservation and maintenance of equipment. For these cases, it would also be necessary to consider fixed costs associated with equipment (depreciation, insurance, and others) in the portion corresponding to the use of equipment directly in soya production, information that was not collected in this survey.

These relations reflect a common reality in small family farming. In the case of producers with No Technology, the income generated, although sufficient to cover the cash costs, is not enough to cover the costs of the work of the producer and family and the value of the seed produced. However, the monetary income generated, reflected by Gross Margin I, is sufficient to allow an availability of cash equivalent to the average expenditure on the purchase of food, declared by this group, for eight months. The Low Technology group is positioned in a situation of the same type, with less extreme values. The value of total variable costs is practically equivalent to the value of Gross Income. In this case, the money generated through soya cultivation is equivalent to the value of the household's food purchasing expenses declared by this group for a little over a year (13 months). In the following groups the economic result generated has considerably higher values. At the Medium Technology level, the total variable costs release about 15% of the Gross Income. It should be noted that, in this group, the structure (fixed) costs should be inexpressive. This fact somehow reinforces what was referred to above in relation to the physical dimension of the farms from which acceptable situations of productivity and profitability are verified.

4.8 Relation between Labour and Capital

The (stepwise) adjusted model for the production function (Table 8) is statistically very acceptable.[8]. It was given the possibility that the model could incorporate the variable Land which, as seen above, is a very relevant production factor for this type of farming system. However, the adjustment method did not include this independent variable, a situation that is analysed further down.

Table 8. Family farmers´ soya crop production function(n=128)

Variable	Coefficient (β)	Erros Stand.	t-value	Sig (t)
Constant	5,217	0,450	11,586	0,000
LnWorking Capital	0,151	0,014	10,669	0,000
LnLabour	0,842	0,088	9,553	0,000
R^2 = 0,73		F-statistic (ANOVA) = 165.083 and Sig. = 0.000		
Durbin-Watson = 1,37		Multicollinearity VIF (less than 10) = 1.169		
Return to scale = 0.993 ≈ 1.00				

In the framework of the technological conditions underpinning this model, analysed above, for each 1% increase in the Working Capital variable, soya production increases by 0.15%. For each 1% increase in the Labour variable, soya production increases by 0.84%. This result, which highlights the importance of Labour relative to Working Capital in the technological conditions that the sample captured, results from the incipient level of technology used, described in Table 5. It should be remembered that the distances from the GTI value of each group to the maximum value of this indicator are very considerable. The higher technology level will only be halfway to the maximum value. The two middle groups are one quarter (25.83%) and just over 10% (11.67%) away from that maximum; the No Technology group has not yet integrated the technologies analysed.

[8] The value of the Coefficient of Determination (R^2) indicates that 73% of the total variation occurring in the value of soya production is explained by variations in the factors Working Capital (inputs and machinery services) and Labour (wage and non-wage). The F statistic of the ANOVA test (165.083), with a value $p = 0.000$, demonstrates the explanatory/predictive validity of the set of variables in the model, being significant at 1% and 5%, thus rejecting H0, which means that the model coefficients (statistically different from zero) and the model thus obtained are statistically valid for explaining the values of soya production. The Durbin-Watson test (DW=1.37) has an acceptable value and indicates the inexistence of autocorrelation in the residuals. In order to verify the existence of multicollinearity, the Variance Inflation Factor (VIF) statistic was used and values lower than 10 were found for all variables, confirming the inexistence of multicollinearity. The correlation matrix between the explanatory variables presented low Pearson correlation coefficients, with a value of 0.380, denoting the inexistence of a linear association between the independent variables in the model. The residuals remain randomly dispersed, so that the hypothesis of homoscedasticity is not rejected, that is, the observations have the same variance. The Kolmogorov-Smirnov and Shapiro-Wilk tests revealed that the residuals are normally distributed, with a value $p < 0.05$.
The sum of the elasticities of each of the factors of production obtained by the adjustment is 0.993 ≈ 1. This result reflects constant returns to scale, that is, a framework in which output increases in the same proportion as the increase in all factors of production, a characteristic that is very common in small economic units.

As seen above, the Labour variable, especially the component relating to wage labour, is highly correlated with the physical size of the fields, given the low level of mechanisation of this crop.

The value of the correlation coefficient between Wage Labour and Land is 0.83. Given the inelastic conditions of Family Work, this relationship is only 0.35. For this reason, the variable Labour considered in the model (which includes all the work used in soya cultivation) includes the effect of the physical dimension of the farms, that is, the Land factor. For this reason, this factor was excluded from the model, as its incorporation would introduce statistical problems resulting from that strong correlation.

In labour-intensive farming systems the physical size of the farms has a very strong association with the value of production. In the case of this sample, the correlation coefficient is 0.92. This aspect will also contribute to justify the magnitude of the result obtained in relation to the elasticity of the Labour factor, as it incorporates the effect of farm size.

Given this result, obtained for the set of 128 observations of the sample, it makes sense to analyse the same type of relationship only for the set of 75 observations involved in the technological development process, that is, excluding the observations that make up the No Technology group.

Thus, it is possible to obtain an idea of the impact that technology makes at the microeconomic level (Table 9).

For the subgroup of these producers, the returns to scale remain constant, although slightly higher than in the previous case (only 1.31% higher).

The most relevant difference between these two models is the inversion of the value of the elasticities of production factors considered.

Table 9. Soya crop production function of family farmers with technology (n=75)

Variable	Coefficient (β)	Erros Stand.	t-value	Sig (t)
Constant	4,552	0,565	11,964	0,000
LnWorking Capital	0,536	0,071	7,570	0,000
LnLabour	0,470	0,130	3,623	0,001
R^2 = 0,71		F-statistic (ANOVA) = 90,015 e Sig. = 0,000		
Durbin-Watson = 1,22		Multicollinearity VIF (less than 10) = 1,704		
Return to scale = 1,006 ≈ 1,00				

In this second model, the elasticity of Working Capital (0.54) is higher than that obtained for Labour (0.47). The value of the elasticity of Working Capital increases 3.55 times compared to the previous model. On the other hand, the elasticity obtained for the Labour factor is reduced by more than half of the value of the previous model (55.82%).

In other words, although the values of the elasticities obtained in the latter case are close, from the moment the technologies are introduced, the response of production to increases in Working Capital has a greater impact than the response of production to increases in Labour (and, implicitly, in farm size, as argued before).

This result suggests that the introduction of capital into these farming systems tends to be justified. As systems intensify Capital, the resulting production responses will be stronger than those arising from increased Labour.
The possibility remains open that this relationship may strengthen in purely economic terms as this process develops, an aspect that this survey does not allow us to analyse. It can be assumed that at a certain technology level there are increasing returns to scale, greater elasticity of capital, and a corresponding decline in the relative importance of Labour and Land.

5.DISCUSSION AND CONCLUSIONS

The main conclusion of this study is that there has been a significant advance in the technological development of soya cultivation in the region, but there is still a long way to go to reach high technology levels, even by the most technologically advanced producers. According to the methodology followed in this study, the group of producers with more developed technology levels are, on average, halfway to reaching the maximum defined technology level.

At the time of this survey, many small soya producers were still excluded from this process. Others, perhaps also numerous, were using some of the technological items in an incipient way, but with positive results. These two groups surely represent a considerable part of the family farming sector in the region. In these cases, the economic results of soya production were not sufficient to cover all costs. However, this crop generates sufficient cash income to cover cash costs, providing sufficient cash resources to meet other types of family expenditure. However, the income generated is not sufficient to remunerate family labour at the average level of remuneration of wage labour in the region. While in the first set of observations (No Technology) this limitation has great expression, in the second case (Low Technology) the situation is close to equilibrium, with producers obtaining a level of income practically sufficient to remunerate non-cash costs at the levels usual in the region. It should be noted, however, that this reasoning is centred on soya cultivation, carried out on the farm alongside other activities.

As long as market conditions are able to provide these producers with the price levels that have been experienced, they will maintain their interest in this crop under current technological conditions. However, should prices fall, these producers need to progress technologically to compensate for this fall in prices or, alternatively, seek other ways to generate cash income.

It will be important to generate solutions so that producers at these levels find the opportunity for technological progression. The direct involvement of medium-sized producers who have evolved technologically with public support is a suggestive solution. However, it is reasonable to question whether the mechanisms thus constituted will be sufficient to break the poverty that characterises them. Rural extension activity requires characteristics that a more technologically advanced producer does not necessarily possess. Certainly, it was for being an outstanding extension agent that such a producer deserved to be recognised as an entrepreneur in order to receive the support he was granted.

Regarding the level of mechanisation of cultivation operations, the number of producers who used mechanical cultivation processes without owning equipment is already large. This process was made possible through the provision of machinery services by producers who own equipment. In average, the cost of acquiring machine services competes with the low levels of remuneration for labour that are applied. The advantage in using mechanical processes lies in the short time required to perform the operations and the simplicity of management required to do so. In particular, those operations whose opportunity to be carried out under good conditions is not compatible with the long periods of time that the manual solution involves.

As farm size increases, this argument gains importance. The increased use of machine services is closely linked to the increase in the size of the cultivated area. However, numerous cases of technological progress in reduced size farms have been identified. It is believed, however, that the increase in the cultivated area constitutes a sufficient condition to induce interest in increasing the use of working capital. In this sample, the intention to extend the area of the farms is very frequent and the need to extend the DUAT allocation was clear, especially at lower technological levels. That is, on the one hand, the possibility of increasing the areas of cultivation and, on the other hand, the attribution of political-administrative conditions that ensure the guarantee of use of a certain area in the long term, will constitute two prominent aspects to accommodate the process of technological development. This is not the place for the discussion on the Land Law, but it was clear that, from the viewpoint of many producers, the existence of a land market (purchase or lease) would provide a favourable condition for the expansion of their enterprise.

Mechanised land preparation and mechanical threshing are already relatively widespread processes. The results suggest that if a greater number of producers have the possibility of acquiring this type of equipment, there will certainly be an expansion of its use and profitability through the provision of machine services to other producers. However, the overwhelming majority of the producers interviewed sell their production on the local market, very often in the commercialisation points located on the roads. The survey found a small number of producers who sold their production through other producers. This result indicates that the expected success has not been achieved with the solution of producers supported in the acquisition of equipment of becoming agents of production integration, through contract farming type of schemes. However, the acquisition of machine services on a commercial basis will have expanded, making profitable the public and private investment made. The creation of a market for the provision of machine services is of considerable interest when small farming is proliferating.

The mechanisation of other phases of the production process is, however, very low. With the exception of the higher technology level, where practically all sowing is done mechanically, at all technology levels sowing operations are done manually. Mechanical sowing prepares the crop for the introduction of mechanical weeding processes and other mechanisable operations, such as fertilisation, and pest and disease treatment. Manual weeding requires considerable amounts of hired labour, not only because of the characteristics of the operation itself, but also because it must be carried out at least twice a season. Mechanical weeding can be sufficiently effective. These two phases of soya cultivation can be mechanised relatively easily. However, probably due to the shortage of this type of equipment, there is some difficulty in doing this step, even for producers cultivating larger areas.

The same can be said for harvesting, which is always done manually at practically all the technological levels observed. Only in the two middle groups were there cases of mechanical harvesting, although with very low incidence. Manual harvesting usually generates high production losses, although the soya varieties selected and spread in the region, which will remain predominant, considerably reduce this loss. However, mechanical harvesting equipment, which often associates the threshing phase in the same operation, requires large cultivation areas to allow the equipment to manoeuvre within the parcel, which must be free of obstacles and have a regular and levelled floor. They also require the existence of a rural road network of adequate quality for the circulation of equipment between parcels. In other words, the mechanisation of these phases of production may require, in many cases, a considerable investment effort in infrastructure and will not adapt to the generality of small producers. However, there are appropriate technological solutions for mechanisation in small areas. It could be admitted that this type of solution could be adapted to smaller farming systems, if they are given access to the acquisition of smaller equipment. The dissemination of this type of equipment could theoretically constitute a factor of progress for small size farms.

One possible solution, already in use in the region, is based on the shared use of equipment among members of cooperative structures and it could be expanded. In areas with a prevalence of small-scale farming, these solutions make it possible to concentrate skills in handling equipment, which is demanding in technical knowledge, as well as building up small stocks of parts, fuel, lubricants, and other goods. Once these solutions have been created, the main constraint lies in the difficulty in making the work schedule compatible between the different associated producers at critical periods of the production cycle.

Maintenance and repair of equipment are hampered by the small market for technical assistance in rural areas. For this reason, the results of this research suggest that a considerable effort should be made, both in training machine operators and in boosting the creation of maintenance and repair units for agricultural equipment. It should be noted in this regard that, within the framework of a process of public promotion of agricultural mechanisation, the greater the diversity of brands available to producers in a given region, the more difficult it becomes to ensure satisfactory conditions for maintenance and repair of equipment.

The main obstacle detected with producers owning motorised equipment was the existence of excessively long downtimes due to the inability of repair service providers in the area to carry out the necessary repairs, usually due to lack of stocks. Sometimes, the producer will have to source a part himself and then have it repaired in a workshop. A long downtime of a tractor at a critical period of farming production can undermine its viability.

Another and perhaps more striking result of this work is the very low use of agro-chemicals. In general terms, in this sample, the spread of mechanical cultivation processes is greater than the spread of input use.

With regard to the use of fertilisers and correctives, their non-use results, over the years, in the introduction of imbalances or the depletion of the soil fertility fund. For this reason, the traditional solution is crop rotation, a reality that is difficult to reconcile with the production of a crop on a larger scale and technologically developed. In equilibrium situations, there is a need to annually promote the incorporation of nutrients into the soil, theoretically in the amount of nutrients extracted by the crops grown there. Another aspect to consider in these circumstances will be the need to incorporate soil correctives, in order to ensure the improvement of production conditions and the correction of imbalances already installed. The soil fertility conditions should be monitored and studied in detail and with precision in the areas where commercial agriculture is concentrated.

Chemical (inorganic) fertilizers are the viable solution in this case since producers do not practice livestock activities that produce organic material on a sufficient scale to change this situation. The experience of introducing cattle farming and other animal production activities in the region did not produce the desired effects. No producer in the sample included any type of livestock activity on his farm, with the exception of a small number of birds for domestic supply. However, as it is foreseen in this region the expansion of poultry production on a large scale, there is the possibility of creating a market for organic fertilizers arising from the use of by-products of this activity, particularly the materials that make up the substrate ("bedding") of the enclosure where the animals are raised. It will be necessary to know, however, the adaptation of the use of this type of material as fertilizer and to what extent its composition is suitable for the type of soil and crops in the region.

However, since this will not be the case in the short term, there is a need to rely on the use of inorganic fertilisers so that soil fertility is not depleted. Conservation agriculture techniques, namely the incorporation of crop stubbles into the soil, is a positive step in this regard, but it is possibly insufficient and there may certainly be cases where it is necessary to go further in technologies to restore soil fertility levels.

In addition to these environmental considerations, the appropriate use of chemical fertilisers is strongly recommended to improve crop productivity. In normal conditions, the cost of appropriate fertilisation is economically attractive, especially at the first levels of use which correspond to escalating increments in production. This demands knowledge of the fertility conditions of the parcels, determining the choice of the appropriate fertiliser and the adjusted quantity. The agronomic trials already carried out and the demonstration fields installed have certainly raised the awareness of producers about this and other technological areas. However, this type of work is never finished, and it is necessary to continue it and actively involve agronomic research in carrying out field trials in the different agro-ecological areas of the Country, aimed at different crops. Continuing to test varieties of this and other crops, formulating technical guidelines for their fertilisation and developing ways of conducting crops remain very relevant in this context. It is necessary to develop scientific support for the technical knowledge transmitted to producers, based on experimental work carried out in laboratories and in situations close to production. This represents a significant investment that has been proven to have a long-term return. Therefore, industries, agricultural research bodies, and universities should be actively involved in this work. The great investment that is being made in increasing rural extension services should correspond to an investment in the production of technical and scientific knowledge based on the reality of the Country.

Many of these considerations regarding fertilization can be replicated with respect to the use of crop protection products use of which is almost non-existent in the sample, even by producers with higher technology levels. The geographical concentration of the cultivated area of a given crop usually increases the risk of proliferation and persistence of harmful organisms. These lead not only to a reduction in productivity but also to a decline in product quality and increased difficulties in storage conditions. In normal conditions, the fall in quality means that the market pays less for the product. At the end of the season, the producer is faced with a price level below his expectations. This type of situation is very common. In contract farming systems, this situation has led many producers and their associations to react to the low prices charged by authorised buyers, which result from the disqualification of the product due to its poor quality, as a consequence of its sanitary level.

Given the situation identified in this work, there is a need to promote special attention to this aspect of production. The use of these chemicals, which are generally very toxic, requires a high level of technical knowledge on the part of producers, not only in their correct handling and application, but above all in the assessment of the degree of infestation of a particular plot and the associated economic risk. It is on the basis of this assessment that the producer must decide on the application of a given active principle, the time and area of its application, and the determination of the dosage to be used.

Instead of the preventive application of this type of chemical, frequently in quantities greater than necessary, economically unfeasible and promoting a greater quantity of chemical residues in the final product, it is considered that, for reasons linked to human and animal health and environmental and economic considerations, the use of these products should be reduced to the minimum necessary to limit the economic impact of a certain disease or pest on production. In other words, nowadays it is argued that it is preferable for the producer to live with a certain degree of infestation in a given crop, as long as it does not affect production, rather than the alternative of preventively avoiding it later on.

On large parcels, mechanical application of these products requires that the crop be installed in such a way as to allow the tractor to enter the parcel without damaging the plants. Otherwise, pesticide application is carried out using knapsack sprayers, which are less rigorous and less effective, and more dangerous for the operator's health. In the survey carried out, all producers who applied pesticides did so using the latter type of equipment.

In this framework of low technological level, it is very positive to see that the practice of seed inoculation is widespread, covering all technological levels, with the exception of the No Technology group. Inoculation improves the productive capacity of this type of plant, and is to some extent equivalent to fertilisation, as it improves nitrogen fixation in the soil. However, it does not replace fertilisation entirely, as other nutrients are not made available to the plants through this process.

In most cases, even at the highest technological level, producers use part of the grain produced as seed for the following season. As this is an ancestral solution, it is believed that it will be well managed technically, both in terms of grain selection and storage techniques. No relevant issues have been identified on this point.

Since soya is a recently disseminated crop, the solution of using, year after year, seed obtained from the production of the previous year is a way to promote the genetic selection of germplasm adapted to the region, usually with high rusticity, although usually with lower productive potential when compared to hybrid varieties, which are more demanding and susceptible. The seed varieties that are formed in this long process are adapted to small-scale production and to the conditions under which small family farmers produce. Although not controlled from a technical and scientific point of view, this process leads to the selection of seed varieties of future interest.

In view of these results, the improvement in the conditions of access to inputs will have to be considered with great attention. Campaign credit and micro-credit solutions are known and have relevant practical application in Mozambique. It is believed that there is a need to go further and with greater creativity to design models for producer´s access to working capital in a consistent manner, over several campaigns, without relying on linkages between producer which, in this study, have shown less than expected effectiveness.

On the economic side, the results suggest that increased capital will tend to develop favourable conditions in production conditions. Thus, there is an interest in focusing the study on producers with more advanced technologies. A study of this nature would also make it possible to analyse the constraints that exist in relation to the performance of the most developed producers in relation to the others, in order to assess in sufficient detail, the effectiveness of their performance as promoters of technological development.

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ANNEXES

ANNEX I - Chronology of support for family farmers in Gurué District and the promotion of soya cultivation in Alta Zambézia

Chronology	Intervener	Purpose of intervention	Impacts on family farming
Late 1970s and early 1980s **Soya production in a state enterprise, with technical support from Brazilian cooperation, established from the land of the settlements and private enterprises created in the colonial period; occupation of the land by family farmers after the end of the civil war hostilities, which in some cases still continues**			
1980s	State enterprise "Complexo Agrícola de Lioma" (CAPEL) (late seventies to mid-eighties).	Agricultural production to supply the national market based on improved technologies - among other crops, soya was produced in an area of about 500 ha with technical support from Brazilian Cooperation.	CAPEL's activity ceased as a result of the civil war; after the end of hostilities, in 1992, part of the land was gradually cleared and cultivated by small and medium-sized family farmers, encouraged by the local/district authorities. The number of producers installed varies between 450 and 800, according to sources.
Period after end of civil war until end of 20th century **Support for family farmers with a view to improving nutritional conditions and food security; start of the establishment of partnerships with agribusinesses, namely based in Nampula, promoted by NGO and international partners**			
1992- 1999 (after the end of the civil war)	World Vision	"Zambezia Agricultural Development Project (ZADP) - World Vision, the implementing entity and DIFID (UK), the financial entity; Project in two distinct phases: Phase I (from 1994 to 1998), only focusing on agriculture, in a top-down logic; Phase II (from 1998 to 2003) covering agriculture, land use rights and micro-finance, in a bottom-up logic; In phase II various activities were developed in partnership, namely with CLUSA (associativism) and the Organização Rural da Ajuda Mútua (ORAM) (Rural Mutual Aid Association) in the land use right component; micro-finance integrated in the Zambezia micro-credit Project (PROMIZA)/KARELA	Introduction and promotion of agricultural production with the aim of improving nutritional conditions and food security of the communities in several districts of Zambézia; diversification of production by promoting goat farming and duck rearing; Insipient introduction of soya cultivation, but with promising results among small and medium producers, many of them producing in areas belonging to the former State company of Lioma, with support from the district services; institutions of partnerships with agro-businesses; Introduction of new varieties of soya with the support of the International Institute for Tropical Agriculture (IITA); creation of seed multiplication fields; Promotion of local associations / cooperativism, namely among women, and promotion of the

		Activity focused on the Districts of Gurué, Nicoadala and Namacurra. CARGILL with relevant position in input supply.	introduction of soya in food (soya bread, soya milk and soya "baby food "); adoption of soya cultivation by family farmers; Support for land demarcation and formalization of DUATs.
First decade of the 21st century **Continued direct support to family farmers by NGO in diversified and multifaceted projects, continued technological development of production through the use of working capital (inputs), reinforcement of associations and the organisation of production; considerable development in the demand for soya induced by the development of the poultry value chain.**			
2000 2010	Cooperative League of the USA (CLUSA) - established in Mozambique since 1995; relevant action in Zambezia from 2003 to date	2003/2012 (Gates Foundation funding) - Promotion of soya production and market, and promotion of local and regional producers' organization (PROSOJA project) 2003 - 3,000 small producers 2013 - 8 000 small producers 2016 - 16 141 small producers Collaboration with the Mozambican company Phoenix Seeds, with Zimbabwean management	Creation of the Federação dos Produtores do Gurué - FEPROG – (Federation of Producers of Gurué) (2006) and about 127 local associations of small farmers, organised in about 11 local forums (about 5 200 associated family farmers); The Federation was the centre of dissemination of the crop in the region; Promotion of contract production and the creation of a Seed Bank produced by the producers of the region (supplying seeds to the producers, who become contractually responsible for delivering the double of this quantity to feed the Seed Bank; this grain was sold and generated revenue that allowed for the acquisition of quality seeds; promotion of the use of agro-chemicals, namely fertilisers, within the framework of contract farming; Support for land demarcation and formalization of DUATs; Creation of demonstration fields and capacity building actions for family farmers (2019); Support in the preparation of 300 ha of the former State company CAPEL for soya cultivation by family farmers;

			Reinforcement of the market through intervention by the Federation of Producers with the "big buyers" of soya, namely with the large poultry producers of Manica (Abílio Antunes) and Nampula (Frango King) to supply the compound feed factories.
	2005-2010 TECHNOSERVE (financed by USAID)	Development of the poultry value chain and of the supporting and regulating administrative apparatus	Between 2004 and 2009, the Mozambican poultry industry grew more than fourfold, with annual production reaching over 23,000 tons of chicken meat in 2009. This trend continued and total production of compound poultry feed, essentially composed of maize and soya, grew after that period from a total 93 893 ton in 2010 to 573 000 ton in 2014. Launch of a poultry promotion programme, with the following components: - Along with about 11 poultry producers in various Provinces, upgrading equipment, expanding production capacity, improving the quality of production and reinforcing links with small producers in an integration regime; - Organisation and dynamization of the value chain, through the Associação Moçambicana de Avicultura (Mozambican Aviculture Association), and the launch of a campaign to promote the consumption of domestic poultry products (use of a stamp) and strengthen the public veterinary services; - Regulation of the importation (mainly affecting massive imports from Brazil, via the Middle East, South Africa and Zimbabwe); - Regulation of bio-security standards, in collaboration with

			Cargill and two American universities (Michigan and Minnesota). In 2005, for every two chickens imported, one was produced domestically. In a few years, domestic chicken production reached a self-supply level of around 85%, with emphasis on large vertical systems and advanced technology, with own and integrated production; high concentration of production in Manica (Empresa Avícola Abílio Antunes) and Nampula (Novos Horizontes).
	2007-2009 International Institute of Tropical Agriculture (IITA) and the Institute of Agricultural Research of Mozambique (IIAM)	Soya seed adaptation test from Nigeria (about 70 seed varieties)	Selection of five soya seed varieties adapted to the soil and climate conditions of Alta Zambézia.
Second decade of the 21st century **Introduction of the development model with a reinforced commercial base, based on the "Emerging Small Commercial Farmer" as a vehicle for disseminating technological progress in contract farming solutions with small producers; creation of a local market for machinery services; contract production of certified seed production; introduction and promotion of conservation agriculture techniques; increased role of the State in the development process**			
2010-2020	2010-2014 TECHNOSERVE (2010-2013) with funding from the GATES Foundation and CLUSA (2010-2014)	Joint GATESOYA and AGRIFUTURO projects for increasing the scale of soya production	Projects included, among other actions of promotion, seed multiplication, adaptation tests of Brazilian soya varieties to the soil and climate conditions of the region
	2012-2018 TECHNOSERVE (USA) with funding from the Netherlands	Promotion of soya production and of the certified seed market, creation of conditions for partial mechanisation of the crop in the region, through support to the commercial producers' "class", development of a	Creation of the Cooperativa de Produtores Agrícolas da Alta Zambézia (COPAZA) (Alta Zambezia Cooperative of Agricultural Producers) in 2014 - Gurué District (24 producers) and

		market for agricultural machinery services and development of associations	Alto Mulócué (2 producers); about 800 ha of soya; Program supported the supply of inputs (mainly seeds and inoculants), access to credit, and promoted capacity building among a selected group of producers – Small Commercial Farmer (PAC) Promotion of basic level of mechanization among commercial producers: support in the acquisition of 32 tractors and various implements (31 ploughs, 19 seeders, 29 disc harrows, 15 threshers, 30 trailers and 10 irrigation systems); about 50% program funding, 40% bank loan (BCI, BIM and GAPI) for a period of five years, with interest rate between 14% and 17.25%. Each PAC provides mechanization services to a group of Small Family Farmers (PAF) in its area of influence, contracting the production with them, and may also provide inputs and training Around 3300 PAF assisted, totalling around 3 531 ha of soya at the end of the programme. 2016-2018 Creation of the private company Sociedade de Beneficiação de Sementes (SBS) in the District of Gurué, resulting from investment by COPAZA producers, Mozambican funds (Txopela Investments, SA), with support from the TECHNOSERVE project
	Solidaridad (2012 to date) – international network based in the Netherlands (KDV, Dutch supply chain organization of	Collaborated in the work of the TECHNOSERVE project in the past; is now a partner in the SUSTENTA programme in the District - which follows and extends the same type of strategy for the dissemination	Direct involvement with larger producers, who transmit information and means of production to smaller producers in the area where they are located.

	sustainable "inputs" for pork production)	of this production as previously implemented. The Southern Africa Towards Soy Bean Import Substitution (SATSBIS) programme was created to develop soya production in Northern Mozambique (Gurué), Zambia and Malawi. This programme consists of the following elements: • Multiplication of soya seeds; • Demonstration of Good Agricultural Practices in soya cultivation; • Promotion of soil analysis; • Promotion of soya processing in the producing region.	Activities with 350 "farmer leaders", each working on average with 30 surrounding small producers (about 30% of these are women), making a total of 10,500 producers (this includes the "COPAZA universe" generated by the previous project). The support given, besides production techniques and use of improved seeds, includes other areas, such as, through the Gender and Youth Department of the organisation, nutritional aspects linked to the use of soya beans, equity issues, domestic violence, entrepreneurship and climate change. This organisation reaches out to 10,500 producers in and around the locality of Lioma, where there is a high concentration of soya production in the District. It promotes soil analysis and recommends Good Agricultural Practices (for example, in the area of hygiene and health at work, discouraging the use of fires and mowing, and encouraging the incorporation of stubbles into the soil). Installation of demonstration plots to support the dissemination of production and advised agricultural practices.
	2018 onwards SUSTENTA Rural Development Programme (funded by the World Bank)	SUSTENTA was approved in June 2016 and launched eight months later, in February 2017. The Programme is based on the selection of a small number of family farmers with farms between 10 ha and 50 ha in size, who are granted certain types of support, assuming a commitment to extend	In total, in these areas, the Programme has identified 31 Pequenos Agricultores Comerciais Emergentes (PACE) (Emerging Small Commercial Farmers), with a total of 1 274 Pequenos Agricultores (PA) (Small Farmers) - on average 41 PA for each PACE:

		certain effects to their area of influence, seeking to indirectly benefit family farmers in the neighbourhood with farms of less than 10 ha. The latter producers receive direct support from the Programme, namely for accessing inputs and knowledge of sustainable agriculture. This first group of family farmers will constitute the fundamental vehicle for the multiplication and territorial dispersion of the effects of the Programme, mobilised by public and private rural extension actions.	- Nampula: 18 Villages in 17 Localities (11 Administrative Posts), 18 EPAC and 771 SF; - Zambézia: 13 Villages in 9 Localities (7 Administrative Posts), 13 EPAC and 503 SF. This programme has other areas of action, namely capacity building for the PACE, the PA and rural extension agents in various areas of technical knowledge of good agricultural practices. In parallel, SUSTENTA foresees a number of interventions in rural infrastructure, such as the rehabilitation of rural roads, construction of small bridges or aqueducts.
Large-scale commercial production resulting from the inflow of foreign capital associated with Mozambican economic interests; emergence and consolidation of some "agrodealers" in the region; promotion of contract production; expansion of production distribution channels and the start of soya exports to nearer Asian markets			
2009-2012	Large land concessions in Gurué District, Alta Zambézia: HOYO-HOYO (2009) 3 000 ha; Rei do Agro (2010) 4 000 ha; closed AGROMOZ (2012) 9 000 ha; Murrimo Macadamia (2012) 3,200 ha.	**Hoyo-Hoyo Agribsiness** (Lioma/Ruace): BXR Agro group (Netherlands; initially (2009) the initial concession of 10 000 ha in Gurué District allocated to Quifel Natural Resourses group (Portugal) associated with Mozambican capital; DUAT of 3 000 ha, looking for expansion; in the 2015/2016 campaign cultivated 2 500 ha with rainfed maize and soya; 838 resettled producers, who worked about 1 945 ha on farms of the former State company CAPEL; employs 150 workers in the low-season and about 400 in the high-season. **AGROMOZ** (Lioma): Amorim Group (Portugal) and INTELEC Holdings (Mozambique) with	Around 6000 ha of soya in production, in rainfed areas, with a tendency to increase; Resettlement of around 1084 producers (around 6504 people, for an average size of 6 people per family unit); In the concession areas the level of employment generated, which is usually seasonal, falls far short of the number of people resettled; Supply of soya seeds to some family farmers (number not determined) in a contract farming system.

		Brazilian management by PINESSO; concession of 9 000 ha in 2012; resettlement of about 96 producers; production on 2 100 ha with soya (1 700 ha), maize, cotton and beans (failed attempt at rice farming). **Rei do Agro** (Lioma): ASLAM (USA) group with Zimbabwean management. Own and contract production; 2 500 ha to be cleared, with 1 500 ha of arable land; slow start-up of activity; 700 ha in the 2012/2013 campaign; very selective in the choice of producers (objective of 500 ha contracted in 2012/2013); irrigation project with USAID support; enterprise currently in an expectant phase, with a close connection to Hoyo-Hoyo (*to be confirmed*) **Murrimo Macadâmia** (Gurué); 3 200 ha concession in 2012: Crookes Brothers Limited group; company specialised in the production/export of macadamia nuts; secondary production of maize under irrigation in expectant areas; resettlement of around 150 producers.	
2010-2020	Most relevant agribusinesses in the sector, namely in the field of production and commercialisation of seeds, usually within the framework of contract farming solutions	**Sociedade de Beneficiação de Sementes (SBS):** Contracts the production of seed certified by the National Seed Service (about seven varieties, mainly c3 and c2) from 27 producers of the COPAZA universe - 307 ha of production, corresponding to about 411 ton of seed in 2018/2019 (income of 1.33	Great difficulty in broad promotion of contract farming, either for grain, or seed production; Increased production of soya and maize (and other cash crops) in the region has reinforced the interest on new marketing channels - new stakeholders to intervene in the region (India/Bangladesh and Somalia); around 16,000 tonnes exported in 2017/2018 to India,

		ton/ha); industrial unit with seed processing equipment (cleaning, calibration, cooling, packaging and storage) acquired in Brazil, in operation from 2019. Processing capacity of 2,500 tons of seed. **African Century Agriculture (ACA)**, ex-GETT (established in 2011, South Africa, with support from Norway): production of chicken meat and supply of feed to poultry farming in Nampula (King Frango); major promoter of soya production by contract (in 2011, about 844 producers/1 250 ha), with initial support from Swiss Cooperation (InovAgro); about 1000 ha under concession; activity also in Niassa; **ALIF Química** (Mozambique): contract farming system with producers who cultivated land under concession before the start of the war; 155 producers on 300 ha in the 2011/2012 campaign; **Lozane Farms** (Mozambique): company with its own production and production under contract. Distribution of about 70 tonnes of soya seed to about 1000 producers who will have cultivated an area of 1400 hectares; production of about 1700 tonnes of soya commercialized (2018/2019); support AGRA cooperative (Alto Molóqué).	likely to be reinforced in the following campaign

		Phoenix Seeds (2002, Zimbabwe): sale of about 30 tonnes of seed (2011); **ETG** - importation of seed from Tanzania, distributed to about 400/500 producers (Swiss/INOVAGRO support); **Lusosem** (2017, Portugal): importation of seed from Zimbabwe.	

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ANNEX II – Survey Form

OMR
Observatório do Meio Rural **ID:___________**

Inquérito realizado por: *Inquérito APROVADO:*

_______________________ _______________________
Data e Assinatura *Data e Assinatura*

INQUÉRITO AOS PRODUTORES FAMILIARES DE SOJA
Campanha 2018/2019

001 Identificação do inquiridor (nome): ______________________________ cod |_|_|_|_|

002 Critério de selecção do Produtor (**área da machamba):** cod |_|_|_|_|
Tipo de produtor: Pequeno (até 5 ha) O
Médio (5-20 ha) O
Grande (mais de 20 ha) O

003 Localidade onde vive o(a) produtor(a): _____________________________ cod |_|_|_|_|

Dados sobre o(a) produtor(a)
004 Idade ________ anos
005 Sexo (M ou F): ________ cod |_|_|_|_|
006 Nível literacia do produtor (assinalar apenas 1 caso): cod |_|_|_|_|
não sabe ler nem escrever O
sabe ler e escrever com dificuldade O
sabe ler e escrever O

007 É membro de alguma associação ou cooperativa? Sim O Não O cod |_|_|_|_|
008 Se SIM, é ou já foi no passado dirigente? Sim O Não O cod |_|_|_|_|
009 Quantas vezes <u>no ano passado</u> foi visitado por extensionistas? ______vezes

I – AGREGADO FAMILIAR

Agregado familiar
101 Quantas pessoas compõem o agregado familiar? _______ pessoas

Chefe de família
102 É líder comunitário? Sim O Não O cod|_|_|_|_|
103 É ou foi Secretário de Bairro Sim O Não O cod|_|_|_|_|
104 Trabalha TODO O ANO na machamba? Sim O Não O cod |_|_|_|_|
105 Se NÃO, que outro tipo de ocupação tem? __________________ cod |_|_|_|_|

106 Tem algum grau de familiaridade com o líder comunitário? Sim O Não O cod |_|_|_|_|

107 Se SIM, qual? cod |_|_|_|_|

1º grau (pai/mãe ou sogro/sogra) O

2º grau (avô/avó, por via directa ou da esposa(o)) O

3º grau (primo, tio, por via directa ou da esposa(o) O

108 Pertence a alguma associação de produtores Sim O Não O cod |_|_|_|_|

109 Pertence a alguma associação religiosa Sim O Não O cod |_|_|_|_|

110 É membro do Conselho da Escola Sim O Não O cod |_|_|_|_|

111 Já participou no Conselho Consultivo Distrital Sim O Não O cod |_|_|_|_|

112 É membro de algum partido político Sim O Não O cod |_|_|_|_|

113 Usa trabalhadores assalariados? Sim O Não O cod |_|_|_|_|

114 Se SIM, recorre a trabalhadores do Malawi? Sim O Não O cod |_|_|_|_|

Família

120 Número de mulheres da família que trabalham na machamba: ___________

Número de filhos sexo masculino que trabalham na machamba:

121 até 12 anos: _________

122 mais de 12 anos: _________

Número de filhos sexo feminino que trabalham na machamba:

123 até 12 anos: _________

124 mais de 12 anos: _________

125 Número de filhos ou filhas **com mais de 12 anos** que não trabalham na machamba: _____

II FONTES DE RENDIMENTO DO AGREGADO FAMILIAR

130 Qual é a origem **PRINCIPAL** de rendimento da família (assinalar **UM CASO**): cod |_|_|_|_|

Venda de produtos agrícolas no mercado local: O
Venda de produtos agrícolas a comprador: O
Salários recebidos do Estado: O
Salários recebidos de empresas privadas ou ONG: O
Ganho-ganho: O
Venda de carvão ou lenha: O
Outro tipo de rendimento (*por exemplo, venda de bebidas alcoólicas, madeira, caça, animais*):
Qual: ______________________________

131 Qual a origem **SECUNDÁRIA** de rendimento da família (assinalar **UM CASO**): cod |_|_|_|_|

Venda de produtos agrícolas no mercado local: O
Venda de produtos agrícolas a comprador: O
Salários recebidos do Estado: O
Salários recebidos de empresas privadas ou ONG: O
Ganho-ganho: O
Venda de carvão ou lenha: O
Outro tipo de rendimento (*por exemplo, venda de bebidas alcoólicas, madeira, caça, animais*):
Qual: ______________________________

A família possui, ainda, **OUTRAS FONTES DE RENDIMENTO**? (*pode assinalar mais de um caso*):

132 Venda de produtos agrícolas no mercado local: O cod |_|_|_|_|
133 Venda de produtos agrícolas a comprador: O cod |_|_|_|_|
134 Salários recebidos do Estado: O cod |_|_|_|_|
135 Salários recebidos de empresas privadas ou ONG: O cod |_|_|_|_|
136 Ganho-ganho: O cod |_|_|_|_|
137 Venda de carvão ou lenha: O cod |_|_|_|_|
138 Outro tipo de rendimento (*por exemplo, venda de bebidas alcoólicas, madeira, caça, animais*):
Qual: ______________________________ cod |_|_|_|_|

III - TERRA

Informação geral

201 A machamba tem DUAT? Sim O Não O cod |_|_|_|_|
202 O DUAT cobre a totalidade da área da machamba? Sim O Não O cod |_|_|_|_|
203 A quantos hectares se refere o DUAT? ____________ ha

Como teve ACESSO aos terrenos da machamba?

				Área	Ano
204	Por herança	O	cod |_|_|_|_|	**205** ______ ha	**206** ______
207	Adquiri de uma empresa Estatal	O	cod |_|_|_|_|	**208** ______ ha	**209** ______
210	Comprei a um particular	O	cod |_|_|_|_|	**211** ______ ha	**212** ______

213 Arrendado O cod |_|_|_|_| **214** ______ ha **215** ______
216 Cedência da Comunidade O cod |_|_|_|_| **217** ______ ha **218** ______
219 Emprestado O cod |_|_|_|_| **220** ______ ha **221** ______
222 Outra forma. Qual? ___________ O **cod** |_|_|_|_| **223** ______ ha **224** ______

227 Os terrenos onde produz soja foram desmatados para fazer soja? Sim O Não O cod |_|_|_|_|

Uso da terra – CULTURAS DE RENDIMENTO

Que culturas de rendimento (para venda) fez no ano 2018/2019?

230 Soja cod |_|_|_|_| **231** Área: _________ ha
232 Feijão Bóer cod |_|_|_|_| **233** Área: _________ ha
234 Gergelim cod |_|_|_|_| **235** Área: _________ ha
236 Tabaco cod |_|_|_|_| **237** Área: _________ ha
238 Outra cod |_|_|_|_| **239** Área: _________ ha

250 Há quantos anos produz soja para grão? _____________ anos

251 Na campanha 2018/2019 produziu soja para semente melhorada? Sim O Não O cod |_|_|_|_|
Se SIM, **252** em quantos ha? ________________ ha
253 quantidade produzida ____________________ (kg)

254 Que quantidade de grão de soja guardou para semente para o próximo ano? ___________kg

Uso da terra – CULTURAS ALIMENTARES

Que culturas para consumo da família fez no ano 2018/2019?

260 ____________________________________ cod |_|_|_|_|
261 ____________________________________ cod |_|_|_|_|
262 ____________________________________ cod |_|_|_|_|
263 ____________________________________ cod |_|_|_|_|
264 ____________________________________ cod |_|_|_|_|
265 ____________________________________ cod |_|_|_|_|

270 Qual a área aproximada ocupada por **todas** as culturas alimentares? __________ ha

271 O terreno onde faz culturas alimentares tem melhor qualidade do que o terreno onde faz culturas de rendimento? cod |_|_|_|_|

Sim, é melhor o terreno onde faço alimentos O
Não, o terreno para culturas de rendimento é melhor O
Os terrenos são todos iguais O

272 Possui REGA na área onde produz alimentos para a família? Sim O Não O cod |_|_|_|_|
Se SIM,
273 Como obtém a água para regar? (rio, poço, furo, etc.) ___________________
cod |_|_|_|_|

IV ALIMENTAÇÃO

274 A alimentação da família é constituída por produtos da machamba?
Sim O Não O cod |_|_|_|_|

275 Em média, quanto gasta normalmente por mês em alimentos comprados? _______ MZM

Que tipo de produtos alimentares compra habitualmente?

276 ________________________________ cod |_|_|_|_|
277 ________________________________ cod |_|_|_|_|
278 ________________________________ cod |_|_|_|_|
279 ________________________________ cod |_|_|_|_|
280 ________________________________ cod |_|_|_|_|
281 ________________________________ cod |_|_|_|_|
282 ____________________________________ cod |_|_|_|_|

Nas refeições da família comidas em casa, que alimentos foram **ONTEM** utilizados?

285 Milho, mapira, arroz, outro cereal O cod |_|_|_|_|
286 Mandioca, inhame, batata O cod |_|_|_|_|
287 Feijão, soja, outras leguminosas O cod |_|_|_|_|
288 Couve, repolho O cod |_|_|_|_|
289 Cebola, tomate, quiabo O cod |_|_|_|_|
290 Banana, laranja, papaia, outra fruta O cod |_|_|_|_|
291 Carne, peixe, ovos O cod |_|_|_|_|
292 Leite O cod |_|_|_|_|
293 Açúcar , mel O cod |_|_|_|_|

294 Na **ÚLTIMA SEMANA**, a família comeu menos refeições por dia do que queria por não haver comida suficiente em casa? Sim O Não O cod |_|_|_|_|
295 Se SIM: cod |_|_|_|_|
Isso acontece raramente O
Isso acontece poucas vezes O
Isso acontece muitas vezes O

Árvores de fruto

Possui árvores de fruto na sua machamba? Quais?

300 ________________________ cod |_|_|_|_| **301** Quantas árvores? _________
302 ________________________ cod |_|_|_|_| **303** Quantas árvores? _________
304.________________________ cod |_|_|_|_| **305** Quantas árvores? _________
306 ________________________ cod |_|_|_|_| **307** Quantas árvores? _________

Outros usos da terra

310 Possui áreas de uso não agrícola? (*mato, pastagens naturais, pousio, floresta, ou outras*)

Sim O Não O cod |_|_|_|_|

311 Se SIM, que ÁREA TOTAL possui com estas ocupações? _______________ ha

Que TIPOS de ocupação? (*se possível indicar área aproximada*):

312 Maior parte da área: _________________ cod |_|_|_|_| **313** Área: ________ ha

314 Outra:____________________________ cod |_|_|_|_| **315** Área: ________ ha

319 Utiliza áreas florestais comunitárias? Sim O Não O cod |_|_|_|_|

320 Está a pensar aumentar a área da sua machamba? Sim O Não O cod |_|_|_|_|

321 Se SIM, como vai fazer? _______________________________ cod |_|_|_|_|

V PRODUÇÃO DE SOJA PARA GRÃO – campanha de 2018/2019
Informação Geral

350 Pretende produzir soja para grão no próximo ano? Sim O Não O cod |_|_|_|_|

351 Qual a razão? ____ cod |_|_|_|_|

352 Que área de soja cultivou no ano passado? __________________ ha

353 E que área de soja cultivou há dois anos? ___________________ ha

Nas áreas onde hoje cultiva soja, que culturas fazia antes?

354 ____________________________________ cod |_|_|_|_|

355 ____________________________________ cod |_|_|_|_|

356 ____________________________________ cod |_|_|_|_|

357 ____________________________________ cod |_|_|_|_|

Semente:

360 Que quantidade de semente utilizou no ano passado? _____________kg

Qual a origem da semente de soja que utilizou no ano passado?

361 Grão produzido na machamba no ano anterior O cod |_|_|_|_|

362 Semente comprada a outro produtor local O cod |_|_|_|_|

363 Semente comprada no mercado local O cod |_|_|_|_|

364 Semente cedida por comprador do grão O cod |_|_|_|_|

365 Semente melhorada comprada a fornecedor de insumos O cod |_|_|_|_|

366 Qual a despesa de compra de semente? ______________________ MZM

370 Utilizou semente inoculada? Sim O Não O cod |_|_|_|_|

Se SIM:

371 Que quantidade de inoculante utilizou? ______________ (*indicar sacos ou gramas*)

372 Inoculante foi: cod |_|_|_|_|

comprado O

cedido pelo comprador do grão O

373 Quanto custou o inoculante utilizado no ano passado? _______________ MZM

Preparação do terreno:

380 Em que mês começou a preparar o terreno onde cultivou soja no ano passado? ___________ cod |_|_|_|_|

381 Quantas vezes foi lavrado/sachado o terreno? cod |_|_|_|_|

Uma vez O

Duas vezes O

Mais do que duas vezes O

382 Preparação do terreno foi: cod |_|_|_|_|

Manual O

Mecanizada O

Se foi MANUAL, quantos dias de trabalho?

390 da família:______________ dias **391** Quantas pessoas? _______

392 de trabalhadores contratados:_________ dias **393** Quantas pessoas?________

398 Se foi MECANIZADA (com tractor), especificar: cod |_|_|_|_|

Tractor próprio O

Tractor alugado O
Tractor do comprador do grão O
Tractor da associação ou cooperativa O

399 Se adquiriu o serviço, quanto pagou? ____________________MZM
400 Quantos dias levou a preparação do terreno para semear soja? ____________ dias

401 Custo TOTAL de mão-de-obra na preparação do terreno: _______________ MZM

Sementeira:

450 Em que semana/mês efectuou a sementeira? ______________________ cod |_|_|_|_|

451 A sementeira foi: cod |_|_|_|_|
Manual O
Mecanizada O

452 Em quantos dias fez a sementeira? _________ dias

Se foi MANUAl, quantos dias de trabalho?
456 da família: ______________ dias **457** Quantas pessoas? _______
458 de trabalhadores contratados:____ dias **459** Quantas pessoas? _______

460 Se foi MECANIZADA, especificar: cod |_|_|_|_|
Tractor próprio O
Tractor alugado O
Tractor do comprador do grão O
Tractor da associação ou cooperativa O
Outro O
Qual? ____________________________ cod |_|_|_|_|

461 Se adquiriu o serviço, quanto pagou? _________________________ MZM

462 Custo TOTAL de mão-de-obra na sementeira: ________________________ MZM

Adubos e Fertilizantes:

470 Utilizou fertilizantes químicos na produção de soja? Sim O Não O cod |_|_|_|_|
471 Se SIM, que quantidade de fertilizante aplicou? _____________ kg
472 Quantas aplicações efectuou? ___________ aplicações
473 Despesa com salários pagos? ___________________ MZM

474 Utilizou outro tipo de fertilizante? Sim O Não O cod |_|_|_|_|
475 Que tipo de fertilizante utilizou? _________________________ cod |_|_|_|_|

Em que altura aplicou fertilizantes? (*pode assinalar mais do que um caso*):
476 Antes da sementeira: Sim O Não O cod |_|_|_|_|

477 No momento da sementeira: Sim O Não O cod |_|_|_|_|
478 Por altura da floração: Sim O Não O cod |_|_|_|_|
479 Se adquiriu o fertilizantes, quanto pagou? ____________________MZM

Sacha:

480 Quantas sachas realizou na soja o ano passado? _____________

481 As sachas foram: cod |_|_|_|_|
Manuais O
Químicas (herbicida) O

Se foram MANUAIS, quantos dias de trabalho?
482 da família:___________________dias **483** Quantas pessoas? __________
484 de trabalhadores contratados:_____dias **485** Quantas pessoas?___________

490 Se foi MECANIZADA (com tractor), especificar: cod |_|_|_|_|
Tractor próprio O
Tractor alugado O
Tractor do comprador do grão O
tractor da associação ou cooperativa O
Outro O
491 Se adquiriu o serviço, quanto pagou? ____________________MZM
492 Quantos dias? ____________ dias

493 Custo TOTAL de mão-de-obra da sacha: _____ ____________________ MZM

Produtos de protecção das culturas:

500 Detectou alguma doença ou praga nos seus campos de soja?
Sim O Não O cod |_|_|_|_|
Se SIM, quais:
501 Ferrugens Sim O Não O cod |_|_|_|_|
502 Atracolose Sim O Não O cod |_|_|_|_|
Outras:
503 1. ______________________________ cod |_|_|_|_|
504 2. ______________________________ cod |_|_|_|_|
505 3.______________________________ cod |_|_|_|_|

506 Utilizou métodos tradicionais de combate a doenças? Sim O Não O cod |_|_|_|_|

507 Utilizou fungicida? Sim O Não O cod |_|_|_|_|
508 Utilizou insecticida? Sim O Não O cod |_|_|_|_|
Se usou insecticida, fungicida ou outros químicos:
509 Quanto gastou na compra de fungicidas e/ou insecticidas? ____________ MZM
510 Como aplicou estes produtos: cod |_|_|_|_|

Pulverizador de dorso O
Pulverização com tractor O

Na aplicação destes produtos utilizou:

511 Trabalho familiar? O cod |_|_|_|_| **512** Quantas pessoas? __________
513 Trabalho assalariado? O...cod |_|_|_|_| **514** Quantas pessoas? __________
515 Quantos dias de trabalho? _____________ dias

516 Se adquiriu o serviço, quanto pagou? ____________________MZM

517 Em que época efectuou aplicação destes produtos? __________________ cod |_|_|_|_|

518 Custo TOTAL de mão-de-obra na desinfecção: ________________________ MZM

Ceifa:

520 Em que mês realizou a ceifa? __________________________________cod |_|_|_|_|

521 A ceifa foi realizada de forma: cod |_|_|_|_|

Manual O
Mecanizada O

522 Em quantos dias fez a ceifa? __________ dias

Se foi MANUAL quantos <u>dias de trabalho</u> utilizou?
523 da família:_____________________dias **524** Quantas pessoas? _______
525 de trabalhadores contratados:_______dias **526** Quantas pessoas?_______

527 Se foi MECANIZADA (com tractor), especificar: cod |_|_|_|_|

tractor próprio O
tractor alugado O
tractor do comprador do grão O
tractor da associação ou cooperativa O
Outro O

528 Se adquiriu o serviço, quanto pagou? ____________________MZM
529 Quantos dias de trabalho? ____________________________ dias
530 Custo TOTAL de mão-de-obra na ceifa: _______________________ MZM

Debulha:

540 Em que mês realizou a debulha? __________________________________ cod |_|_|_|_|
541 A debulha foi realizada de forma: cod |_|_|_|_|

Manual O
Mecanizada O

542 Em quantos dias fez a debulha? __________ dias

Se a debulha foi MANUAL quantos <u>dias de trabalho</u> utilizou?
543 da família:___________________ dias **544** Quantas pessoas? ______

545 de trabalhadores contratados:______dias **546** Quantas pessoas?_____

547 Se a debulha foi MECANIZADA, especificar: cod |_|_|_|_|
Debulhadora própria O
Debulhadora alugada O
Debulhadora do comprador do grão O
Debulhadora da associação ou cooperativa O
548 Se adquiriu o serviço, quanto pagou? ____________________MZM
549 Quantos dias de trabalho? ____________ dias
550 Quantidade de grão produzido? ______________ Kg

551 Custo TOTAL de mão-de-obra da debulha: ____________________ MZM

Transporte:

560 Utilizou veículo próprio (tractor/camioneta/carrinha/outro) para transporte do grão para o local da venda? Sim O Não O cod |_|_|_|_|
561 O transporte do grão foi feito sem veículo? Sim O Não Ocod |_|_|_|_|
562 O comprador deslocou-se ao campo para recolher o grão? Sim O Não Ocod |_|_|_|_|

Venda

Como realizou a venda do grão? (*pode assinalar mais do que uma opção*)
566 No mercado local O cod |_|_|_|_|
567 Nos pontos de compra na estrada O cod |_|_|_|_|
568 Vendeu a outro produtor O cod |_|_|_|_|
569 Outra forma de venda. Qual:________________ cod |_|_|_|_|

570 No caso de vários canais de venda, qual a forma de venda da maior parte da produção)?
____________________________________ cod |_|_|_|_|
571 Recebeu logo o dinheiro da venda Sim O Não O cod |_|_|_|_|
572 Qual o preço por Kg da maior parte vendida? ________________ MZM

Financiamento:

580 Possui empréstimos por pagar neste momento? Sim O Não O cod |_|_|_|_|
Se SIM, contraiu o empréstimo junto de que entidade?
581 Banco O cod |_|_|_|_|
582 Estado O cod |_|_|_|_|
583 Fundo de Desenvolvimento dos Distritos (FDD) O cod |_|_|_|_|
584 Fundo de Desenvolvimento Agrário (FDA) O cod |_|_|_|_|
585 Outra entidade O cod |_|_|_|_|
586 Qual? _______________ cod |_|_|_|_|
590 Quantos anos tem ainda para pagar todo o empréstimo? _______________ anos
591 Sabe qual a taxa de juro do seu empréstimo? _______________________%
592 Quanto paga por ano pelo empréstimo? __________________________ MZM

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125	Terra da abundância, terra da miséria. Usurpação sinergística de recursos em Massingir	Natacha Bruna	Junho de 2022
124	**Dinâmicas na produção agrícola no vale do limpopo: o caso do arroz**	**Nelson Capaina**	**Maio de 2022**
123	Efeitos das mudanças climáticas nos sistemas de produção em Moçambique: Implicações para a segurança alimentar	Máriam Abbas	Abril de 2022
122	Evolução dos Preços dos Bens Alimentares (2021)	**Yara Nova e Jonas Mbiza**	**Março de 2022**
121	**Ingredientes para uma revolta de jovens - Pobreza, sociedade de consumo e expectativas frustradas**	João Feijó, Jerry Maquenzi e Aleia Rachide Agy	**Fevereiro de 2022**
120	Caminhos para a segurança alimentar em moçambique: Uma abordagem de sistemas de produção	Máriam Abbas	Janeiro de 2022
119	**A configuração da estrutura económica de Manica e Sofala e processos de resistência à colonização**	**Janete Cravino**	**Julho de 2021**
118	Caracterização socioeconómica da zona centro de Moçambique. Enfoque no corredor da Beira	João Mosca	Julho de 2021
117	**Cobertura Florestal em Moçambique**	**Mélica Chandamela**	**Julho de 2021**
116	Processos administrativos e práticas na titulação da terra em Moçambique: O caso dos municípios de Maputo e Matola	Nelson Capaina	Junho de 2021
115	**Mudanças nos padrões tradicionais de exploração da terra e do trabalho: O caso da açucareira de Xinavane**	**Joana Manuel Matusse Joaquim, João Mosca, Ana Sampaio**	**Junho de 2021**
114	O papel das mulheres no conflito em Cabo delgado: entendendo ciclos viciosos da violência	João Feijó	Maio de 2021
113	**Pobreza e desigualdades em Moçambique: um estudo de caso em seis distritos**	**Jerry Maquenzi**	**Maio de 2021**
112	Os determinantes do desmatamento em moçambique: uma abordagem econométrica para o período de 2000-2016	Ibraimo Hassane Mussagy, João Mosca, Mélica Chandamela e Natasha Ribeiro	Maio de 2021
111	**Des(continuidades) políticas e económicas de longa duração do sector familiar (camponeses) em moçambique**	**João Mosca**	**Abril de 2021**
110	Política Monetária do Banco de Moçambique: Qual É O Gato Escondido?	João Mosca	Abril de 2021
109	**Caracterização e organização social dos machababos a Partir de discursos de Mulheres raptadas**	**João Feijó**	**Abril de 2021**
108	Moçambique e a Importação do Carapau: Um desafio sem Alterativas (?!)	Nelson Capaina	Março de 2021
107	**Por Uma política Monetária Ajustada à Economia Real em Contexto de Crise: Humanidade e Sabedoria**	**Fáusio Mussá, Roberto Tibana, Inocência Mussipe Coordenador: João Mosca**	**Março de 2021**
106	Comércio Externo e crescimento económico em Moçambique	João Mosca, Yasser Arafat Dadá e Yulla Marques	Março de 2021
105	**Macroeconomia das pescas em Moçambique**	**Nelson Capaina**	**Fevereiro de 2021**
104	Influência de factores institucionais no desempenho do sector agrário em Moçambique	João Carrilho e Rui Ribeiro	Fevereiro de 2021
103	**Evolução de preços e bens alimentares em 2020**	**Yulla Marques e Jonas Mbiza**	**Fevereiro de 2021**
102	**Contributo para o planeamento e Desenvolvimento de Cabo Delgado**	**João Mosca e Jerry Maquenzi**	**Fevereiro de 2021**
101	Desenvolvimento socioeconómico de Cabo Delgado num contexto de conflito	João Feijó, António Souto e Jerry Maquenzi	Fevereiro de 2021
100	**Caracterização do sector das pescas em Moçambique**	**Nelson Capaina**	**Janeiro de 2021**
99	Dificuldades de Realização de Pesquisa em Moçambique	João Feijó	Setembro de 2020
98	**Análise de conjuntura económica2º trimestre de 2020**	**João Mosca**	**Setembro de 2020**
97	Género e desenvolvimento: Factores para o empoderamento da mulher rural	Aleia Rachide Agy	Agosto de 2020
96	**Micro-simulações dos impactos da COVID-19 na pobreza e desigualdade em Moçambique**	**Ibraimo Hassane Mussagy e João Mosca**	**Julho de 2020**
95	Contributo para um debate necessário da política fiscal em Moçambique	João Mosca e Rabia Aiuba	Junho de 2020
94	**Economia de Moçambique: Análise de conjuntura pré COVID-19**	**João Mosca e Rabia Aiuba**	**Junho de 2020**
93	Assimetrias no acesso ao Estado: Um terreno fértil de penetração do jihadismo islâmico	João Feijó	Junho de 2020
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92	**Implementação das medidas de prevenção do COVID-19: Uma avaliação intercalar nas cidades de Maputo, Beira e Nampula**	**João Feijó e Ibraimo Hassane Mussagy**	**Junho de 2020**
91	Secundarização da agricultura e persistência da pobreza rural: Reprodução de cidadanias desiguais	João Feijó	Maio de 2020
90	**Transição florestal: Estudo socioeconómico do desmatamento em Nhamatanda**	**Mélica Chandamela**	**Abril de 2020**
89	Produção bovina em Moçambique: Desafios e perspectivas – O caso da província de Maputo	Nelson Capaina	Março de 2020
88	**Avaliação dos impactos dos investimentos nas plantações florestais da Portucel-Moçambique na província da Zambézia**	**Almeida Sitoe e Sá Nogueira Lisboa**	**Março de 2020**

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86	***"senhor, passar para onde?"*** **Estrutura fundiária e mapeamento de conflitos de terra no distrito de Nhamatanda**	**Uacitissa Mandamule**	**Fevereiro de 2020**
85	Evolução dos preços dos bens essenciais de consumo em 2019	Rabia Aiuba e Jonas Mbiza	Fevereiro 2020
84	**Repensar a segurança alimentar e nutricional: Alterações no sistema agro-alimentar e o direito à alimentação em Moçambique**	**Refiloe Joala, Máriam Abbas, Lázaro dos Santos, Natacha Bruna, Carlos Serra,e Natacha Ribeiro**	**Janeiro de 2020**
83	Pobreza no meio rural: Situação de famílias monoparentais chefiadas por mulheres	Aleia Rachide Agy	Janeiro de 2020
82	**Ascensão e queda do PROSAVANA: Da cooperação triangular à cooperação bilateral contra-resistência / The rise and fall of PROSAVANA: From triangular cooperation to bilateral cooperation in counter-resistance**	**Sayaka Funada-Classen**	**Dezembro de 2019**
81	Investimento público na agricultura: O caso dos centros de prestação de serviços agrários; complexo de silos da bolsa de mercadorias de Moçambique e dos regadios	Yasser Arafat Dadá, Yara Nova e Cerina Mussá	Novembro de 2019
80	**Agricultura: Assim, não é possível reduzir a pobreza em Moçambique**	**João Mosca e Yara Nova**	**Outubro de 2019**
79	Corredores de desenvolvimento: Reestruturação produtiva ou continuidade histórica. O caso do corredor da Beira, Moçambique	Rabia Aiuba	Setembro de 2019
78	**Condições socioeconómicas das mulheres associadas na província de Nampula: Estudos de caso nos distritos de Malema, Ribaué e Monapo**	**Aleia Rachide Agy**	Agosto de 2019
77	Pobreza e desigualdades em zonas de penetração de grandes projectos: Estudo de caso em Namanhumbir - Cabo Delgado	Jerry Maquenzi	Agosto de 2019
76	**Pobreza, desigualdades e conflitos no norte de Cabo Delgado**	**Jerry Maquenzi e João Feijó**	**Julho de 2019**
75	A maldição dos recursos naturais: Mineração artesanal e conflitualidade em Namanhumbir	Jerry Maquenzi e João Feijó	Junho de 2019
74	**Agricultura em números: Análise do orçamento do estado, investimento, crédito e balança comercial**	**Yara Nova, Yasser Arafat Dadá e Cerina Mussá**	**Maio de 2019**
73	Titulação e subaproveitamento da terra em Moçambique: Algumas causas e implicações	Nelson Capaina	Abril de 2019
72	**Os mercados de terras rurais no corredor da Beira: tipos, dinâmicas e conflitos.**	**Uacitissa Mandamule e Tomás Manhicane**	**Março de 2019**
71	Evolução dos preços dos bens alimentares 2018	Yara Nova	Fevereiro de 2019
70	**A economia política do Corredor da Beira: Consolidação de um enclave ao serviço do *Hinterland***	**Thomas Selemane**	**Janeiro de 2019**
69	Indicadores de Moçambique, da África subsaariana e do mundo	Rabia Aiuba e Yara Nova	Dezembro de 2018
68	Médios produtores comerciais no corredor da beira: dimensão do fenómeno e caracterização	João Feijó **Yasser Arafat Dadá**	**Novembro de 2018**
67	**Polos de crescimento e os efeitos sobre a pequena produção: O caso de Nacala-porto**	**Yasser Arafat Dadá e Yara Nova**	**Outubro de 2018**
66	Os Sistemas Agro-Alimentares no Mundo e em Moçambique	Rabia Aiuba	Setembro de 2018
65	Agro-negócio e campesinato. Continuidade e descontinuidade de Longa Duração. O Caso de Moçambique.	João Mosca	Agosto de 2018
64	**Determinantes da Indústria Têxtil e de vestuário em Moçambique (1960-2014)**	**Cerina Mussá e Yasser Dadá**	**Julho de 2018**
63	Participação das mulheres em projectos de investimento agrário no Distrito de Monapo	Aleia Rachide Agy	Junho de 2018
62	**Chokwé: efeitos locais de políticas Instáveis, erráticas e contraditórias**	**Márriam Abbas**	**Maio de 2018**
61	Pobreza, diferenciação social e (des) alianças políticas no meio rural	João Feijó	Abril de 2018
60	**Evolução dos Preços de Bens alimentares e Serviços 2017**	**Yara Nova**	**Março de 2018**
59	Estruturas de Mercado e sua influência na formação dos preços dos produtos agrícolas ao longo das suas cadeias de valor	Yara Pedro Nova	Fevereiro de 2018
58	**Avaliação dos impactos dos investimentos das plantações florestais da Portucel-Moçambique nas tecnologias agrícolas das populações locais nos distritos de Ile e Namarrói, Província da Zambézia**	**Almeida Sitoe e Sá Nogueira Lisboa**	**Novembro de 2017**
57	**Desenvolvimento Rural em Moçambique: Discursos e Realidades – Um estudo de caso do distrito de Pebane, Província da Zambézia**	**Nelson Capaina**	**Outubro de 2017**
56	A Economia política do corredor de Nacala: Consolidação do padrão de economia extrovertida em Moçambique	Thomas Selemane	Setembro de 2017
55	**Segurança Alimentar Auto-suficiecia alimentar: Mito ou verdade?**	**Máriam Abbas**	**Agosto de 2017**
54	A inflação e a produção agrícola em Moçambique	Soraya Fenita e Máriam Abbas	Julho de 2017
53	**Plantações florestais e a instrumentalização do estado em Moçambique**	**Natacha Bruna**	**Junho de 2017**
52	Sofala: Desenvolvimento e Desigualdades Territoriais	Yara Pedro Nova	Junho de 2017
51	**Estratégia de produção camponesa em Moçambique: estudo de caso no sul do Save - Chókwe, Guijá e KaMavota**	**Yasser Arafat Dadá**	**Maio de 2017**
50	Género e relações de poder na região sul de Moçambique – uma análise sobre a localidade de Mucotuene na província de Gaza	Aleia Rachide Agy	Abril de 2017

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48	Perfil socio-económico dos pequenos agricultores do sul de Moçambique: realidades de Chókwe, Guijá e KaMavota	Momade Ibraimo	Março de 2017
47	Agricultura, diversificação e Transformação estrutural da economia	João Mosca	Fevereiro de 2017
46	**Processos e debates relacionados com DUATs. Estudos de caso em Nampula e Zambézia.**	**Uacitissa Mandamule**	**Novembro de 2016**
45	Tete e Cateme: entre a implosão do el dorado e a contínua degradação das condições de	Thomas Selemane	Outubro de 2016
44	**Investimentos, assimetrias e movimentos de protesto na província de Tete**	**João Feijó**	**Setembro de 2016**
43	Motivações migratórias rural-urbanas e perspectivas de regresso ao campo – uma análise do desenvolvimento rural em moçambique a partir de Maputo	João Feijó e Aleia Rachide Agy e Momade Ibraimo	Agosto de 2016
42	**Políticas públicas e desigualdades socias e territoriais em Moçambique**	**João Mosca e Máriam Abbas**	Julho de 2016
41	Metodologia de estudo dos impactos dos megaprojectos	João Mosca e Natacha Bruna	Junho de 2016
40	**Cadeias de valor e ambiente de negócios na agricultura em Moçambique**	**Mota Lopes**	**Maio de 2016**
39	Zambézia: Rica e Empobrecida	João Mosca e Yara Nova	Abril de 2016
38	**Exploração artesanal de ouro em Manica**	**António Júnior, Momade Ibraimo e João Mosca**	**Março de 2016**
37	Tipologia dos conflitos sobre ocupação da terra em Moçambique	Uacitissa Mandamule	Fevereiro de 2016
36	**Políticas públicas e agricultura**	**João Mosca e Máriam Abbas**	**Janeiro de 2016**
35	Pardais da china, jatrofa e tractores de Moçambique: remédios que não prestam para o desenvolvimento rural	Luis Artur	Dezembro de 2015
34	**A política monetária e a agricultura em Moçambique**	**Máriam Abbas**	**Novembro de 2015**
33	A influência do estado de saúde da população na produção agrícola em Moçambique	Luís Artur e Arsénio Jorge	Outubro de 2015
32	**Discursos à volta do regime de propriedade da terra em Moçambique**	**Uacitissa Mandamule**	**Setembro de 2015**
31	Prosavana: discursos, práticas e realidades	João Mosca e Natacha Bruna	Agosto de 2015
30	**Do modo de vida camponês à pluriactividade impacto do assalariamento urbano na economia familiar rural**	**João Feijó e Aleia Rachide**	**Julho de 2015**
29	Educação e produção agrícola em Moçambique: o caso do milho	Natacha Bruna	Junho de 2015
28	**Legislação sobre os recursos naturais em Moçambique: convergências e conflitos na relação com a terra**	**Eduardo Chiziane**	**Maio de 2015**
27	Relações Transfronteiriças de Moçambique	António Júnior, Yasser Arafat Dadá e João Mosca	Abril de 2015
26	**Macroeconomia e a produção agrícola em Moçambique**	**Máriam Abbas**	**Abril de 2015**
25	Entre discurso e prática: dinâmicas locais no acesso aos fundos de desenvolvimento distrital em Memba	Nelson Capaina	Março de 2015
24	**Agricultura familiar em Moçambique: Ideologias e Políticas**	**João Mosca**	**Fevereiro de 2015**
23	Transportes públicos rodoviários na cidade de Maputo: entre os TPM e os My Love	Kayola da Barca Vieira Yasser Arafat Dadá e Margarida Martins	Dezembro de 2014
22	**Lei de Terras: Entre a Lei e as Práticas na defesa de Direitos sobre a terra**	**Eduardo Chiziane**	**Novembro de 2014**
21	Associações de pequenos produtores do sul de Moçambique: constrangimentos e desafios	António Júnior, Yasser Arafat Dadá e João Mosca	Outubro de 2014
20	**Influência das taxas de câmbio na agricultura**	**João Mosca, Yasser Arafat Dadá e Kátia Amreén Pereira**	**Setembro de 2014**
19	Competitividade do Algodão Em Moçambique	Natacha Bruna	Agosto de 2014
18	**O Impacto da Exploração Florestal no Desenvolvimento das Comunidades Locais nas Áreas de Exploração dos Recursos Faunísticos na Província de Nampula**	**Carlos Manuel Serra, António Cuna, Assane Amade e Félix Goia**	**Julho de 2014**
17	Competitividade do subsector do caju em Moçambique	Máriam Abbas	Junho de 2014
16	**Mercantilização do gado bovino no distrito de Chicualacuala**	**António Manuel Júnior**	**Maio de 2014**
15	Os efeitos do HIV e SIDA no sector agrário e no bem-estar nas províncias de Tete e Niassa	Luís Artur, Ussene Buleza, Mateus Marassiro, Garcia Júnior	Abril de 2015
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11	Crédito Agrário	João Mosca, Natacha Bruna, Katia Amreén Pereira e Yasser Arafat Dadá	Novembro de 2013

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9	Orçamento do estado para a agricultura	Américo Izaltino Casamo, João Mosca e Yasser Arafat	Setembro de 2013
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7	Agro-Negócio em Nampula: casos e expectativas do ProSAVANA	Dipac Jaiantilal	Junho de 2013
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5	Contributo para o estudo dos determinantes da produção agrícola	João Mosca e Yasser Arafat Dadá	Abril de 2013
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