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Analysis of determinates for the adoption of agricultural technologies by family farmers in the administrative post of OCUA, Northern Mozambique

Abstract

The adoption of new technologies in agriculture has attracted special attention in economic development because they offer the opportunity to substantially increase production and income. Therefore, the present research aims to analyze the potential factors for the adoption of agricultural technologies by farmers in the family sector in the Administrative Post of Ocua. To carry out the research, semi-structured interviews were carried out to collect information/data, which were then processed using Excel and SPSS software. The results show that around 73% adopt row cultivation using the compasses and density recommended for each type of crop, 54% use improved seeds, 52% apply some type of irrigation, 33% seed conservation, 32% use organic fertilizers, 34% use tractors and 21% capture and conserve rainwater on the farm. Regarding the determining factors for the adoption of different agricultural technologies, 91% point to Access to rural extension services, followed by Access to agricultural credit (89%) and membership in a farmer association (78%). Another significant part points to formal education at a rate of 53% and finally access to information on agricultural products at a rate of 42%. Access to credit, access to extension consultancy services and members of farmer associations are more likely to adopt new agricultural technologies.

Keywords: agrarian technologies, agriculture in the family sector and community

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Introduction

Agriculture is the engine for economic growth and poverty reduction in developing countries such as those in Sub-Saharan Africa.[1,2] It plays an important role in food and nutritional security, combating poverty, generating rural employment and reducing rural exodus.[4–7] Therefore, increasing productivity and agricultural income is important in the fight against hunger and malnutrition, especially in rural regions of developing countries.[3]

Agriculture in Mozambique is still predominantly explored by rural populations on small farms that cultivate in an environment characterized by rainfed production and without a significant link with the market[8,9] where within them, the production of food for consumption constitutes the main basis of the productive structure of the family sector,[10] characterized by the use of rudimentary production techniques, intensive use of labor force, low level of capitalization and use of inputs, enabling the reduction of dependence on inputs and services that are difficult to access (extension) in local markets (Singo, 2020).[11,12]

Mozambican agriculture has low productivity.[13] This situation contributes to the perpetuation of poverty in the country. In this sense, increasing agricultural productivity is considered one of the crucial actions for reducing poverty in Mozambique.[14] Agricultural productivity growth is promoted by improved technologies, including improved seeds, fertilizers and control of water resources.[15,16]

The adoption of new technologies in agriculture has attracted special attention in economic development because the majority of the population in developing countries survives on subsistence agriculture and new technologies offer the opportunity to substantially increase their production and income.[17] There are few studies that seek to explain the slow adoption of improved agricultural technologies in Mozambique. Bandiera and Rasul,.[18] ; Langyintuo and Mekuria,.[19] and Zavale et al.,[20] are among the few researchers who have looked at the adoption of improved technologies in Mozambique.

Therefore, the present study aims to analyze the potential factors for the adoption of agricultural technologies by farmers in the family sector in the Administrative Post of Ocua. The study is important because of the possibility of identifying how family farmers from different PAO communities have reacted to the adoption of agricultural technologies.

Materials and methods

Study area

The research location for this research was the localities of Mahipa, Ocua-sede, Samora Machel and Napuco of the Administrative Post of Ocua, district of Chiúre, province of Cabo Delgado circumscribed to the North with the district of Ancuabe, to the South with the province of Nampula through the Lúrio River to the East with the district of Mecufi and to the West with the districts of Namuno and Montepuez.[21]

The inhabitants of the PAO community are generally characterized by essentially rural origins. Agriculture is the dominant activity practiced manually on small family farms in a system of intercropping based on local varieties. The population uses various forest products in the construction of their homes.[21]

In these locations, the primary technologies used and the low crop yields, the main harvest is generally insufficient to cover basic food needs, which are only met through food aid, second harvest, non-agricultural income or other mechanisms of survival. During times of scarcity, families resort to a variety of survival strategies that include collecting wild fruits, selling firewood, charcoal, stakes, reeds, drinks, hunting and fishing.[21]

Data collection procedures

To obtain information from the communities, a questionnaire was prepared with open and closed questions, with a view to obtaining information on the subject to be researched through a survey (questionnaire survey). A questionnaire is a technique that aims to obtain information in a systematic and orderly manner about the population being studied and the quantitative variables that are the object of the study. Therefore, the questionnaire that was applied went through a testing stage, in a reduced universe, so that possible formulation errors could be corrected.

The questionnaire was designed to find answers to central questions such as:

1) Socioeconomic information of research participants
2) Main agricultural technologies adopted by local producers
3) Main cultivation strategies and practices used
4) Determinants of adoption and use of technologies by producers

Sample and sampling

The sample for this research was made up of farmers from the family sector residing in the Administrative Post of Ocua in the localities of Mahipa, Ocua-sede, Samora Machel and Napuco, who represented, in total, 100 families. The type of sampling used was non-probability convenience sampling. In this type of sampling, the constituents are people who are within reach of the researcher and willing to respond to the data collection instrument.[22] From the perspective of Gil,.[23] non-probabilistic convenience sampling constitutes the least rigorous of all types of sampling, which is why it is devoid of any statistical rigor. The researcher selects the elements he has access to, assuming that these may, in some way, represent the universe.

Procedure for data analysis

After data collection, they were checked, possible errors were corrected and validated. After validation, the data were subsequently coded and processed in a Microsoft Excel spreadsheet and in the Social Science Statistical Package, (SPSS) version 25, then grouped into tables and graphs of frequencies and percentages depending on the analysis requirements. After processing, the results obtained allowed us to give a general idea of the current situation in the study area, in order to compare different positions of the respondents.

Results and discussions

Characterization of the socio-demographic and socioeconomic profile of producers

100 households were interviewed, 29% of which were headed by women and the remaining 71% by men. The table below presents the demographic characteristics of the families interviewed at the Administrative Post of Ocua (Table 1).

Analyzing the level of education in the families interviewed, it was observed that 32% of the population is illiterate. Around 50% of those interviewed have primary education, with the majority having attended up to seventh grade. A smaller proportion have education and attended secondary level, 18% having mostly attended up to the 10th grade, the others attended up to the 12th.

Regarding the age range of the interviewees, it was possible to observe that the majority of the population (50%) is adults, in an age range between 30 and 50 years old, followed by the elderly population (31%), over 50 years old. and finally the young population (19%) aged between 18 and 29 years old. Regarding the age range, Mário (2015), in a similar study, obtained the following results: in the range of 11 to 20 years with 5 producers, from 21 to 30 years with 44 producers, from 31 to 40 years with 67 producers, from 41 50 years ago 42 producers, and finally over 50 we have 11 producers.

Table 1 Characterization of the socio-demographic profile

Education level			
Frequencies	No level	Primary	Secondary
Absolute	32	50	18
Relative (%)	32%	50%	18%
Age group			
Frequencies	18-29	30 to 50	≥ 50
Absolute	19	50	31
Relative (%)	19%	50%	31%
Number of individuals in households			
Frequencies	≤ 4	5 to 7	≥ 7
Absolute	27	60	13
Relative (%)	27%	60%	13%

It was observed that most families (60%) have a number of households ranging from 5 to 7 individuals. A value that can be considered high, compared to the average for households in other rural communities in Africa and the world in general. This is probably due to the fact that in Mozambique the birth rate is very high, especially in rural areas.

The results of this research are in accordance with the census carried out by MAE[19] and studies carried out by INE and MISAU.[24,25] The high birth rates observed in Mozambique are related to poverty and high illiteracy rates.[24] According to Ribeiro,.[26] Mozambique has an estimated population of 22.4 million inhabitants, 70% of whom live in rural areas and approximately 75% depend on agriculture, forestry and fishing.

Analyzes carried out allow us to conclude that the greater the number of households, the larger the area of the farm, as the greater the labor force for agricultural production and other activities, given that the population depends on agricultural production for survival, the same fact it was also found by (Nube, 2013;).[27]

In relation to the economic activities carried out, the data show that 100% of those interviewed dedicate themselves to agriculture as their main activity. In turn, 62% dedicate themselves to agriculture as their main activity. Therefore, the remaining "non-beneficiaries" who practice agriculture as a complementary activity, indicated commerce (19%), casual employment (11%) and provision of services in the public service (8%) as their main activities.

Main agricultural activities practiced by households

Regarding the main agricultural and livestock activities practiced by PAO AFs, the results show that all families practice agriculture and around 59% practice livestock. In relation to activities related to the exploitation of forest resources, the percentages vary from 52% for the collection of wild fruits and other non-timber products, 20% for the production and sale of charcoal and less than 10% for the cutting and sale of stakes and firewood.

Characteristics of the family's agricultural activities

In relation to time in agricultural activity (Table 2), it appears that most interviewees have dedicated themselves to the activity for more than 10 years.

Table 2 Time in agricultural activity

Time in agriculture(years)	Absolute frequency (fi)	Relative frequency (fri)
Up to 5	21	21%
5 to 10	37	37%
10 to 15	25	25%
More than 15 years	17	17
Total	**12**	**100%**

According to Karam,.[28] family sector farmers can be considered those farmers who generally have a life path that is reproduced materially, socially and culturally in rural areas.

Regarding the size of the farms, respondents indicate that 15% of family farmers interviewed practice agriculture in areas smaller than 1 hectare, 40% in areas ranging from 1 to 2 hectares, and 32% have areas ranging from 2 to 5 hectares. and 14% in areas equal to or greater than 5 hectares as shown in the figure below (Figure 1).

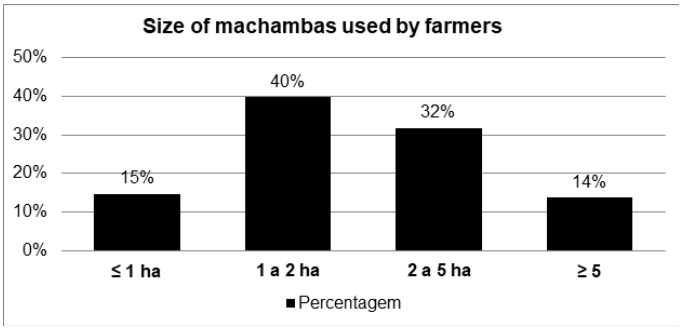

Figure 1 Size of family farmers' farms.

Source: Authors (2022).

It was found that there are more farmers practicing agriculture in medium areas (1 to 2ha and 2 to 5ha) than larger areas, as found by Reis,.[29] According to the same author. The lack of production areas larger than 5ha is partly due to the lack of land for farming and, on the other hand, soil degradation. The findings described above are in line with what was described by MINAG,.[30] when it states that the family sector cultivates an average area of 2 ha. The results are in line with Sitoe,.[10] when he states that the agrarian sector in Mozambique is essentially made up of the family sector and in rural areas of Mozambique, family farming is made up essentially of small farms (cultivating less than 5 ha).

The results on the main crops practiced by the AFs of the villages surveyed in the PAO show that the main crops, in terms of number of families that cultivated, are the following: Corn, which was cultivated by around 99% of AFs, cowpeas (77%), jugo beans (39%), pumpkin (27%), peanuts (70%), sorghum (52%), millet (52%) and cucumber (51%).

Main cultivation strategies and practices used

Table 3 presents the number of Family Farmers who applied each of the 15 agricultural practices surveyed.

Main agricultural technologies adopted by local producers

To improve production and productivity, the SDAE and other partners linked to agriculture have carried out technical assistance activities in matters of using new production technologies and the subsidized sale of inputs has begun. Farmers are technically assisted in matters of sowing, demonstration and consolidation of measures, seed density per hole, phytosanitary control, harvest monitoring and product storage, among others (Table 4).

Table 3 The number of family farmers who applied each of the 15 agricultural practices surveyed

S. no	Cultivation strategies	Frequency	Percentage
1	Fertilizer application	11	11%
2	Manure application	21	21%
3	Compost preparation and application	23	23%
4	Application of synthetic pesticides	22	22%
5	Preparation and application of natural pesticides	4	4%
6	Crop rotation	79	79%
7	Mulch	72	72%
8	Use of cover crops	53	53%
9	Minimum tillage	42	42%
10	Use of improved varieties	57	57%
11	Intercropping with forest/fruit trees found on farms	60	60%
12	Improved fallow using fast-growing, drought-tolerant species	37	37%
13	Rainwater collection and conservation on the farm	21	21%
14	Row cultivation using the calipers and recommended density for different crops	89	89%
15	Use of land preparation practice for cultivation through the slash and burn system	54	54%

Table 4 Main agricultural technologies adopted

Technologies	Frequency	Percentage
Row cultivation using the recommended compasses and density for each type of crop	73	73%
Use of tractors	24	24%
Use of improved seeds	54	54%
Use of organic fertilizers	32	32%
Use of some type of irrigation	52	52%
Seed conservation	33	33%
Rainwater collection and conservation on the farm	21	21%

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Regarding the agricultural technologies incorporated by producers, most of the interviewees 73% mention row cultivation using the compasses and density recommended for each type of crop, 54% indicate the use of improved seeds, 52% refer to the application of some type irrigation, 33% mention seed conservation, 32% mention the use of organic fertilizers, the use of tractors with a percentage of 24% and finally the capture and conservation of rainwater in the farm with a rate of 21%.

In almost every place in the world where the process of agricultural transformation has been documented, growth in agricultural productivity is promoted by improved agricultural technologies, including improved seeds, fertilizers, and control of water resources.[15,16]

Determinants of the adoption and use of agricultural technologies by PAO producers

The Figure below presents the main factors that determine the adoption of agricultural technologies by farmers in the Administrative Post of Ocua (Figure 2).

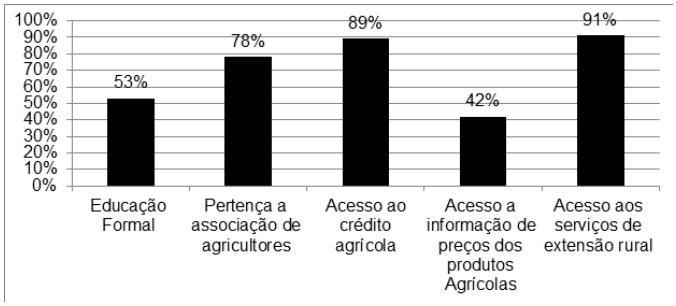

Figure 2 Factors determining the adoption of different agricultural technologies.

Source: Authors (2022).

Regarding the determining factors for the adoption of different agricultural technologies, it is possible to observe in the figure above that the majority of farmers, 91% point out Access to rural extension services, followed by Access to agricultural credit (89%) and membership in some association. farmers (78%). Another significant part points to formal education at a rate of 53% and finally access to information on agricultural products at a rate of 42%.

Regarding access to extension services, Pattanak et al. (2003) cited by Lopes[31] argue that access to public/private extension services plays an important role in the adoption of new technologies because producers are exposed to information about new technologies by extension agents (through group discussions, demonstrations field reports and other sources of information) tend to adopt new technologies.

Most studies carried out in the country indicated that access to extension services had a positive response to adoption.[32–34] Artur[35] argues that increasing crop productivity requires efforts in several directions, which means that new technologies and knowledge must be developed and introduced and, for this, the existence of a strong research and extension service is important and also involves education. and training producers in various areas.

The lack of access to agricultural credit negatively affects the adoption rate of new technologies. Therefore, it is a prominent variable and favorable to adoption. It is therefore argued that producers with credit restrictions are unlikely to be interested in investing in new technologies and typically allocate a considerable part of their capital to traditional technologies. Most studies indicate that there are influences from differentiated access to credit and the adoption of technologies.[36,37]

Regarding membership in farmers' associations, Sitoe and Sitole[38] state that farmers' associations are extremely useful in reducing information asymmetries and empowering their members to negotiate prices for agricultural products and inputs. According to Come,[14] in Mozambique the percentage of agricultural holdings with farmers affiliated to associations is extremely low.

The formal education of the head of the household has a consistently positive relationship to most technology adoption decisions. The effect is strong for high levels of education. Having completed at least five years of schooling indicates completion of first grade primary education. The completion of at least primary education implies a greater inclination to adopt new technologies than a low level of education, or zero.[36]

Access to information on the prices of agricultural products is essential for reducing information asymmetries between farmers, consumers and intermediaries. This has the potential to improve market efficiency.[14] Information asymmetry is one of the factors that cause market failures. This is particularly relevant in the case of Mozambique where agricultural production is mostly small-scale, a situation that results in the farmer having weak bargaining power to negotiate the price of products. Under these conditions, the farmer has no other option than to accept the price determined by the retailer, which is often low.[14,39–42]

Conclusion

The agricultural technologies incorporated by producers in the communities studied are: row cultivation using the compasses and recommended density for each type of crop, use of improved seeds, the application of some type of irrigation, seed conservation, the use of organic fertilizers, the use of tractors and the capture and conservation of rainwater on the farm (control of water resources).

Access to credit, access to extension consultancy services and members of farmer associations are more likely to adopt new agricultural technologies.

The findings regarding credit are particularly strong and robust. The difficulty in accessing credit seems to be one of the biggest constraints for the adoption of technology. Being a member of an association also appears to positively influence adoption decisions through the dissemination of improved information.

The results also indicate the positive impacts of extension contact on the adoption of new technologies. The role of extension becomes stronger when household heterogeneity is recognized through the use of the panel data model.

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Conflicts of interest

Authors declare that there is no conflict of interest.

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