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Full length Research paper

Decision-making methods on farming management in Madagascar

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This research focuses on the analysis about decision-making on farming management of Malagasy farmers. An analogy exists between a farm and a business. The latter operates with a decision-making center and a distinct objective, which is profit optimization. The farm manager should do everything possible to achieve his goal: either self-subsistence or monetary income. However, decision-making is not so easy. The objective of this study is to give a proposal of a decision-making tool toward the farmer, in order to help him optimizing his farm. The result led to a model allowing the farmer to make a decision between two objective functions: self-subsistence or monetary revenue. After a literature review, field observations, a survey of 340 households and simulations were carried out. The resulting model could be useful and replicable in other places while taking into account local realities.

Keywords: Toamasina II District, objective functions, self-subsistence, monetary revenue, food security.

INTRODUCTION

A farm is similar to a business with a decision-making center and a distinct objective, which is profit optimization (Robinson et al., 1986; Marchesnay M., 1993). In this case, the farm manager should plan and rationally combine all available resources or production factors to reach the planned objective (Cerf, 1996; Jacobsen, 1994). However, decision-making is not so easy. How then could farmers be helped to have the right tools to make decisions about the rational management of their farms?

The objective of this research is to propose a scheme for the farmer's decision-making in order to enable him to set his goal. It is a system that integrates the variables and/or parameters according the environment of the study area. So, a hypothesis has been put forward: the farmer manages poorly the production factors in terms of time, labor and surface area. As an expected result, a decision-making system on the management of a family farming will be established.

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To achieve this objective, observations and surveys were conducted after a literature review.

MATERIALS AND METHODS

Study Area

The study area is the eastern central coastal part of Madagascar. It is administratively formed by the District of Toamasina II.

It covers an area of 5 258 Km² and includes 17 Rural Communes(Ambodilazana, Ambodiriana, Amboditandroho, Ampasimadinika, Ampasimbe Onibe, Ampisokina, Amporoforo, Andondabe, Andranobolaha, Antenina, Antetezambaro, Fanandrana, Foulpointe, Ifito, Mangabe, Sahambala and Sub-Urbaine) (Atsinanana Region, 2015).

The zone had 304,104 inhabitants in 2018, mainly living from agricultural activities (90%). In general, the soils are of the fragile lateritic type, easily exposed to strong water erosion. The average temperature is 25.2°C. The relief is uneven. Farming is traditional and familial.

The existing vegetations are natural forests, secondary forests or Savoka, coastal vegetation and artificial forests or

plantations.

Methodological approach

The adopted methodological approach was visual observation and survey after the literature review.

Observations

Observation is defined as the visit and/or discovery of the study area. It consists on understanding the way in which agricultural space is used and identify the types of crops that exist.

Survey and data exploitation

Conducted in 2017 and 2018, the survey took the form of individual interviews. A questionnaire with semi-open questions was drawn up in order to gather the relevant information. The sample is made up of 340 farmer-peasants. They were selected by random draw from the population registers of the 17 Communes, with 20 respondents per Commune. With the appropriate tools, the data and information obtained were processed and analyzed using the ACCES and XLSTAT software.

Creation of the models

The approach has been to develop a model for a farmer's decision making on how he should run his farm. In Madagascar, farmers' production purposes are generally of two kinds: food self-sufficiency and monetary revenue.

Livelihood model

In the subsistence model, the goal of the farmers is to reach a level of auto-consumption with the least possible labor, called self-subsistence. In this concept, if the prices of agricultural products or labor productivity increase, two cases may arise:
- the revenue effect: the farmer has more income from the sale of his harvests; he wants more rest time; then
- the substitution effect: the farmer has more income per working day; he wants to extend his cultivation area and his activities.

Variables

To materialize the approach, a theoretical representation has been developed based on the following very simple assumptions. A household has:
- an exploited surface area, noted S (in ha),
- a number T (in man-day (md) of labor
On area S, he grows i crops such as rice, cassava, sweet potato, maize, sugar cane and vegetable crops. Let S_i be the exploited area for speculation i, with $S = \sum Si$.

The framer distributes the labor T, with $T = T_0 + \sum Ti$ (1) between crops such as:
- T_i for the workloads of each speculation, and
- T_0 for rest or social activities.
For each type of crop,
- He has a number of agricultural assets for one season per hectare: αi expressed in md/ha and so, $T_i = \alpha i \, . \, S_i$ (2), and
- the crop's i productivity is R_i. It is assumed that the harvest frequencies and the yields are constant.
- P_i is the annual total production, where $P = \sum Pi = \sum R_i.S_i$
- P_{op} is the optimal production for self-subsistence with $P_{op} = \sum R_i \, .S_{op}$
- S_{op} is the optimal cultivation area corresponding to P_{op} with
- $S_{op} = \sum S_{i.op}$(3), and
- $S_{i.op}$denotes the optimum area used for a cropi.

Objective functions of self-subsistence

The objective function is written from equations (1), (2) and (3) as:
$\text{Max } (T0) = T - \sum (\alpha i.S_{i.op})$

Open economy model

For an open economy model, the objective of the heads of households is to maximize an economic function or monetary revenue. The farmer looks rather to the market where trade takes place. It is in his advantage to plant high value-added crops.

Variables

A household has:
- a total cultivation area S (in Ha)
- an exploited area S_i for a crop i, with $S = \sum S_i$ where i represents crops such as rice, cassava, sweet potato, maize, sugar cane and vegetables etc., the area is exploited.
For each type of crop:
- the productivity of the household is Q_i. It is assumed that the frequency of harvests and the yields are constant.
- The annual total production is P. It is expressed in $P = \sum P_i = \sum Q_i. S_i$. With P_i the production of the crop i
- C denotes the annual total costs with $C = \sum C_i$ where $C_i$is the costs of the culture i
- p_i is the unit selling price
- R expresses the revenue from harvest sales. $R = \sum R_i$ with R_i as the sales revenue of crop i.

Objective functions: Money income

The simplest and capable objective function that can

translate the farmer's goal is the monetary margin M corresponding to the difference between harvest sales revenue and operating costs. This is a maximization of the margin M such as: Max (M) = [R - C].

RESULTS

Typology of farmers

After the analysis of the collected information, the 340 interviewed households can be classified into three types according to their farming purpose. So, classified as Type I, 71% of the farmers, which have self-subsistence as their objective. Classified as Type II, 18%, those who made revenue as their objective and Type III, 11%, those with a mixed objective combining both. It was found that the distribution of these three types of farmers among the 17 Communes appears to be homogeneous.

Socio-economical characteristics of farmers

Globally, the socio-economic characteristics of the farmers inthe 17 Communes do not differ. In fact, according to the investigations, the former inhabitants of the area formed aunited rural community governed by approximately homogenous socio-anthropological rules.

Age of heads of household

The average age of farm managers of the self-subsistence type is 42 years, those of the revenue type is 36 years and those of the mixed type, 34 years. Type I has the most people over 55 years of age, and is marked by the strong presence of the [65.75] age group.

Educational level

In this zone, the school enrolment is at 35%; it is lower than the regional average which is 57%. The drop-out rate is very high. The main causes are multiple, including (i) the involvement of children from the age of 10 in agricultural work to help their parents and (ii) early marriage, from the age of 14 for girls and 18 for boys.

Main crops

In general, the main crops vary according to the farmer's strategy. For Type I farmers, rice cultivation predominates at 96.5%. For Type II farmers, banana and cassava crops predominate at 89%. Type III is characterized by the dominance of rice cultivation at 62%.

Revenue generation

The sources of money come from the sale of agricultural products and off-farm activities. The latter are essentially the sale of harvested forest resources (leaves and heart of *ravenala*, falafa, etc.) and rarely mining or wage labor resources. The survey results are presented in Table 1 below.

Table 1: Average monthly household income

Type / Products	Self-subsistence strategy		Revenue strategy		Mixed strategy	
	Value (Ariary[1])	%	Value (Ariary)	%	Value (Ariary)	%
Agricultural	46 047	30	83 735	65	64 044	50,4
Non-agricultural	107 443	70	45 088	35	63 027	49,6
Total	153 490	100	128 824	100	127 072	100

Source: Author, 2020

Compared to agricultural activities, three crop productions are essentially market-oriented: sugar cane, lychee and banana.

Characteristics of the production system

In this area, the production means are labor, land, tools and agricultural inputs. They are similar for all three types of farmers.

Work and labor

The main agricultural works are soil preparation (clearing, cleaning, ploughing, flower beds, digging), planting or transplanting, maintenance and harvesting. In this area, the labor force employed is most often family-based. However, family labor is largely insufficient to carry out all agricultural work, which explains the presence of casual labor. This labor is either paid in cash or responded by the community-help system, which is currently disappearing.

Land

According to the survey, the area cultivated and its distribution may vary from one year to another depending on the decision of the head of household. In general, farmers of all three types work on an area of between 0.5 and 8.8 hectares. The heads of household get possession of their land in several ways. For the Self-subsistence type, 100% are owners by inheritance. For the Income Type and the Mixed Type, 47% and 38% are owners, respectively.

Agricultural inputs and tools

Organic or mineral fertilization is poorly practiced in the area except for vegetable gardening. For seeds or cuttings, farmers use their previous harvests, about 82% of the cases. Being strongly attached to habits and traditions, they do not even think about renewing seeds. In the study zone, farming tools are almost the same for all. The agricultural equipment used is mainly made up of small and very rudimentary materials: Angady or spade (82%), spade-pickaxe (18%) and Antsy or cutter (95%).

1USD = 3 320 Ariary

Decision on the operation of the production system

Non-working time T_0

After calculation, Type II operators have more rest or non-working time, 80%, compared to Type I, 45%, and Type III, 77%. This is due to the relative variation of workers in rice cultivation. It is very high for Type I, 241 md, and low for Types II and III, of 20 md and 39 md respectively. It should be noted that, according to the survey, a person consumes an average of 165 kg of rice per year. Therefore, to maximize T_0, the household must produce strictly sufficient rice as needed. 165 kg/year/person. Therefore, contrary to their initial objectives, Type I households have less maximum rest time T_0, 219 md, compared to Type II, 418 md, and Type III, 391 md.

Farm income

For the three Types of farmers, the theoretical margins generated by the 6 crops (Cassava, Sugar Cane, Vegetables, Sweet Potato, Maize and Banana) are all positive and cover the negative operating margins for rice ranging from -192,600 Ariary to - 64,200 Ariary. This situation is due to ancestral farming practices still adopted by farmers. It should be noted that in the area, farmers still grow rice as a matter of tradition and believe that a cultivation year without rice is a blank year.
Consequently, this model correctly follows the initial objectives set by the farmers because Type II farmers achieve higher annual operating margins than the other Types, i.e. 6,413,916 Ariary.

DISCUSSIONS

The diversity of production conditions and producers' purposes no longer allows for a normative approach to economic and technical recommendations. The complexity and variability of production processes have led agronomic research to develop and propose decision support tools to the various stakeholders (Eric Jallas, Michel Crétenet, 2003).

On the model based on self-subsistence

The T_0 non-working time depends mainly on the size of the household from which the head of household will determine the area to be planted. The latter is a function of the optimal production or P_{iop}; the optimal production of white rice is 825 kg for Type I and 660 kg for Type II and III. To ensure a good labor management, the Type I farmer should only cultivate a rice area of 1.18 ha; for Types II and III, that area is 0.94 ha. After optimization, the areas are reduced for Type I: from 1.8ha to 1.1ha. For the 3 Types, the areas can be further reduced and the non-working time can be increased provided that the farmer agrees to make improvements. These results confirm the hypothesis put forward. The self-subsistence model reflects the behavior of households of the self-subsistence type.

On the model based on the open economy

Grouping the 28% of households, they chose the revenue as the purpose of farming, of which 18% were Type II and 10% Type III. For Type II and III farmers, they grow bananas in abundance. Margins are 3,242,800 Ariary and 1,815,968 Ariary respectively. In addition, there is sugar cane, with margins of 1,928,000 Ariary for Type II and 1,638,800 Ariary for Type III. The model also truly reflects the behavior of households of these two Types in relation to their crop.

CONCLUSION

The research aimed to propose a scheme about decision-making at the level of a Malagasy farmer, on the conduct of the farming system according to the characteristics of the household and in relation to the local context. The adopted method corresponds to models that deal with realities, which, as far as possible, consider the situation of the farmers; so, these models reflect their objectives and limitations. So, it is up to the farmer to make a decision on the conduct of his holding according to context around him. This decision concerns the orientation of the farming system that should enable the farmer to achieve its main objective. This model can be applied to any Malagasy rural situation by tuning variables to the context of study.

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