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Family farming and Agrobiodiversity: the case of Madagascar

1. Introduction

With more than 500 million out of 570 million farms in the world, family farming is the predominant mode of agricultural production. It produces about 80 percent of the world's food in value terms, and collectively they are the largest source of employment worldwide [3]. This is absolutely true for a country like Madagascar where 68 percent of families practice farming as their first activity [5]. Malagasy farmers are generally smallholders which cannot afford external inputs like mineral fertilizers or chemical pesticides. They rely mostly on agrobiodiversity to provide some biocontrol of pest infestations and stabilize production. Therefore, family farming and agrobiodiversity are important issues for food production in Madagascar. In this paper I give a general overview of the situation of family farming and agrobiodiversity and its relevance for the overall development of the country. I provide also a summary of my PhD project linked to the topic. This report is based on bibliography, relevant statistic data and my general knowledge about my own country.

2. Geography and history

Madagascar is an island located in the South East of Africa in the Indian Ocean. Its surface is around 587 000 km² and the population around 23.6 million [11]. About climate, the country has two seasons: a hot, rainy season from November to April; and a cooler, dry season from May to October. There is, however, great variation in climate owing to elevation and position relative to dominant winds. The East coast has a subequatorial climate and gets the heaviest rainfall, averaging as

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much as 3.5 m annually. Very often, this region suffer from destructive cyclones. The Central Highlands are appreciably drier and, owing to the altitude, also cooler. They receive around 1.4 m of rainfall every year. The West coast is drier than either the East coast or the Central Highlands. The Southwest and the extreme south are semi-desert; as little as one-third of a m of rain falls annually. About pedology, the red lateritic soil predominates in a large part of the country, it has a very low fertility and consequently causes some restrictions for agriculture. There are anyway richer soils in a few regions due to former volcanic activities. As history, the country is a former French colony. In 1960, Madagascar regained independence but afterward has undergone successive political troubles undermining the development process. Two political crisis has recently occurred, the first in 2002 and another one in 2009 slowing down the economic growth.

3. Poverty and food security issues

The country is plagued by chronic poverty. The nominal Gross National Income (GNI) is only 10.6 billion US\$ and the GNI per capita per year is 440 US\$. This economic situation puts 92 percent of Malagasy population with less than 2 US\$ per day [11]. Madagascar is ranked 155th out of 166th countries in term of Human Development Index (HDI) and qualified as a country with a very low HDI [9]. The population growth is very fast, around 3 percent per year and food production growth is rather slow. As a matter of fact, the population growth literally outpaces food production. This context plunges more and more people in a situation of food insecurity year after year. FAO recent data shows that one-third of the Malagasy population are undernourished [2]. In addition, food production is endangered due to the country's vulnerability to natural disasters including drought, cyclones, and flooding.

4. Agriculture

The total area is around 58 million of hectares but the total of arable land and permanent crops is only 4.1 million hectare [2]. Lands suitable for agriculture is limited mostly because of a mountainous topography, extensive laterization and inadequate or irregular rainfall.

Agriculture is dominated by rice cultivation. Rice is the staple food which is well reflected in Malagasy diet because almost everybody eats rice three times a day. Crop production is usually intended for home consumption. After rice, the most important crops in terms of quantity produced are cassava, sweet potato and maize. Vegetables, groundnuts, beans, peanuts are among the most common cash crops. In some part of Madagascar, like the East and the North West, there are different crops for exportation as vanilla, clover, litchi, bananas. On the other side, animal productions are usually intended for cash. Poultry production is the most important, followed by the indigenous meat of the zebu Malagasy, then pork and all the other animals like muttons, goats and rabbits [5].

Agriculture is critical for the overall economy. Its value is estimated to be around 3.7 billion US\$ equivalent to one-third of the total Gross Domestic Product [11]. This sector is also the most important source of employment, as there are 8.35 million of farmers in Madagascar equivalent to 68 percent of the total labor force [2]. The country is one of the most rural country in the world with 65.5 percent of the population still living in rural areas.

5. *Agrobiodiversity*

Biodiversity is defined as the diversity at genetic, species and ecosystem level [10], and agrobiodiversity is defined as the variety and variability of animals, plants and micro-organisms that are used directly or indirectly for food and agriculture, including crops, livestock, forestry and fisheries [1]. Due to long isolation from African mainland, the biodiversity of Madagascar has become extremely rich, diverse and highly endemic. For instance, the island hosts more than 300 species of birds (around 60 percent endemic), around 260 species of reptiles (more than 90 percent endemic), and more than 14,000 species of plants (more than 80 percent endemic). This rich endemic flora and fauna places Madagascar as one of the top hotspots worldwide for biodiversity conservation [6]. This island offers certainly a large range of resources for agricultural purposes for present and future use. Meanwhile, this biodiversity is endangered and a rational agricultural management is necessary to slow down biodiversity loss.

6. *Family farming*

Around 80 percent of Malagasy families can be considered as farmers if we define family farmers as those who practice farming as first or second activity. Around 70 percent of them are smallholders with less than 1.5 hectares of land [5]. To understand better how those people live, we give in table 1 the description of the most common Malagasy farmer.

Table 1. Profile of the most common farmer in Madagascar.

| FAMILY RAKOTO |
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| <ul style="list-style-type: none">• FAMILY RAKOTO is the most common family farmer in Madagascar (<i>Rakoto is the most common name in Madagascar</i>).• There are five persons in the family: Rakoto, his wife and three children (<i>4.9 is the average size of families</i>).• Rakoto is the head of his family (<i>80% of family has a man as leader</i>).• Rakoto is hardly able to write his name (<i>only 12% of family leader is above primary school level</i>). |

- He owns 1.4 hectare of land
(*the national average for farmers*).
- His children participate in agriculture activities, even the youngest
(*Rate of kids at work between 5-9 years: 10.4%, 10-14 years: 29.9%, 14-19 years: 75.8%*).
- His choice is to grow first rice (occupies 50 percent of his total land), then some crops alternative to rice (cassava, sweet potato, maize), and finally cash crops like beans or vegetables.
- He prefers polyculture to diversify the family food and to manage risk.
- The annual value of the family crop production is around 350 US\$
(*the national average for farmers*).
- Rakoto first choice concerning animal is poultry (small investment and short production cycle), then cows (interesting because of animal traction and milk but lead sometimes to insecurity problem because they are the favorite targets of bandits), and at last pigs followed by all the other animals.
(*Rate of farmers breeding poultry: 54%, cows: 26%, pigs: 19%*).
- Rakoto sells animals for special occasions (celebration) and in case of financial problem (disease of one member of the family, drought, cyclones, etc.).
- RAKOTO spends 70% of the family total production value for food, however he does not eat enough to reach 2000 Kcal per day, having a quantity deficiency. In one year he eats 97 kg of rice, 62 kg of tubers, 9.3 kg of meat, having a quality deficiency (*average diet for farmers concerning these products*).

Data source [5].

7. *The contribution of my PhD project*

The topic of the PhD project is «Management of weeds in upland rice using cover crops».

Rice, as noticed before, is the most important crop in Madagascar, but the country is still unable to produce enough of it to feed its population. A special report from the FAO estimated a rice deficit around 240,000 tons (milled equivalent) for the 2013-2014 marketing year [4].

In the Central Highland and the Middle West of Madagascar, farmers face a shortage of lowlands due to the high speed of population growth. This situation pushes them to exploit uplands (slopes and hill tops). During the last few years, upland rice has become vital for rice production in the region.

In lowlands, irrigation is mostly practicable, so weeds are in some ways controlled by the presence of permanent water. In upland cropping system, hand weeding is a hard labor and most of the time farmers cannot achieve it correctly; in this case weed pressure causes serious damages. Preliminary results from an ongoing research work carried out in another region of Madagascar (Lake Alaotra), showed that weeds infestation could cause rice yield losses from 20 to 80% [7].

Conservation agriculture cropping systems have been proposed in the Middle West region of Madagascar, including crop rotation management, soil mulching and reduction of tillage. The impacts of these technical options in the region have been assessed on rice blast disease, on the parasitic weed *Striga asiatica*, and on white grubs [8] but not yet on weed communities.

The field work for my research project will be performed in Madagascar, where the student is hosted by the research institution CIRAD-SPAD (*Système de Production d'Altitude et Durabilité*).

Currently, a project called STRADIV (System approach for the TRAnSition to bio-DIVersified agroecosystems) wishes to address the issues of agroecosystems and biodiversity. It is a multinational research project which involves Nicaragua and Costa Rica, Guadeloupe and Martinique, Madagascar, Cameroon, Brazil and Burkina Faso. Because we have a common interest on the subject, we decided to include our PhD project inside STRADIV. Experiments will be conducted in controlled environments and in real farms in the Middle West of Madagascar. The efficiency and downsides of *Stylosanthes guianensis* as a cover crop to control weeds infestation will be assessed. A survey on farmers' perception on weed communities and weeds floristic recordings will be performed. The result should help us to understand the interaction between weeds and rice based cropping systems, and later on to explore different options of management. We expect that this study will help family farmers to increase their production, to reduce their work labor by significantly diminishing weeds infestation, and to obtain an overall sustainable upland rice based cropping systems.

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