

Full Length Research Paper

Managing various *Musa* varieties cultivated in Pissa district in the Central African Republic

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The diversity of cultivated crops, kernel element of food security, seems today to be threatened by contemporary worldwide, regional and local agricultural mutations. This study shows that there are thirty seven (37) accessions among which one can find *Musa paradisiaca* (33), *Musa sapientum* (03) and *Musa nana* (01). This sharing does not depend on the ethnic diversity because many ethnic groups share among themselves a great deal of ways of using accessions which number varies between 4 to 26 in function of villages and quarters. The banana tree holds the second rank behind cassava and constitutes an important source of income and a means of food supply for peasants who are the producers. Cocoyam and yam are the most associated crops to banana trees with 48% of accessions that are on the move of disappearing. Among the causes of this disappearing, one can find the long cultural cycle of some accessions, the weak productivity, the height of bunches and fruits that are much reduced and their weakness to sickness. Any ameliorated crop has not been signaled the weak level of instruction and the lack of technical accompaniment are the main obstacles to the management of these resources.

Key words: *Musa* species, diversity, peasant, management, Pissa and Central African Republic.

INTRODUCTION

Agro biodiversity or various cultivated crops, an essential element of food security, seems to be threatened today by worldwide, regional and local contemporary agricultural mutations. Production and managing measures of varieties applied in favor of executing some development projects did not take into account and conjectural determinants. Taking efficient instruments to conserve Phylogenetic better of determinant factors of

the estate of various cultivated crops either they be specially inter or intra. The main role played by local populations in the domestication and conserving crops is not to be no more demonstrated. It lasted from the period when agriculture came to be from the preservation and the Protection of useful varieties and ecotypes (Tourte, 2005).

In fact, in traditional agro systems, farmers use a great

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deal of various species local varieties. This variety is sometimes culturally important (Brush, 2000; Teshome et al., 2007; Barnaud, 2007). Meanwhile, if farmers' rule is recognized, the processes' comprehension taken into account and social, economic and ecologic factors of this evolutive dynamism of domesticated crops is even fragmentary and unequally known according to species and agro-ecologic conditions. The local taxonomy stays in this way, a preamble to documenting farmers' knowledge linked to managing genetic diversity of cultivated crops. Investigations made on many crops have confirmed this importance.

Dessert bananas and plantains are one the major crops that are used in humans' food, because they are cultivated in more than 100 countries in tropical and subtropical regions of the world. They constitute the main basic food for millions of people and play an important role in the social structure of many rural communities (Lassoudiere, 2007). They hold the fourth rank in the most list important list of food livestock behind rice, wheat and corn. Its worldwide production is 74 millions of tons per year. As cultural crops, banana trees are particularly important because they produce the best quality of food all along the year and can be adapted to any various cultural systems (Bakouétilla et al., 2016).

In Central and West Africa, dessert bananas and plantains essentially contribute to food security, creating employments, income diversification in rural and urban areas, thus to struggle against poverty (Temple et al., 1997).

In the Central African Republic, this cultural holds an importance place in the rural economy with an annual production of 129129 tons (FAO, 2008), by traditional cultural practices. Farming managing this diversity is directly influenced by many social, economic cultural and environmental factors. The great part of this product is locally used, showing the strategic rule of bananas and plantains in food security of households (FAO, 2008). There are many ways of using bananas and plantains. Meanwhile, the national production today is not sufficient for the local consumption due to a high demand, although the geographic situation of the South-West of the country is favorable for the production.

Studies to collect data on knowledge, practices and traditional systems of managing diversity over many plants together with those of banana trees have been carried out in many zones of production and their impacts on keeping in farm have been analyzed.

On Duupa, an ethnic group in North Cameroon, a study locally carried out has shown that there is a great deal of local varieties of plantain in only one village and has shown that the dynamism of that variety even in space and time (Barnaud, 2007). In Ethiopia, a study on sorghum explored the dynamism of farmers' management in marginal environments of production and has shown its non static and open character, its constraints and its limits. This study has clearly shown the necessity to conciliate *ex-situ* conservation and *in situ* conservation in

preserving sorghum genetic resources (Seboka and Hintun, 2006). Thus, it is important to extend such a study in other cultural spheres in order to analyze the impacts of these farmers' knowledge, practices and traditional systems of managing on long term conservation more preciously or to generalize them, as genetics of bananas and plantains are concerned and to lead research programs in order to ameliorate it. In matter of agricultural production, knowledge and farmers' practices linked to managing diversity and leading to local opportunities of this speculation have no documentation yet in the Central African Republic.

Thus, the general aim of this study is to understand how farming practices contribute to diversifying bananas cultivated in the Pissa district. It specifically: (1) to cense bananas and plantain and (2) to evaluate farmers' way of managing.

METHODOLOGY

Area of study

The study was carried out in the district of Pissa (Figure 1), located in the Lobaye prefecture. It is one of the areas where bananas and plantains are produced in the Central African Republic, which is an important way that allows going to Bangui, the capital city to draw its products.

The Pissa district has a subequatorial climate which has deep forestall vegetation and a clear forest due to human activities and savannah areas due to hydromorph soil nature. Savannah is at the first sight near the village whereas forest is at the second plan. The hydromorph soil supports "woody savannah vegetation of the type *Terminalia glauscens*, *Brideia*, etc. The stratification is constituted of herbs mainly of *Imperatua cylindrica*. The average number of the population is 22452 inhabitants spread in 3 districts. There are various economic activities such as agriculture, breeding, harvesting, commerce, arts and crafts, and so on. But agriculture is the main activity because it is practiced by almost 85% of the population (PDRSO, 2018).

Sampling

Pissa district has 61 villages and quarters, all of them are banana and plantains producers. 49 great producers have been identified. An uncertain sampling allowed choosing 30 villages and quarters. The following criteria allowed defining the sampling: being farmer and/or trader and living in one of the villages chosen for the study; having a farm with at least 50 banana trees and being able to answer to the questions on the inquiry leaflets (Adoukonou-Sagbadja et al., 2006).

Ethnobotanic inquiries and data collecting

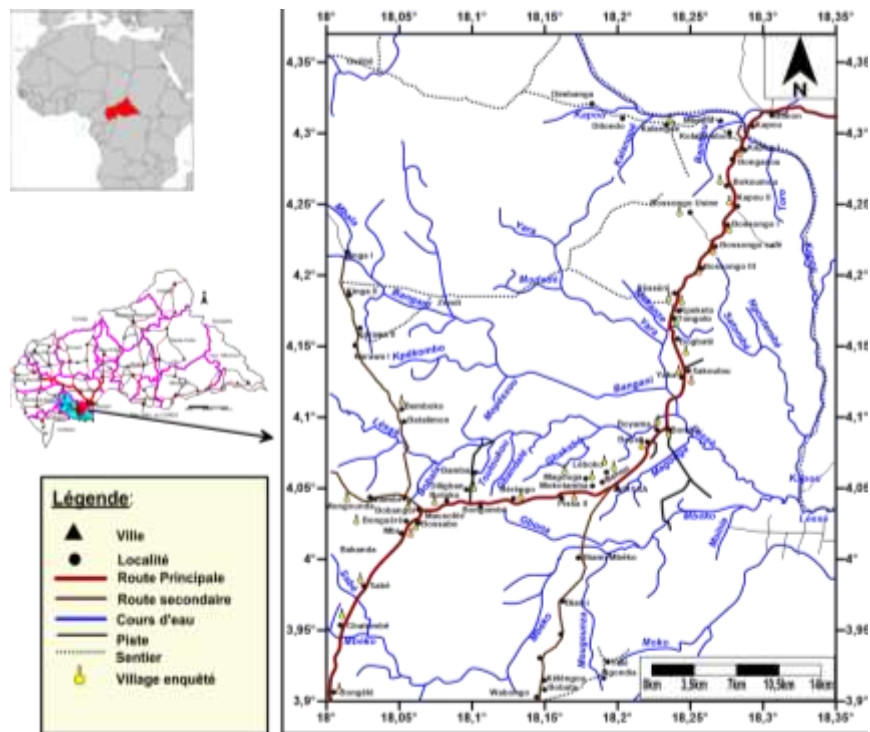
Inquiries on the ground have been done from December 2018 to January 2019 in the identified villages. A prospection followed by collecting information on banana and plantains' accessions cultivated has been done according to tools and techniques of a participative research approach based on direct observations; there were discussions, group entertainments; individual entertainments according to an inquiry leaflet in producer's milieu and visiting farms (Adoukonou-Sagbadja et al., 2006; Missihoun et al., 2012).



Plantation of banana tree in Pissa



Rejections of banana tree for culture



Source: Labo Géoscience/Univ de Bangui/ING de Bangui/Image STRM/M. A - Dave BANGANE /02-2011

Figure 1. Study's area localization.

Preliminary information has been collected near local authorities. These resource people being in contact with the farmers contributed to the choice of prospected villages. The sample is constituted by people whose ages vary from 15 and over, without any distinction of sex. This approach is adopted in order to collect liable information on the varieties such as *Musa* because of the fact they are not well-known by the young generation. In all of the villages and quarters that were submitted to the inquiry, meetings with producers had been well-done because of the local and/or administrative authorities. Entertainments have been carried out in local languages. By doing this work, the real inquiry was preceded by a test of the questionnaire over a sampling of 50 people (Adoukonou-Sagbadja et al., 2006) chosen at random in 30 villages.

Data analysis

The primary data obtained following the administration of the various questionnaires initially were stripped manually and seized in Excel 2010. An analysis of the simple frequencies has allowed to make a description of the sample. Indeed, it has allowed categorizing the actors as well as the diversity of the cultivated phylogenetic resources. The results have been presented in the form of graphs and figures. The simple correlations have been used to determine the percentage of variation between the number of the ethnos groups and the diversity of the accessions as well as the variation between the accessions in disappearance and the total number of the accessions by village. R^2 is the coefficient of correlation and allows to know if there is a linear association

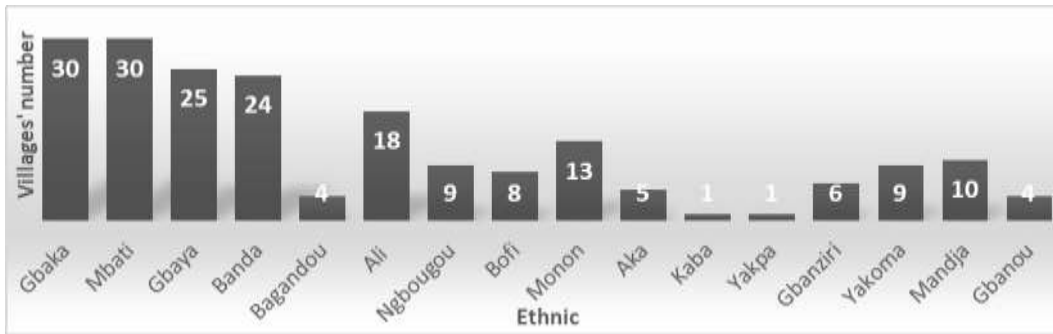


Figure 2. Different ethnic groups' number.

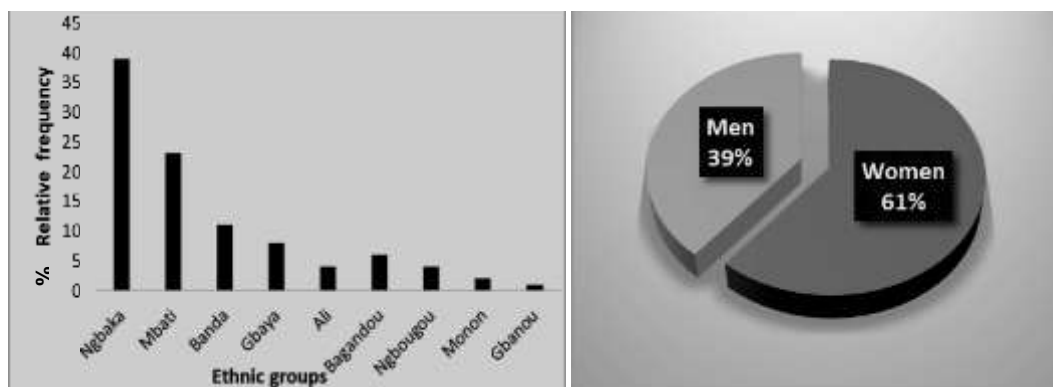


Figure 3. (A) Banana producers' ethnic groups; (B) Producers' repartition according to sex.

between two variables. It must be equal to or higher than 0, 5. The XLSTAT-pro version 2013.5.01.software (https://www.xlstat.com/fr/articles/xlstat-2008) was used for the Factorials analysis of correspondence to determine the percentage of variability in the interests which get the various accessions of banana trees cultivated.

RESULTS

Subjects profiles

Dividing up the subjects according to ethnic groups

Sixteen (16) ethnic groups have been signaled in the 30 villages and quarters in Pissa district. The most represented are Ngbaka followed by the (Mbati) Issongo (Figure 2), because one finds the two ethnic groups in all of the prospected villages and quarters. In the Lobaye prefecture, these two ethnic groups are majority.

Dividing up producers according to ethnic groups and sex

Among the inquired producers (Figure 3A), the Ngbaka

(40%) followed by the (Mbati) Issongo (25%) are the most represented ethnic groups. The Ngbaka and the (Mbati) Issongo are thus the ethnic groups who produce bananas and plantains. In a recent past, plantains were considered as these ethnic groups' basic food. In function of sex (Figure 3B), 61% of the producers are women against 39% of men. In general, in this district, most are the women who are the best implied livestock cultures.

Dividing up producers according to their age

In function of age, producers aged more than 49 years old are majority with a frequency of 43.80%, followed by those aged from 39 to 49 and the young ones (Figure 4).

Diversity of crops cultivated

During the ethnobotanic inquiries, 11 food varieties have been signaled and represented the main cultivated crops (Figure 5). Banana tree holds the second rank after is observed in Bossongo café (04). Many reasons justify these variations: culinary practices; ethnic group diversity manioc. It is this that explains the importance granted to

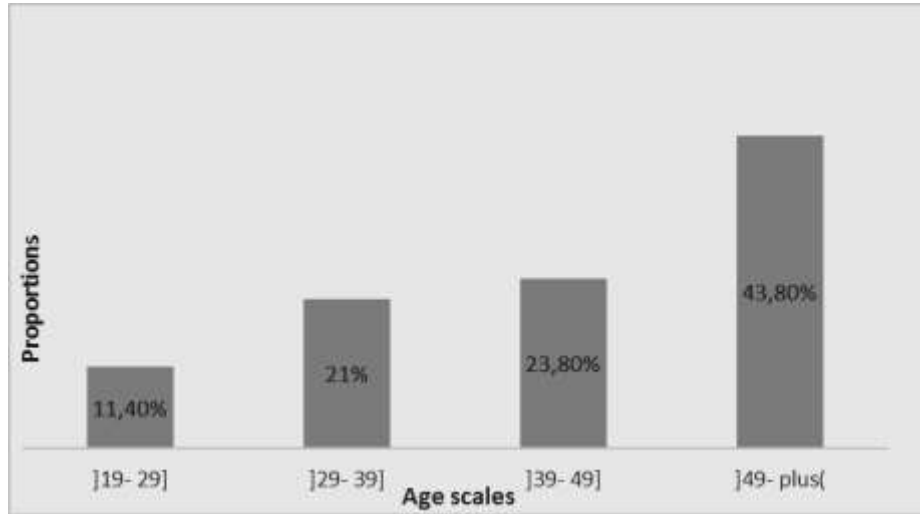


Figure 4. Producers' repartition according to age scales.

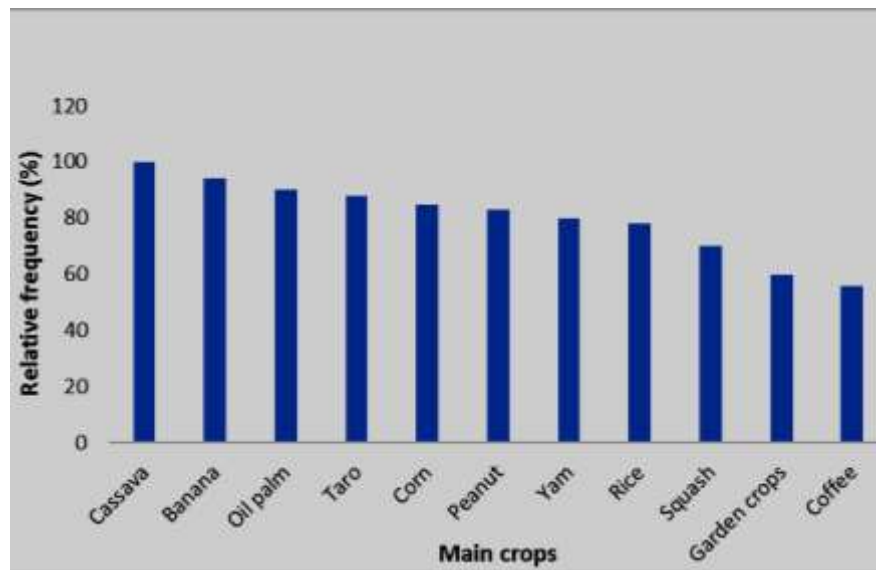


Figure 5. Main crops' relative frequency.

growing bananas in this district. In fact, 94% of producers' associate banana trees with other cultures, bearing in mind to manage cultural areas. Monoculture (6%) as concerned is practiced in gardens near the house.

Cultivating bananas

Importance of cultivating bananas for producers

Bananas and plantains have various importance in the producers' life (Figure 6). They constitute at time a monetary and a food source (89%) for the whole villages and quarters. Other uses such as monetary (10%) or food

(1%) are minor.

Accessions of cultivated bananas

Number of cultivated accessions

At the end of the inquiries, thirty-seven (37) accessions pertaining to three (03) varieties of the kind *Musa* have been signaled (Figure 7). All of these accessions are local cultivars that are not given by structures of seeds' distribution. Names given to accessions are all in Ngbaka and (Mbat) Issongo languages. They are most of the time linked to the duration of the cultural cycle or to the

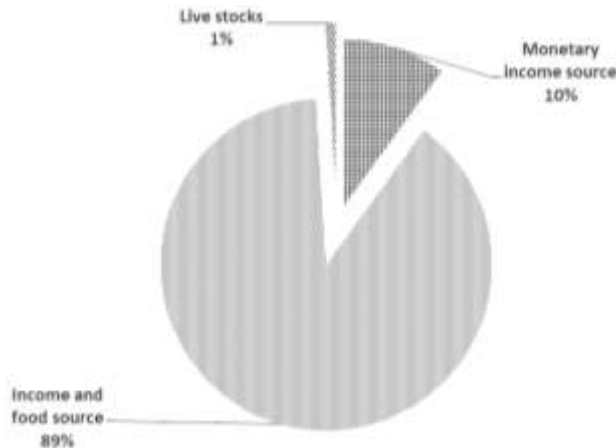


Figure 6. Socioeconomic importance of cultivating bananas.

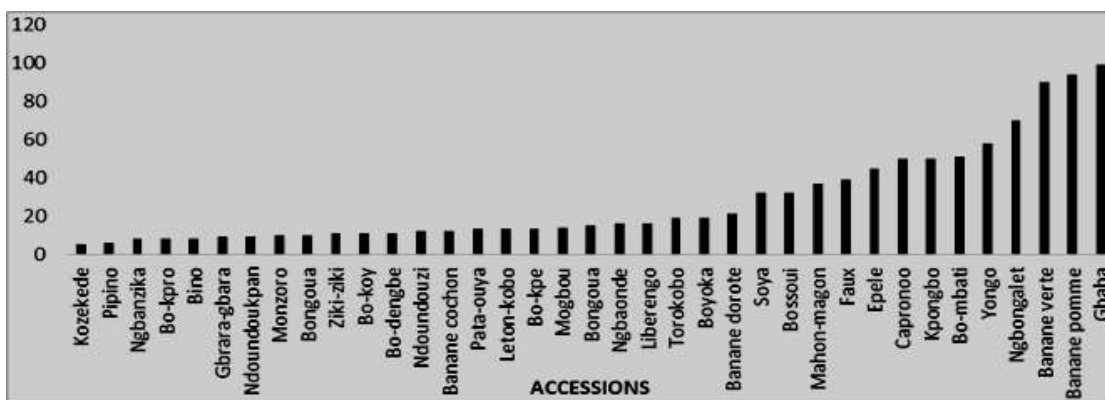


Figure 7. Different accessions' frequencies.

form and the height of the bunches and fruits or to their introduction. Gbaba (100%) is the most cultivated accession all over the villages and quarters. It is a local accession with a short cultural cycle and with a long fruit. It is followed by Knob Banana (95%) and Green Banana (90%). Meanwhile, Kozokede (5%) is the least cultivated accession.

Diversity in the use of different accessions according to villages

Corresponding Factorial Analysis (CFA), realized on variables village and accessions (Figure 8) highlights a weak variability as far as usage of different accessions in function of different villages is concerned. In fact, the two CFA axes contribute for 32.29% of the whole variability.

Average accessions' amount per village

The number of accessions varies from four (04) to twenty-

six (26) according to villages ad quarters (Figure 9), with an average of 10. The greatest diversity is observed in Magouga (26) and Mokotamba quarters (18) and Diligban village (18). Meanwhile, a reduced diversity sustaining cultural practices; material exchange flows in villages; and among communities.

Accessions' diversity according to ethnic group

According to Figure 10, there exists a weak correlation ($R^2 = 0.1871$) among ethnic groups and the number of cultivated accessions. This means that the diversity of cultivated accessions does not depend on the ethnic group diversity.

Accessions' characteristics

For all the accessions, the cultural cycle varies (Figure 11). Three groups are identified. There exist accessions

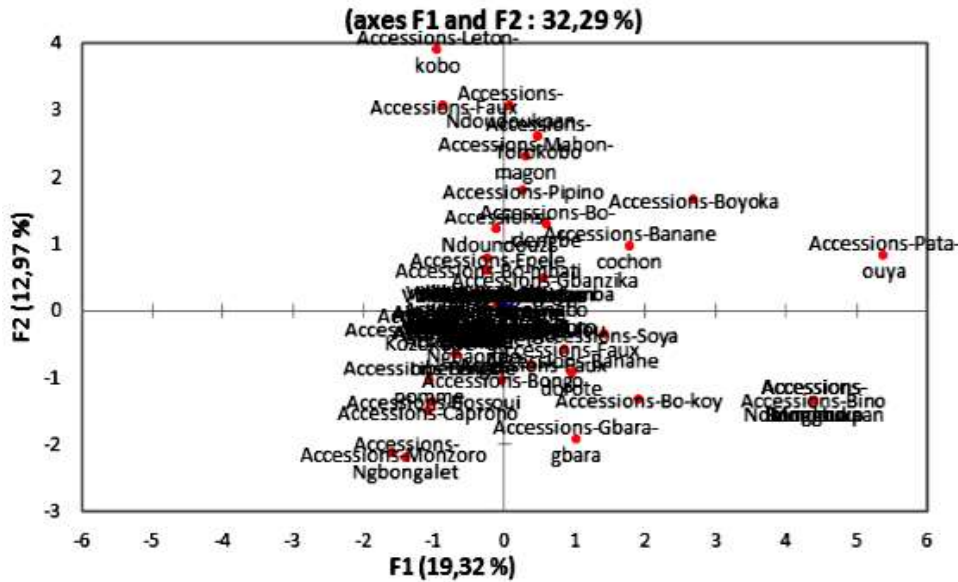


Figure 8. Corresponding Factorial Analysis linking accessions to their uses.



Figure 9. Accession's number per village.

with short cycles that are harvested less than 12 months (11%); accessions with normal or mid cycles that can be harvested between 12 and 18 months (38%) and at last accessions with more longer cycle that can be harvested after 2 years and even more (51%). The cultural cycle is part of choice criteria made by banana producers though there are other selection criteria.

Accessions seeming to disappear and causes of threat to loose diversity

There exists a great correlation ($R^2 = 0.8883$) between the total number of accessions and accessions that are

on the verge of disappearing (Figure 12). This means that there is a great probability of genetic wiping when there is an important diversity.

Figure 13 attests that 48% of accessions are threatened to disappear. The long cultural cycle (39%) is considered as the main cause, followed by the weak agricultural yield (22%) and the height of the bunches and the fruits (21%).

Managing cultural areas

The traditional system of culture practiced shows the association of five (5) other types of food livestock always

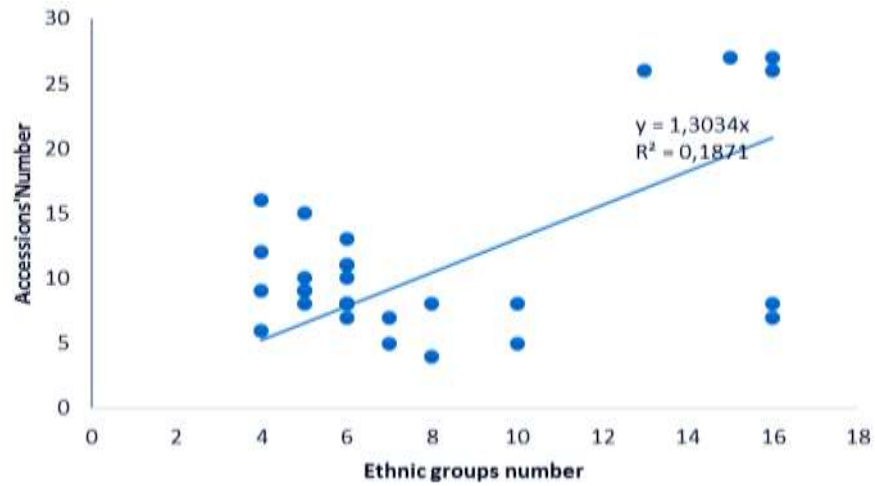


Figure 10. Correlation between ethnic groups and cultivated accessions.

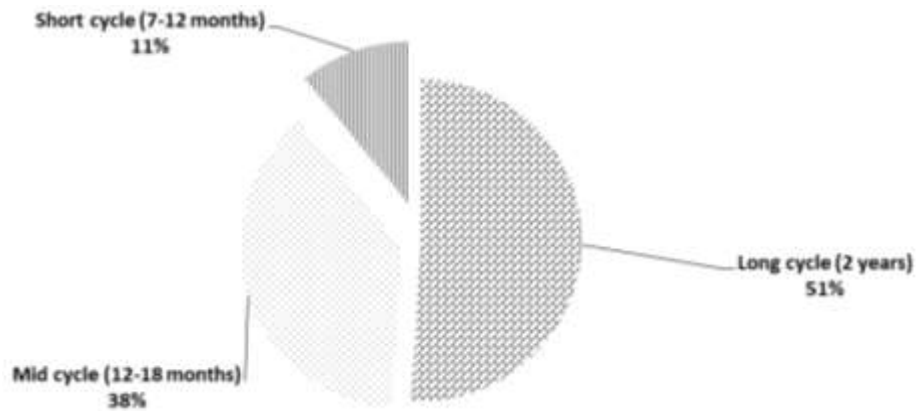


Figure 11. Accessions' proportions according to cultural cycles.

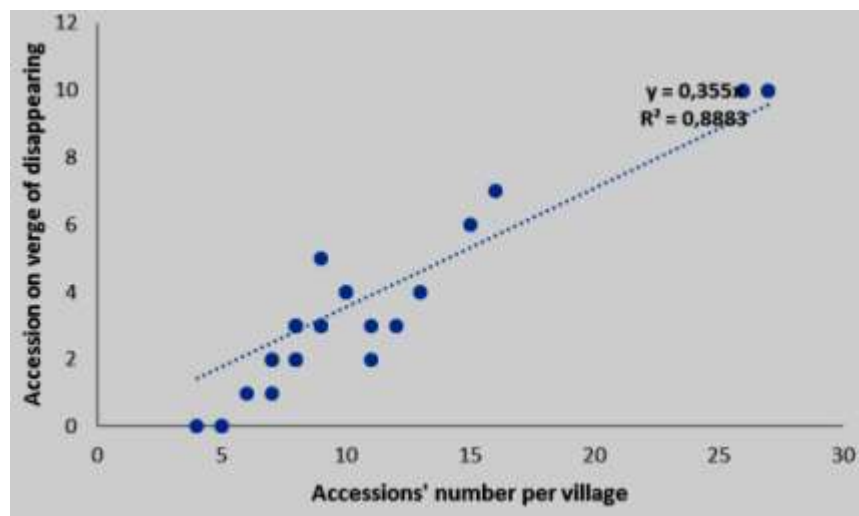


Figure 12. Accessions seeming to disappear in villages and quarters.



Figure 13. Threat causes loss of diversity.

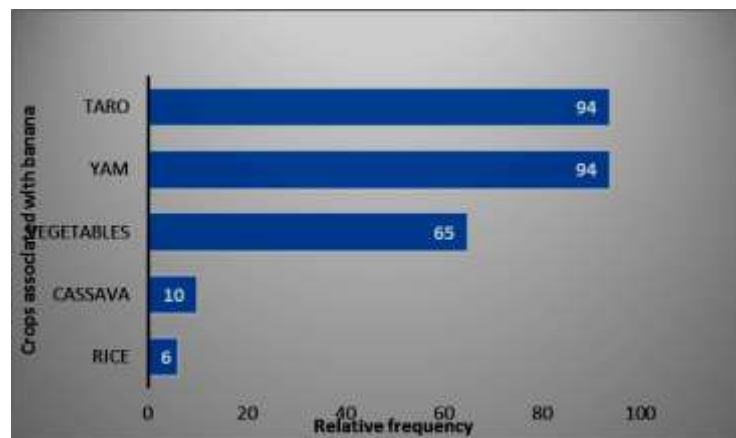


Figure 14. Plants' frequencies associated to banana trees.

associated to banana trees (Figure 14). Cocoyam and yam followed by vegetables are the plants. Meanwhile, manioc and rice are less associated to bananas. Figure 15 reveals that two types of bananas are frequently cultivated; the plantain and the pudding banana or the sweet one. The majority of producers cultivate the two types of bananas in their fields, that is to say a frequency of 93%. Producers specialized in the production of only one type of banana: dessert or plantain represents a weak proportion with, respectively 1 and 6% and in garden near their houses.

Managing seeds

There is no structure nor popularizing agricultural service that intervenes in the seeds' distribution. Thus, managing species' seeds are made traditionally (Figure 16). After harvesting, the majority of producers (99%) use the same seeds cut from the trees to plant them in the next field. More than 14% of producers use very old seeds because

they inherited them from their parents. Moreover, in order to have the best quality or to get a new seed, 56% of producers who were interviewed use their friends' seeds and 30% buy seeds from other producers.

Constraints linked to bananas and plantains' production

Producing banana and plantains in the Pissa district meets many problems, among which one can find sickness and rodents, the weak level of producers' instruction, the lack of technical and organizational training and the technical ways used. One of the major constraints to the production is the weak level of the producer's instruction. In fact, 57% of producers stopped learning at the primary school, and 29% are illiterate. As for cultural techniques, two (2) technical ways (ITK) have been detected among the producers, discriminated by some cultural operations (Figure 17). These technical ways do not allow having a good yield, because some

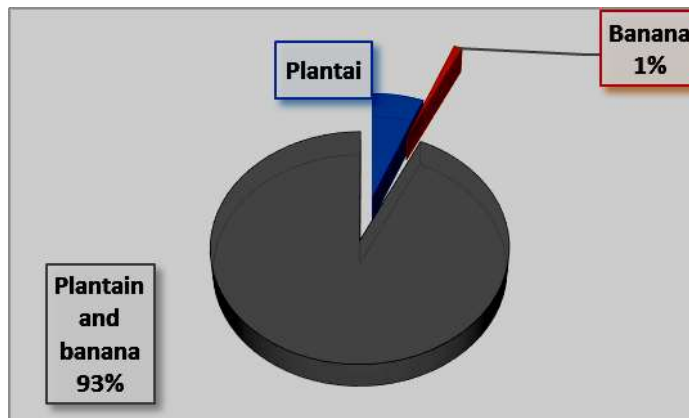


Figure 15. Producers' repartition according to types of cultivated bananas.

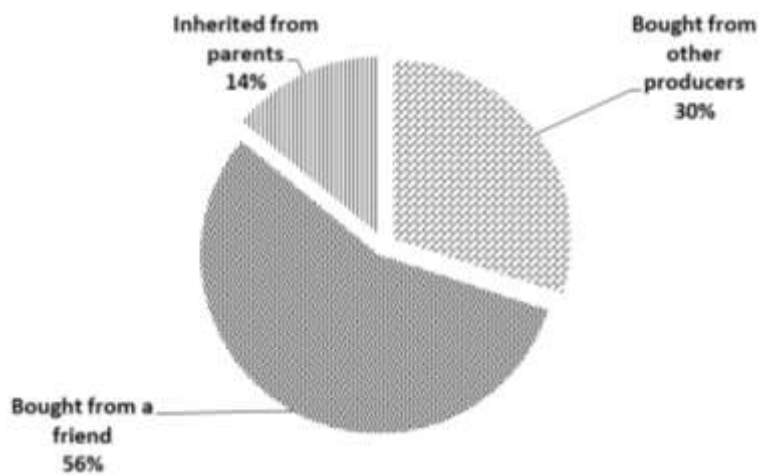


Figure 16. Proportions according to modes of acquiring seeds.

cultural operations such as desuckering constitute a lack.

DISCUSSION

In the Pissa district, different banana and plantains' accessions are cultivated. Inquiries helped censusing 37 accessions diversely represented in the prospected villages. Li et al. (2011) by making a study on the genetic resources and the plants' evolution have even noticed that the important collections of cultivated plants are kept by local communities with their traditional cultural and agricultural practices. This shows that farmers' practices would contribute to the phylogenetic diversification of resources.

Women are most concerned in the banana and plantains' production, because 61% are banana fields' owners. They are even engaged in productive activities and commercializing food supplies. Meanwhile, men are

most interested in industrial crops (coffee and palm oil) and exploiting palm wine. Ngoma (2003), in a similar approach had an opposed point of view, saying that 80% of banana and plantains' producers in sending them to Douala are men, the latter having and managing farms. Tchuisseu-Tchepnkep (2007) has also demonstrated that in productive areas, men practice annual and long lasting crops whereas women are interested those for local food supplies. This means that managing this resource is diversely perceived in the milieus.

People of various age groups produce banana with those aged from 35 years old and even more are numerous (85%) and those aged between 45 and 70 years old (52%). Young people are weakly represented. The great majority of people implied in the production can be explained by the fact that in rural areas, there exists the rural exodus phenomenon (young people leaving villages for towns) on one hand and on the other, it is a culture that demands patience and in terms of income.

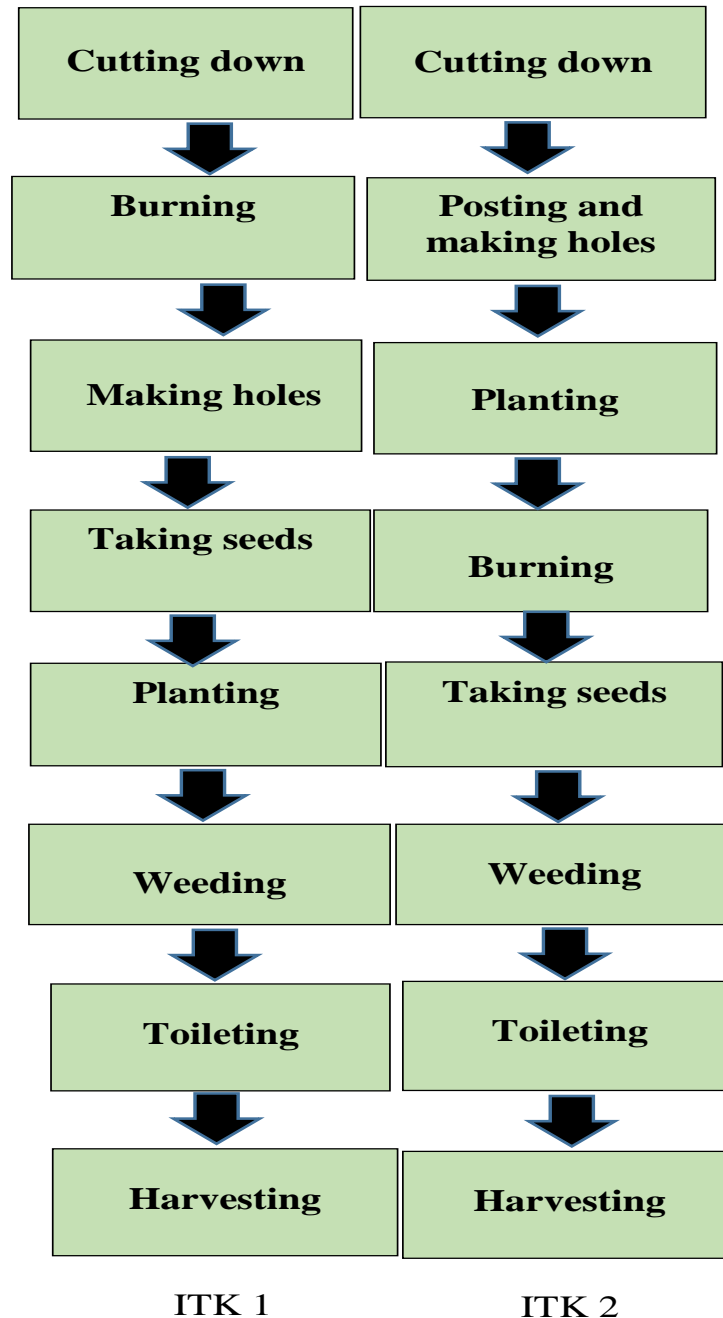


Figure 17. Banana and plantains' technical ways in the Pissa district.

Cultivating banana does not need many physical efforts, except the operations of clearing and cutting trees down, and generates reasonable incomes. It is the same thing for producers whose main activities are only producing. The number of children in charge and the familial needs to be held explain a durable investment in agriculture, turning towards crops that generate more incomes. Nkapnang-Djossi (2011) has shown through a study on technical efficiency determinants of agricultural exploitations on plantain in Cameroon, that age negatively

affects plantain's production. The more the age grows, the more the producer does not have enough physical strength and money to invest in the exploitation. Tchuisseu-Tchepnkep (2007), in a similar approach has shown that 49% of producers were aged 50 to 60 years old and that the age bracket between 20 and 30 years old represented only 14%. Age brackets of older people in the banana production hinder the development of that culture in Mouyondzi.

Producers still have an appreciable phenotypic diversity

of local accessions. But it was also largely reported by producers that because of a great market among producers, long vegetative cycle of accessions (latest) are progressively being abandoned in favor of early cycle accessions, as well as sicknesses and those of weak income accessions. Missihoun et al. (2012) in a study on peasants' managing sorghum confirmed this point of view as cultural cycle is concerned, added to drought tolerance and flexibility of sowing periods. These parameters generally affect at many scales, and contribute either to diversification or to the seeds' reduction according to the areas.

As far as managing the seed system is concerned, in fact 56% of the producers use seeds inherited from their parents. Meanwhile, 30% of them bought from other producers. This information constitutes an obstacle to the introduction of ameliorated accessions in the collection. Gbaguidi's et al. (2013) work on the niebe have confirmed these practices of transmitting seeds from parents their children and that the non-introduction of ameliorated varieties would set aside genetic erosion's risks. Similar observations are largely known and have already been reported on various local speculations such Brocke as fonio (Adoukonou-Sagbadja et al., 2006), millet (Vom et al., 2003; Dagba et al., 2014) and sorghum (Kayodé et al., 2005; Missihoun et al., 2012). Meanwhile, (though there is a rate of threat in losing the relatively high diversity, culture stays subject to many constraints either non biotical, biotical or anthropical. The named constraints reported by producers, the lack of technical training appears here as the first obstacle to the production. Though these results are not in accordance with Teran and Singh's (2002) and Martinez's et al. (2007) who, respectively signified that sicknesses constitute the first constraint linked to the bean's production, the emergence of this constraint can be explained by the fact that toileting operations (desuckering) and that the aim is to high the production which are not known by the producers.

Two systems of cultivating banana have been proved: the monoculture practiced in gardens near the house with a weak frequency of 6% and the cultural association (94%). Producers do not use manure to manage the soils' fertility; nor pesticides to struggle cultures' enemies nor even selected varieties.

This type of cultural system is seen in agriculture for living and the surplus is commercialized. Mazoyer and Roudard (2002) in a similar study qualify it as an orphan agriculture. Identical results have been also obtained in peasants' milieu in Ivory Coast by Traoré et al. (2009), where banana is almost always associated to industrial and/or crops for living.

CONCLUSION AND PERSPECTIVES

The study realized in the Pissa district helped to appreciate the cultivated banana and plantains' managing

mode, together with their diversity. The results show that thirty-seven (37) accessions pertaining to three varieties such as *Musa* (*Musa paradisiaca*, *Musa nana* and *Musa sapientum*) are valorized by the producers. Nine (09) ethnic groups over the 16 numbered are implicated in the production of these resources whose most representatives are the Ngbaka and the (Mbat) Issongo. By order of crops for living importance, banana holds the second rank after manioc, and this fact justifies its importance as a means of living and a source of monetary income. Accessions are diversely represented throughout the villages and quarters, with a greater diversity in Magouga (26). Twenty-one (21) accessions over 37 censed are threatened to disappear. Meanwhile, no introduced accession has been signaled together with a lack of technical help program on the behalf of the producers. Sixteen (16) accessions over the thirty-seven (37) are the most appreciated because of their short cultural cycle. The results confirm a variation in managing these phylogenetic resources in function of villages and quarters that were submitted to the inquiries. The diversity among the accessions is a normal consequence.

CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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