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Characterization of Plantain Banana Cropping Systems in Peasant Farms in the Alibuku Region around Kisangani, DR Congo

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ABSTRACT

The purpose of this study was to characterize plantain banana cropping systems on peasant farms near Kisangani, DR Congo. In order to achieve the expected results, a survey based on a semi-structured questionnaire was done among 60 farmers and banana fields. In addition to the interview with the farmers, a direct observation was also made in the fields of plantain banana in order to complete the information obtained from the farmers. The results obtained indicate that agriculture is the main survival activity and plantain banana rest the priority crop that takes place mainly in primary or secondary forests. For majority of plantain banana farmers, the fields are burned and occupy from 2 to 3 ha. In terms of types of cropping, polyculture is largely used by the majority of plantain banana producers and the plantain-maize, plantain-cassava and plantain-rice are the most frequent intercropping in the area. Compared to the field duration of plantain banana, the maximum time is 5 years and the techniques adopted by the farmers to maintain the plantain are regular maintenance of the field and destruction of diseased or attacked plants, maintenance of certain standing trees and accumulation of plant debris around the tuft.

Introduction

Bananas (bananas and plantains) occupy the fourth place in terms of world production as an agricultural product after wheat, rice and maize (Dhed'a et al., 2019) and are the second most important fruit crop in the world (FAO, 2018). According to (Chabi et al., 2018); Idumah, (2016) and Techeney, (2007), banana and plantain are among the oldest fruits grown in West and Central Africa and the most important staple food crops in the tropics and subtropics of the world.

In the Democratic Republic of Congo (DRC), plantains are grown in lowlands, in the central basin (Devos et al., 1978). Plantains are the key to food security in the country, with a production of more than 4.8 million tonnes in 2019 (INS, 2021). Compared to other staple food crops, banana and plantains are classified as the second crop after cassava in terms of production and demand (D'Haese et al., 2013) Nearly 70% of production is directly consumed by local producers, with the remaining 30% representing the marketed part and the part recorded under crop conservation conditions (Bakelana & Mayumba, 1998).

The production of plantain banana in DR Congo is done according to six systems in the following order of importance: cropping in forests, fallow cultivation, intercropping with perennial or food plants, huts gardens, monocropping and production in agroforestry system (Dhed'a et al., 2019). In these systems, plantains are typically produced in combination with food, vegetable and industrial crops (Tutu et al., 2020; Sivirihauma et al., 2017). This system has the advantage of providing farmers with diversified production at different times of the year.

In the Kisangani region, in Tshopo Province, in DR Congo, large quantities of bananas and plantains are produced on peasant farms and marketed in different markets in the city of Kisangani. At present, the cropping systems and production of plantain banana in this region are poorly understood and the prospects for sustainable exploitation in these different systems remain to be elucidated. Knowledge of different plantain banana growing systems in the region as well as the local know-how of farmers can contribute to improve the production system in this region characterized by shifting cultivation.

Material and Method

This study took place in the Alibuku region located northeast of the city of Kisangani, in the DRC. The search was carried out in three localities including Kazombo, Agbokanga and Likoko located respectively 46, 47 km and 49 km from the city center of Kisangani. The climate of the Alibuku region is the same as that of Kisangani. According to the classification of (Koppen, 1936), Kisangani belongs to the climatic type AF. The soil belongs to the order of Oxisols. This type of climate corresponds to a regular and abundant rainfall (1750 mm per year on average) but variable in time and space (1500 and 2000 mm). Thermal fluctuations are also significant between 20 and 30°C (average of 25°C) and the average monthly relative humidity is 84% (Boyemba, 2006).

As study material, we used the plants or tuft of plantain banana found in the survey area as well as the metric tape to measure the area of fields.

The data collection was done through a direct observation of farmers' fields and a study of nearly 60 plantain producers due to 20 producers per locality.

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The interview technique by means of a semi-structured questionnaire made it possible to materialize this survey.

Results

Main activities, priority cropping and place of production of plantains

In the study area as a whole, agriculture remains the most important survival activity of peasant populations, it is carried out by both men and women and employs about 58.3% of respondents. After agriculture, carbonization (25.0%), livestock, hunting and fishing (Table 1) follows.

Table 1. Distribution of respondents by main activities

Main activities	Women (%)	Man (%)	Total (%)
Agriculture	15.0	43.3	58.3
Carbonization	6.7	18.3	25.0
Breeding	5.0	3.3	8.3
Hunting	0.0	5.0	5.0
Fisherie	0.0	3.3	3.3
Total	26.7	73.3	100.0

With regard to crops considered to be more important for the populations of the villages surveyed, Figure 1 above shows that plantains are given priority not only because of their basic food but also because of the significant income they provide to farmers in these areas. Rice, cassava and maize are in descending order, the other important crops in these areas after plantain banana.

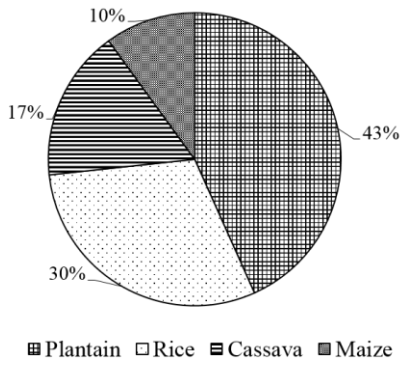

Fig 1. Priority cropping of the area

In relation to the location of the fields, our study reveals that plantains are produced after opening the field either in the primary forest, in the secondary forest or fallow. For example, the majority of plantain banana growers grow in primary forest (48.3%), and many others grow in secondary forests. Only 18.4% of plantain banana fields are set aside (Fig. 2).

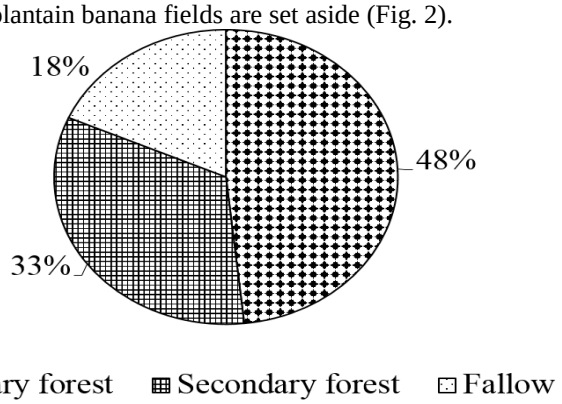

Fig 2. Plantain banana production site

Area of plantain fields, method of opening and time of planting plantain banana

The area of fields farmed by plantain banana varies from month to one hectare to 5 ha (Fig. 3). However, our results show that the majority of producers exploit an area ranging from 2 to 3 ha as expressed by 38.0% of respondents, followed by those who have 3-4 ha or 22.0% and 1 to 2 ha. Farmers who cultivate in less than 1 ha or more than 4 ha are fewer and represent only about 10% of respondents.

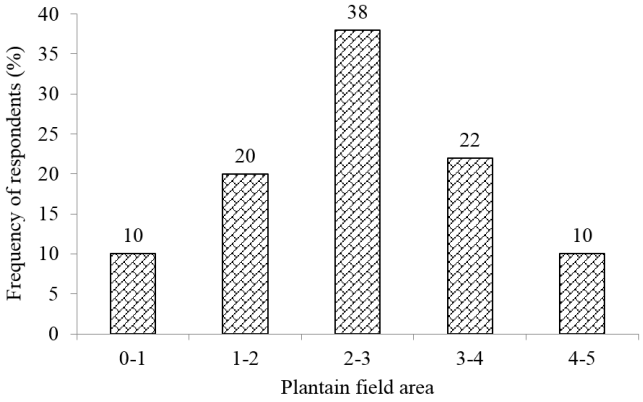

Fig 3. Areas of plantain fields operated by farmers

Regarding the opening of fields before the establishment of crops in general and plantains in particular, some farmers burn the field and others do not. Of these two practices, as shown by the result illustrated by Figure 4 A, burning is the most widely used method of opening the field and is practiced by 70% of respondents, unlike unburning, which is .scarce and is only present in about 30% of respondents. For the planting of plantain banana after opening the field, two planting periods have been recorded (Fig. 4 B): planting before and after burning. Thus, for the majority of respondents (67.0%) plantain banana suckers are planting after burning of the field, at the end of clearing and felling work, unlike the other 33.0% who report planting waste before burning, just at the end of clearing and felling.

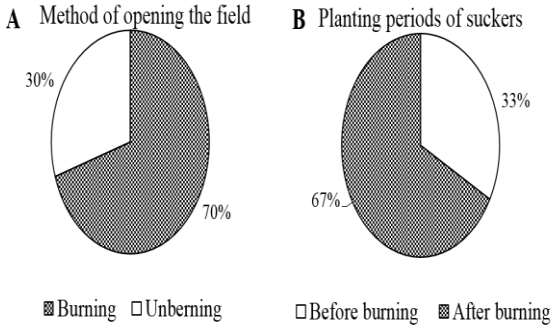

Fig 4. Method of opening the field (A) and time of planting plantains banana suckers (B)

Types of cropping and types of plantain banana intercropped

For plantain banana cropping, farmers usually do polyculture or monoculture. In our study area, almost all or 95% of the plantain banana fields are in polyculture and only a small minority of fields is cultivated in monoculture (Fig. 5). polyculture is appreciated for the diversity of production it offers, while monoculture aims at an important production intended for marketing according to our respondents.

Regarding crop associations with plantains (Table 2), our results show 11 important crop associations in the study area. Of these, the most important are plantain-maize, plantain-cassava, plantain-rice, plantain-maize-cassava-rice and plantain-cassava-rice. The plantain-cocoyam combination was found to be scarce in the area with a frequency of 3.3%.

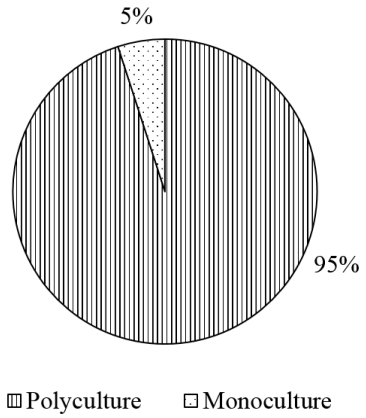

Fig 5. Type of plantain banana intercropped

Table 2. Types of cultural associations with plantains

Types of intercropping	Number Of fields	%
Plantain-maize	10	16.7
Plantain - cassava	10	16.7
Plantain - rice	9	15.0
Plantain - cassava - maize-rice	7	11.7
Plantain - cassava - rice	6	10.0
Plantain - rice -pineapple	4	6.7
Plantain - maize-rice	3	5.0
Plantain - sorghum	3	5.0
Plantain -beans	2	3.3
Plantain – ground nut	2	3.3
Plantain - sweet potato	2	3.3
Plantain-cocoyam	2	3.3
Total	60.0	100.0

Duration of plantain banana field

Regarding the duration of plantain field (Fig. 6), indicates that the majority of farmers (60%) exploit the plantain field for about 4 to 5 years before it is completely abandoned. Some exploit the field for 3 to 4 years (25%), while others acknowledge maintaining it from 2 to 3 (13.0%).

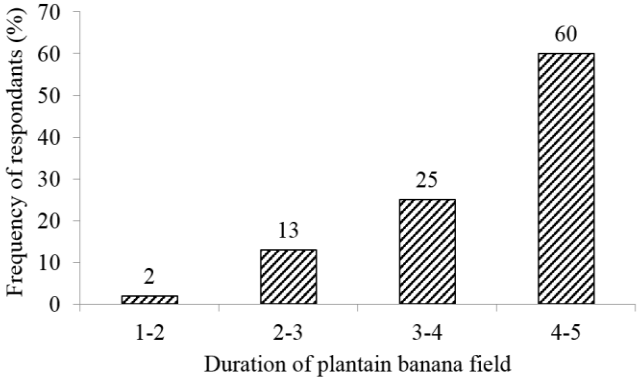

Fig 6. Duration of plantain banana field

Peasant techniques for sustainable banana plantain production

In the conduct of plantain banana cultivation, farmers use a few techniques that can allow them to maintain their fields for a long time (Table 3). These are mainly regular weeding, accumulation of plant debris around the tuft, maintenance of certain trees and destruction of diseased or attacked plants. Overall, all farmers (100%) use these techniques with the exception of the destruction of diseased or attacked plants which is practiced by 82.0% of respondents.

Table 3. Peasant techniques for sustainable banana plantain production

Peasant techniques used	Number of respondents	Number of practitioners	%
Regular weeding of the field	60	60	100
Accumulation of plant debris around the tuft	60	60	100
Keeping a few trees in the field	60	60	100
Destruction of diseased or attacked plants	60	49	81.7

Discussion

Main activities, priority crops and place of production of plantain banana

Our study showed that the main survival activity in these rural areas is agriculture, carried out by about 58% of respondents, followed by carbonization (25%), breeding 8.4%, hunting 5% and finally fishing 3.3%. The classification of agriculture as the first activity of survival of populations in the study area is justified by the wide availability of forest land for agricultural activities, the reopening of the road by the forestry company thus facilitating the evacuation of agricultural products, the absence of other activities generating significant income and the migration of Mbole populations in the region, who are naturally large farmers. Carbonization is the second vital activity favored by the reopening of the road; it supports the farmer while waiting for the production of the field.

As priority food crops in the region, our results indicate that Plantain banana occupy the first place, followed by rice, cassava and maize. The predominance of the plantain banana crop as well as that of three other crops is not only related to the favorable edaphic-climatic conditions, their important contribution to the self-consumption of households, but also and above all to the improvement of roads leading to these areas, which encourages farmers to produce more. The importance of plantains for rural populations has been mentioned by several authors. Kwa and Temple, (2019), report that in rural areas and by country, plantains occupy between first and fourth place in terms of food importance.

In terms of production locations, this study reveals that plantains are more cultivated in primary forest, then in secondary forest, and fallow is less exploited for this crop in the study area, the choice of forests (primary or secondary) for the cultivation of plantain banana is justified by the wide availability of forest land. In addition, the soils from forests are rich in nutrients and lead to significant production of plantain banana over several years before the total abandonment of the

fallow field. These results go in the same direction as those of Temple (1995) which reported that in Cameroon the large production of plantain banana comes from forests or 70% and against 30% of fallow.

Area of plantain fields, method of opening and time of planting plantain banana

The area of field sown for plantain banana in our study area varies from household to household. It varies from less than 1 ha to 5 ha. This large area attests to the importance of the of plantain banana for the populations of this area, whose plantains are an important source of income and are also the staple food. This situation is also favored by the importance of other crops in association including maize, cassava, rice for which the farmer plans to open large areas in order to hope to obtain large productions.

In terms of how fields are opened, two practices are commonly used by farmers before planting plantains suckers: the practice of burning and not burning. Burning is practiced by the majority of respondents, i.e. 70%, while non-burning is less frequent by 30%. Most farmers use the practice of burning to facilitate preparatory work before crops are planted. These works, mainly delimbing and skidding, which are expensive for the farmer, are therefore carried out by fire.

As for the time of planting plantain banana suckers, our results indicate that the majority, 67.0%, plant the suckers only after burning of the field, while 33.0% of respondents do so before burning. Farmers prefer to incinerate the field first before planting in order to have enough space for the establishment of suckers. In Cameroon, on the other hand, Temple (1995) reports that the majority of farmers (57%) grow on unburned and plantain banana are planting for the majority of cases after forest clearing.

Types of crops and association with plantain banana

Polyculture is the type of crop most practiced by the majority of farmers in the region and is justified by the concern to obtain a diversity of production in the same field while the monoculture rare in the localities, is practiced by those of farmers who aims to obtain large productions intended for marketing.

Regarding the type of association with plantain banana, our study shows that many farmers produce the plantain banana in association with one or more food crops. Of all the combinations, the plantain-maize, plantain-cassava, and plantain-rice combinations are the most dominant. The important place of these three crops associated (maize, cassava and rice) with plantain is justified by the fact that maize, cassava and rice are part of the staple foods in the area and also offer important incomes to farmers, which pushes them to grow them primarily in association with plantains. In addition, these three crops in combination produce good yields under the conditions of the study area. A great diversity of species associated with plantains are counted in different African countries: According to Kwa & Temple (2019), at least 18 crops in Cameroon, a dozen in Gabon and Congo, 5 speculations in Côte d'Ivoire, and 5 or 6 speculations in Guinea. The "plantain banana - food crops" systems are modular according to populations, eating habits, economic aspirations, natural potentialities and the dynamism of local populations.

Duration of banana plantain field and peasant techniques for sustainable production

In terms of operating time, most farmers (60%) exploit the fields of plantain banana until the total disappearance of the strains which occurs in 4 to 5 years, others claim to operate a banana plantation for 3 to 4 years. This long duration of exploitation is justified by the fact that plantain fields are installed for the most part in primary or secondary forests, in soil enjoying great fertility. In addition, some associations with plantains would have beneficial effects. Tutu et al., (2020) showed that plantain yield improves in plantain-cocoyam and plantain-cocoyam-groundnut combinations. In Ivory Coast, the total disappearance of plantain banana strains occurs between 2-3 years, but, if soil and pest factors are controlled, the cultivation can be at least 6 years old (Traore, 2009).

According to our surveys, four techniques are applied by plantain banana producers to maintain production over several cycles. These include regular maintenance of the banana plantation, keeping some trees standing, accumulation of plant debris around the tuft and destruction of diseased or attacked plants.

Conclusion

The aim of this research was to characterize the cultivation systems of Plantain banana on peasant farms around Kisangani. To achieve this, a semi-structured questionnaire was administered in the form of an interview to 60 plantain banana growers in 3 villages in the Alibuku region on the outskirts of Kisangani. The results obtained show that:

- Agriculture is the main survival activity in the study area, followed by carbonization. Plantain, cassava and maize are in descending order of priority crops planted mainly in primary or secondary forests.
- An area of 2 to 3 ha is devoted by the majority of farmers to plantain banana cropping. The opening of the field is mainly done by incineration and the plantain banana cultivation occurs for the most part after incineration.
- Polyculture dominates among the majority of plantain producers because of the diversity of production offered by the system. Plantain-maize, plantain-cassava and plantain-rice combinations are the most common.
- The maximum duration of exploitation of the plantain banana plantation can be 5 years before the disappearance of strains. In addition, the techniques put in place by farmers to ensure a more or less sustainable production of their farms are: regular maintenance of the plantain banana plantation, maintenance of certain standing trees, accumulation of plant debris around the tuft and destruction of diseased or attacked plants.

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