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Diversity and Importance of Peasant Cropping Practices of Millet *Pennisetum glaucum* (L) R.Br. in The Bambey Area

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ABSTRACT

In Senegal, the groundnut basin concentrates most of the agricultural production. Millet, the staple food of many rural families, faces many production difficulties, including biotic, abiotic, and cultural ones. To improve the millet production system in peasant areas, this study aims to evaluate the diversity of millet cultivation techniques in peasant areas. Agronomic surveys were carried out in 2015 and 2016 among 45 millet producers in the Bambey area. The analysis of the results obtained confirms a diversity of practices applied by producers, especially in terms of crop maintenance and the nature of the fertilization provided. The finding was that most millet producers place too little emphasis on best crop management practices, such as green manure, crop rotation, or animal manure. In the current context of climate change, especially with the scarcity of rainfall, practices should be reviewed and adapted to the essential and specific needs of the crop to optimize its yield.

INTRODUCTION

In Senegal, annual population growth is estimated at 2.7% (World Bank, 2019). Most of this population lives in rural areas and their main activity remains agriculture (ANSD, 2018). The agricultural sector mobilizes 77% of the active population (Jalloh and *al.*, 2013) and contributes 9.4% to the national GDP (ANSD, 2020). Cereals are the staple food of the population (60% of national consumption). The cereal crop consists mainly of millet, sorghum, maize, paddy rice, and fonio. Pearl millet has an average annual growth rate of the millet of 0.8% and alone accounts for 60% of the country's cereal production. (SARR, 2013; DAPSA, 2017). Production is insufficient and does not cover the food needs of the population, especially the rural population; This insufficiency thus confronts populations with periods of lean; there is often talk of scarcity and we observe, during these periods, a sudden surge in prices accentuated by speculation. However, millet production in Senegal presents significant development opportunities but faces many constraints, including those of a cultural nature. To contribute to the local development of millet cultivation, and by extension to strengthen its production through the development of good agricultural practice sheets for millet, this document highlights the diversity of peasant millet cultivation practices in the BAMBEY area.

METHODOLOGY

The study took place in BAMBEY in the northern part of the Groundnut Basin. The latter provides most of the agricultural production but millet remains one of the main crops in the area. Landscape analysis (THR processing of satellite images) was first performed to characterize land use (NDAO, 2015). Then, on a square area of 400km², centered in the locality of NDANGALMA, forty-five (45) plots of millet were chosen (Figure 1). These plots are at least 2 km apart. The choice was also based on a gradient of proximity to villages and the density of trees. The geographical coordinates of the plots were recorded in the center of the fields thanks to a GPS. The data relating to the village, the name of the producer, and his contact details were also noted (Producer sheets). In 2016, the same protocol was carried out for the selection of the 45 millet plots. The plots, therefore, remain unchanged if the farmer does not carry out a crop rotation, on the other hand, if a rotation is carried out, the nearest plot growing millet is chosen.

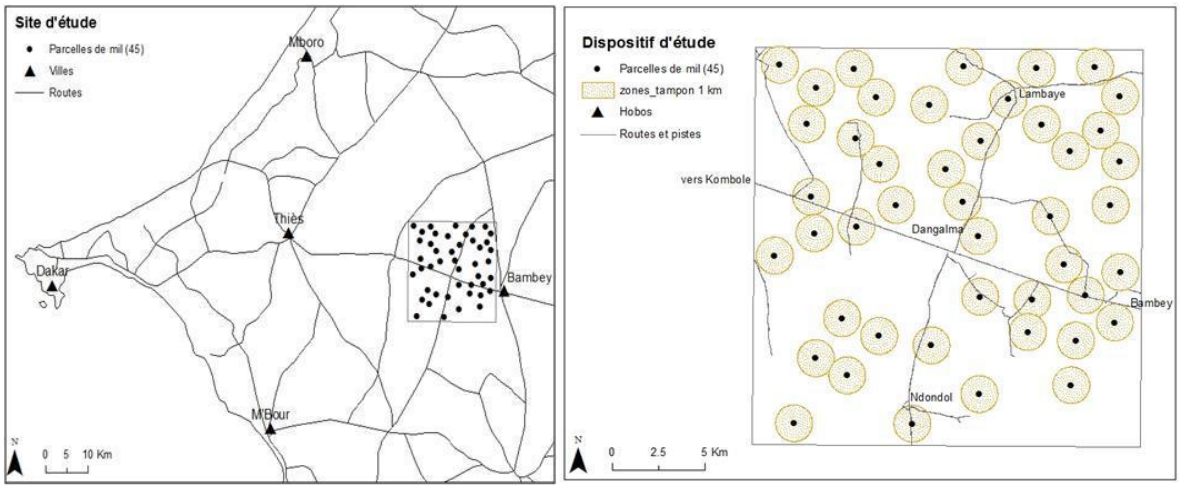

Figure 1 - Map representation of the sampling site

Agronomic surveys

In both 2015 and 2016, field expeditions were made to follow the conduct of the culture. Once in the field, a previously designed survey sheet made it possible to question each producer (Survey sheets). The investigations and follow-ups in the field concerned:

- The previous crop: the previous ones were considered to be the crop grown on the plot in the year preceding the survey (year n-1);
- The type and methods of soil preparation: this variable was determined taking into account the tool used by the producer;
- Variety: The nature of the variety chosen by the producer has been noted to verify whether the varietal map according to the locality has been respected;
- Seed treatment: this involves checking whether a pre-treatment has been applied to the seed before sowing;
- The method of sowing: it is here to note if the sowing was done dry or after a useful rain and the cases of re-sowing carried out;
- The dates of emergence and remarriage: these dates collected from producers will allow us to determine the intervention dates conducive to follow-up activities;
- Fertilization: the nature of the fertilization applied to each plot was noted;

- The number of weeding: the survey focused on the frequency of application of weeding;

Statistical analysis of the data

The data collected is entered using a mock-up with the EXCEL spreadsheet and then presented in the form of tables or graphs. For the analysis of the graphs on the diversity of peasant cultural practices, it is considered that the values recorded by the modalities are statistically different with a value of p-value ($p < 0,05$).

RESULTS

Previous crop

In 2015, the previous crops used are according to the producer's groundnut, millet, cebe, and fallow. Groundnut and millet are the most used with frequencies of 66.77% and 26.67%. Fallow and cebe are used by 2.22 and 4.44% of farmers.

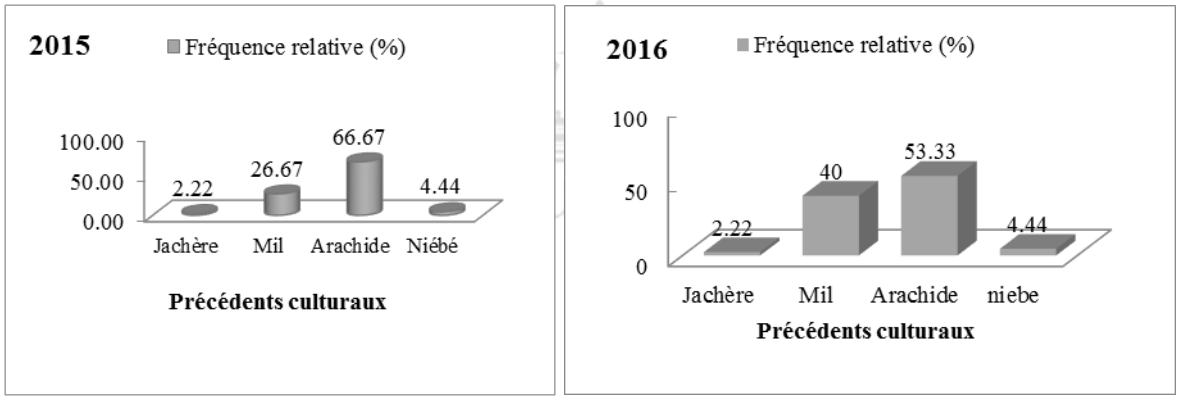

Figure 2: Diversity and frequency of use of previous crop cultivation in 2015 and 2016

In 2016, the same cropping precedents are encountered among farmers: groundnuts, millet, nepeta, and fallow. The adoption frequencies are 53.33 respectively; 40.00; 4.44 and 2.22%.

Soil preparation

For the year 2015, farmers resorted only to light scraping of the soil for the preparation of the seedbed. To do this, rakes, hilarious were used according to the availability for the peasant. On 40% of the plots, the farmers subsequently burned the residues. In 2016, various processes were carried out by producers for the preparation of their crop fields. The technique of cleaning with a

rake followed by the burning of residues is the most used and alone covers almost % of the plots. With the other modalities, we find: unprepared soils (4.44%); soils where only the cutting of shrubs (2.22%) or rake (2.22%) were applied; soils worked with hilar or rakes and where the residues were then burned (4.44%); soils on which plowing followed by simple scraping (2.22%) or burning of residues (2.22%) and; soils on which simple scraping, plowing and burning of residues are carried out.

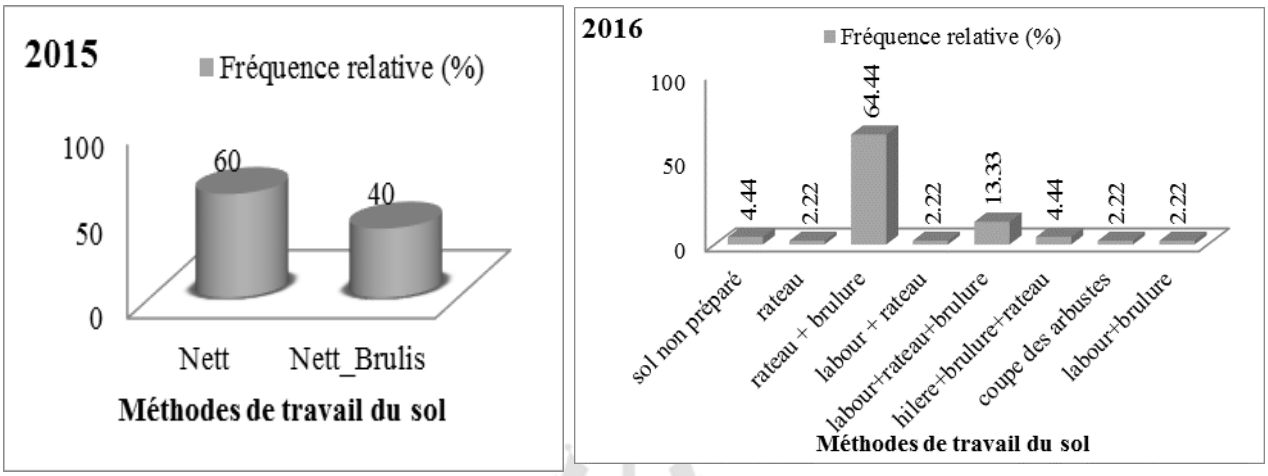

Figure 3: Diversity and frequency of application of tillage methods in 2015 and 2016.

The cultivated variety

The Souna variety of millet was used for all the farmers surveyed. Zoning was thus respected in both 2015 and 2016. Seed treatment In 2015, the analysis reveals a very low rate of use of previously treated seeds (9%).

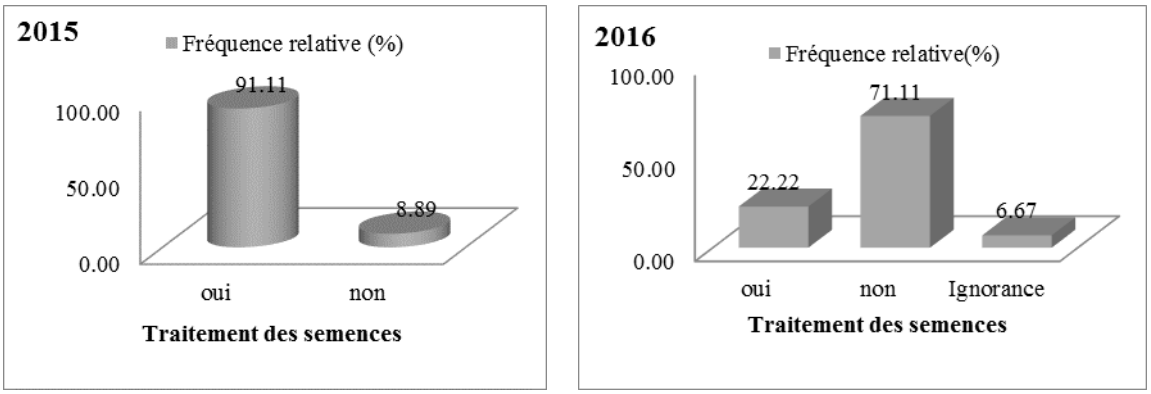

Figure 4: Frequency of seed treatment in 2015 and 2016.

In 2016, the rate of use of treated seeds remains low (22.22%). 6.67% of farmers could not distinguish between treated seeds and those that were not.

In 2015, dry sowing was adopted for all producers and the emergence was done uniformly. On the other hand, in 2016, wet sowing was carried out for 2.22% of the plots. For the rest, the sowing was done dry but with re-sowing carried out for 62.22% of the plots.

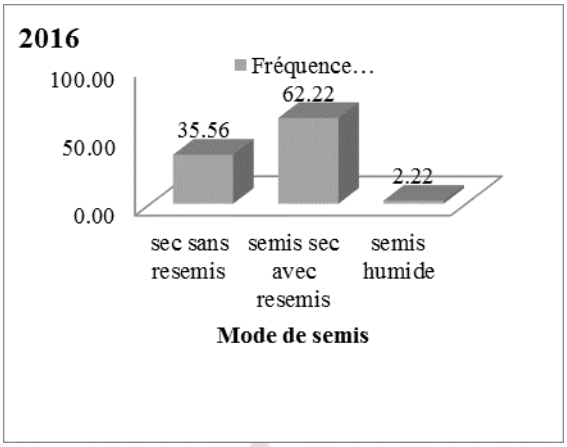

Figure 5: Sowing modalities in 2016.

Fertilization

In 2015, four groups of farmers stand out depending on the nature of the fertilization brought into the study plot. For 37.78% no fertilization method was used. For the rest of the producers surveyed, 22.22% applied mineral fertilizer, 24.44% of organic manure, and 15.56% considered it necessary to make a combination of these two methods for more complete fertilization.

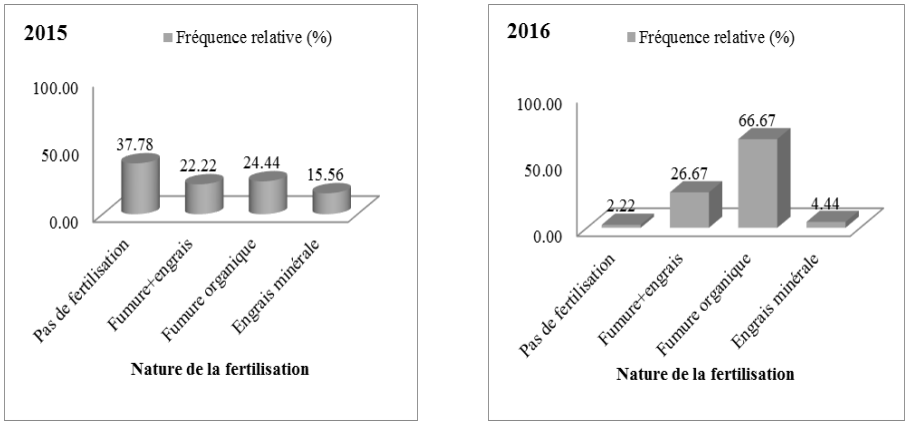

Figure 6: Frequency of use of fertilization types in 2015 and 2016.

In 2016, the same fertilization methods used in 2015 are found but with significantly different rates. Only 2.22% of farmers did not use fertilization. 66.67% applied organic manure alone compared to 4.44% for mineral fertilizer. Fertilization combining organic manure and mineral fertilizer was done on 26.67% of the plots.

The number of weeding

In 2015, the number of weeding varied from 1 to 3 times depending on the plot. Weeding twice was more used by peasants (91.11%).

In 2016, the number of weeding carried out the plots varied from 1 to 4 times depending on the producer. Weeding two (2) times and three (3) times were the most used modalities by peasants with relative frequencies of 60.00 and 24.44%.

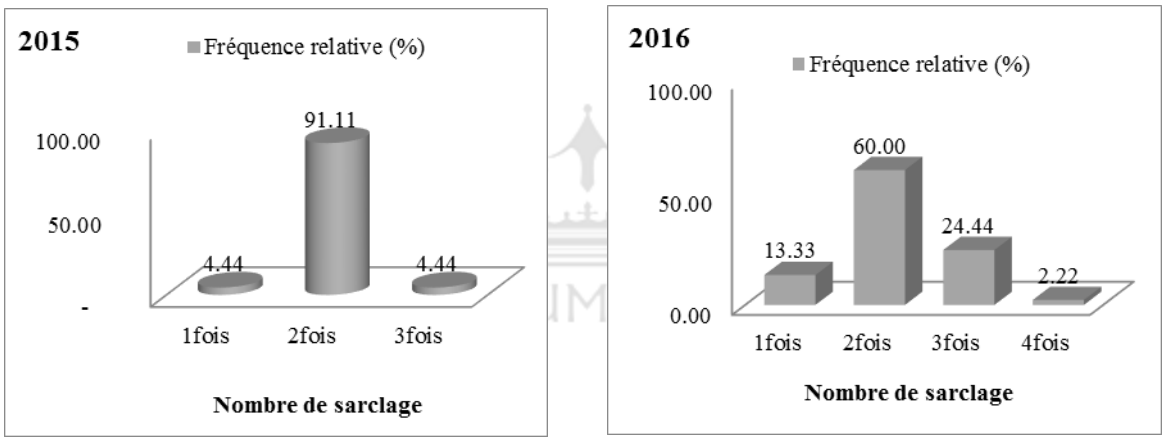

Figure 7: Number of weeding carried out by farmers in 2015 and 2016.

DISCUSSION

In a pleasant environment, diversification of cultivation techniques was observed during the expeditions. However, depending on the geographical position of the plots, the practices could be roughly grouped by zones. This reflects the level of fluidity of cultural information between neighbouring farmers who, through their experience, share methods that they consider more suitable for dealing with a given critical situation. This corroborates with the work of some authors who have been able to highlight the existence of social organizations influencing seed

exchanges and the transmission of knowledge around cultivated plants. (DELETRE and *al*, 2011 ; COOMES and *al*, 2015 ; OROZCO- RAMIREZ and *al*, 2016).

Compared to the previous crop, the cereal-legume rotation is very developed in the area and seems to have already proven itself with local producers so that more than half of the farmers surveyed applied it. The monoculture of millet is also very present. But with the latter, phytosanitary problems can manifest themselves especially if a good preparation of the soil is not carried out before the next agricultural season. Fallow land remains very weakly applied; this could be linked to the strong demographic pressure exerted on land. The acceleration of the cultivation of certain marginal lands can have disastrous consequences for the environment, due to the continuous degradation of soils. This comforts the ideas of BATIONO and SOMDA who in 1997 already reported that African agriculture has always been characterized as mining agriculture in that it takes more nutrients from the soil each year than it returns to the soil. In the absence of being able to re-adopt the current practice of fallow land, in this work Gaye considers that the groundnut-millet rotation on the plots is the main mode of soil fertility management (Gaye, 2008).

Compared to tillage, in rural areas, practices are constantly evolving. The work tools used do not offer a great diversity (rakes, hilarious, plows), but the applications differ as long as a multitude of peasant processes are born. The high cost of fuel and production, awareness of soil conservation pushes producers to change their way of doing things. Despite this diversity, the work carried out is superficial associated or not with the burning of residues; they thus correspond to slight scratching or "pseudo-plowing". The depth of action of the work tools is of the order of ten centimeters and we seek to destroy weeds and regrowth, to promote the humification of organic matter (GUILLEMAN and *al.*, 2003). This way of doing things of the peasants presents risks for the good conduct of the culture. Indeed, in soil preparation processes, it is essential to take into account the cultural precedent, the type and condition of the soil as well as the climate. This requires significant technical and financial resources to decide adequately on the appropriate tillage method for the plot to be cultivated.

Since zoning is respected in the choice of varieties, why is prior seed treatment lacking ? For the majority of farmers, the cultivated seeds are not bought, they come from the stocks of the previous harvest. However, even if a chemical treatment is not applied, farmers sort the grains

and choose the best ones for sowing. Dry sowing is a practice very present among farmers. However, with the current climate change context, the risk of re-sowing is very high with the "false starts" of rains that continue to increase. In general, the use of organic products to fertilize crops and/or amend soils is particularly interesting from an economic point of view (increase in the price of mineral fertilizers) but also from an agronomic point of view, because the addition of organic amendments contributes to improving the organic status of soils, with all the beneficial effects it entails (fight against erosion, maintenance of a good structure, carbon storage, increase in biodiversity...).

In addition, the use of organic waste (such as composts of green waste) makes it possible to recover them by recycling them via agricultural soils (LECLERC, 2009). However, at the level of peasant plots, the application of fertilization is in principle the economic status of the peasant. This explains the low use of mineral fertilizer (15.56 and 4.44%) observed with our results. The application of organic fertilization based on manure (cow dung, horse and oak droppings, ...) very present (+66%), is also very interesting for the culture in terms of restoring soil fertility. In the literature, it has been shown that a contribution of manure, composted or not, enriches the soil with nitrogen, sulfur, phosphorus, potassium, magnesium, and trace elements. They are often the best source of fertilizer available to the grain farmer. And, according to Leclerc: "organic fertilization is integrated and reasoned at the scale of the cultural succession, with a place of choice for legumes that make it possible to significantly enrich the system with nitrogen".

In terms of weeding, the number of weeding carried out by farmers is not static and depends on the level of grass cover of the plot. This practice remains limited by the lack of manpower, especially if the concessionaire owns several plots; thus, it can very often be applied at a not very adequate period.

CONCLUSION

In a pleasant environment, the very diversified cultivation practices of millet reflect a complex peasant knowledge. The finding was that most millet producers place too little emphasis on best crop management practices, such as green manure, crop rotation, or animal manure. These practices are important to prevent soil depletion, improve soil fertility, and increase productivity and ensure a good yield. These difficulties reflect the upstream existence of socio-economic

problems, in particular the lack of appropriate agricultural equipment, proven cultivation techniques, and the lack of agricultural inputs. Added to this are the obsolescence of agricultural equipment used in rural areas and the unavailability of an appropriate workforce. It would also be interesting to understand the how and why of each peasant method and to put oneself at the "school of peasants" for a contribution of knowledge and external techniques well adapted to the concrete situations of rural people.

In addition, with the decrease in the rainy season and the poor distribution of rainfall, agricultural practices must be reviewed and adapted to new climatic conditions to ensure farmers' effective solutions for the proper management of their crops.

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