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Characterization of Millet [Pennisetum Glaucum (L.) R. Br] Cultivation in The Sylvopastoral Zone in Northern Senegal

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Summary

The challenge of self-sufficiency in cereals is a major concern for the Government of Senegal. Millet is the basic food of Senegalese households. Therefore, the promotion of millet cultivation in all favorable ecosystems is a way to increase millet production and contribute to food self-sufficiency. In the sylvopastoral zone in northern Senegal, pastoral livestock production associated with millet cultivation constitutes an economic resilience strategy for pastoral households in the face of climatic risks and food insecurity. However, in this area, millet cultivation is not well known and is neglected to the detriment of pastoral livestock development. This characterization study of millet cultivation aims to assess the current state of millet cultivation in order to propose a strategy for improvement. The data were obtained from a random sample of 339 households in 32 villages. The results show that the heads of households are over 40 years of age, are mostly male and of the Peulh ethnic group, and are mostly married. Pastoral livestock is the dominant economic activity, with 62 cattle and 102 small ruminants per household. Agriculture is the second most important economic activity and is mainly dominated by millet. Millet is cultivated on an average area of 2.64 ha per household in the areas where animals are kept around the homes. The main method of preparing the plots is to clear the brush. Dry, flat sowing is practiced during the mid-June period using manual equipment. Improved seeds are rarely used because of their inaccessibility, to the detriment of crop reserves and off-the-shelf seeds. Chemical fertilizer is not used. Organic fertilizer is mainly used in areas where livestock are kept. Manual weeding is mainly practiced by pastoralists. Millet cultivation face biotics, abiotics et socio-économics constraints. The average yield obtained is 815 kg/ha per household, with a maximum of 1940 kg/ha. Millet is also mainly used for food, and is exchanged in the form of barter for food and non-food products. The average annual income from millet is estimated at 123,000 FCFA per household. The policy implication of this study is that support for the development of millet cultivation in the sylvopastoral zone can contribute to the resilience of pastoralists and to the country's cereal food self-sufficiency.

Key words: millet crop, characterization, silvopastoral zone, Senegal.

1. INTRODUCTION

Millet (Pennisetum glaucum L. R. Br) is a cereal that is used for both human consumption and animal feed in arid and semi-arid areas of Africa and Asia (Haussmann et al., 2006). In Africa and India, millet grains are used to prepare many traditional dishes. Africa provides 40% of the world's millet production, where nearly 500 million people on the continent depend on it (Saidou, 2011). In Senegal, millet is the second

most consumed cereal after rice. On average, per capita consumption is estimated at 30.2 kg/person/year and is higher in rural areas with 53.3 kg/head/year against 23.1 kg/person/year in urban areas (IPAR, 2017). In Senegal, millet occupies 75% of the cultivated area and accounts for 60% of cereal production (MAER, 2001; CRES, 2016). National millet production reached

1,144,775 tons in 2020 (DAPSA, 2020). However, yields are still low (750 kg/ha). The low yields are due to a combination of abiotic factors (rainfall deficit, soil poverty, rustic and unproductive local material), biotic factors (insect pests, diseases, weeds) and inadequate cultivation practices (Kouakou et al., 2013). To increase productivity and cereal production, particularly of millet, Senegal has implemented a flagship program to promote three cereal corridors (millet, rice, maize). Achieving this program requires the promotion of cereal crops, particularly millet, in all favorable agro-ecological zones. In this pastoral area, agriculture, particularly millet, is increasingly practiced by pastoralists as a resilience strategy in the face of the increasingly unfavorable climate (Dianguar, 2004). Millet represents 95% of the cultivated area and serves several functions: food consumption, exchange in the form of barter for rice, groundnuts, and manufactured products) and diversification of income sources (Ba, 2015). Despite its importance in securing the livelihoods of pastoral households, little information is available on millet cultivation in the pastoral zone known as Ferlo in Senegal. There is very little support for the promotion of millet cultivation among pastoralists. All interventions are oriented towards supporting the development of pastoral livestock. In addition, most of the studies conducted in this zone focus on livestock production, which remains the main activity. In this context, improving millet cultivation techniques in the sylvopastoral zone could increase yields in a context of climatic variability and contribute to strengthening the resilience of pastoralists. The objective of this study is to analyze millet cultivation practices in the southern part of the sylvo-pastoral zone of Senegal.

2. MATERIALS AND METHODES

2.1 Description of the study site

The study was conducted in the Ferlo silvopastoral zone of the Matam region in northern Senegal (Figure 1). The Ferlo area of Matam belongs to the vast Ferlo Basin area, which covers one-third of the national territory and spans five (5) administrative areas. In the Matam region, the Ferlo is the largest of the three (3) agro-ecological zones of the region (Ferlo, Diéry and Dande maayo). It covers 2/3 of the regional territory but has less than 10% of the population. It is subdivided into three (03) sub-zones: North Ferlo, South Ferlo and East Ferlo. The area has a relatively flat relief with lateritic soils in most of its space, and sandy in its western part. The climate is marked by two seasons: a dry season that runs from November to June and a rainy season that runs from June to October. The average annual rainfall is about 300-450mm. Maximum temperatures can reach 40 to 50°C. The vegetation cover is essentially made up of thorny plants and a large herbaceous carpet, dominated by various annual grasses. The hydrographic network includes surface water resources (ponds) and groundwater (wells and boreholes) captured at a depth of between 200-300m. More than 80% of the Ferlo de Matam territory is in the classified domain, either in the sylvopastoral reserve or in the wildlife reserve. Extensive livestock farming is the dominant economic activity and accounts for 80% of household income (WFP, 2013). Cereal crops (millet, sorghum and maize) and the exploitation of harvested products (gum arabic, jujube, firewood) come in second place. Cereals and milk constitute the staple diet of the population.

Figure 1 : Study site (CSE, 2018)

2.2 Sampling method, data collection and analysis

The data collected come from a survey of 339 households in the sylvopastoral zone. The survey was organized as a two-stage random sample: (i) at the first stage, villages were selected from a first random draw, a total of 32 villages were selected; (ii) at the second stage, households in each village were selected from a second random draw. In each village, 11 villages were randomly selected and the head of each household was surveyed using a questionnaire. The information collected at the household level related to socio-economic characteristics, millet production and storage inputs and techniques, millet yields and income, and (iv) production constraints. The information was recorded and analyzed using STATA software. Data were collected through interviews using a structured open- and closed-ended questions and focus group discussions. Leaders of farmers' organisations in each village were involved in facilitating focus group discussions and administering the questionnaires. The questionnaires were pre-tested before conducting the actual data collection from farmers. The pre-test was undertaken to streamline the questionnaire and avoid ambiguous questions and improve the clarity of questions. Qualitative data sets collected through the questionnaire were coded into district categories and subjected to statistical analyses using the STATA. Cross-tabulations were computed, tables were constructed, and descriptive statistics were performed to summarise data from the questionnaires and focus groups discussions.

3. RESULTS ET DISCUSSIONS

3.1 Results

3.1.1 Sociodemographic description of respondents

The results in Table 1 show that the average age of the head of household is 46 years with a minimum of 18 years and a maximum of 89 years. The average household size is estimated at 16 persons, including 9 children, 4 adult women and 3 adult men. The majority of household heads are men (95%). In addition, 95% of those surveyed are of the Fulani ethnic group and 100% are Muslim. It should be noted that 96% of the heads of households are married, while those who are single are not. Widowers and divorcees represent 4%. Among the married, 58% are monogamous and 39% polygamous. In the area of education, only 3% of heads of household are enrolled in school, and of these, 96% have not gone beyond

the primary level. Thus, 37% of heads of household are literate and 31% report having received training.

Table 1: Sociodemographic description of respondents

Variables	Means
Age of household head	46
Family members	
Household size	16
Child	9
Adult male	4
Adult woman	3
Sex of household head (%)	
Male	94
Female	5
Ethnic groups (%)	
Peulh	95
Wolof	3
Maure	2
Religion (%)	
Islam	100
Marital statut (%)	
Maried	97
Single	1
Widowed	3
Education level (%)	
Educated	3
Primary school	3
Secondary school	0,29
Literacy	37
Taille cheptel (nombre)	
Cattle	36
Small Ruminants	102

Source : Authors

3.1.2 Pearl Millet plot characteristics and access to inputs

Table 2 : Land and inputs use

Variables	Means
Mode of access to land(%)	
Inheritance	74
Ownership after clearing	22
Others	6
Soil type (%)	

Variables	Means
Sandy	84
Sandy-clay	11
Others	5
Topography of plot (%)	
Flat	80
Gentle slope	16
others	4
Soils degradation s (%)	
Winder erosion	26
Water erosion	6
No degradation	68
Seeds use (%)	
Improved seed	76
Local seeds	18
Common seed	6
Seeds supply (%)	
Own supply	74
Weekly markets	16
Aids	10
Type of fertilizer used (%)	
Chemical fertilizer	-
Organic fertiliszer	100
Labor composition (%)	
Child	22
Adulte male	47
Adult female	31

Source : Autors

3.1.3 Millet cultivation pratices adopted by pastoralists

Tables 3 and 4 indicate the level of knowledge and use of agricultural practices and equipment. For the preparation of plots prior to planting, almost all of the respondents know about brushing and clearing, but the majority use clearing (83%) versus brushing (58%). The most commonly known agricultural equipment used for brushcutting is the axe, the cutter, and the rake. The majority of pastoralists (89%) practice manual seeding as opposed to 22% who practice mechanical seeding (with the seeder). Manual weeding is practiced by 92% of pastoralists using the hilar and the daba, while 19% practice mechanized weeding and use the hoe. The harvesting of standing millet ears using knives and cutters is practiced by the majority of pastoralists. Threshing and shelling by hand (with a pestle and mortar) are practiced by 91%. These operations are carried out by women. Only 11% use mechanical threshing and shelling. Most pastoralists store millet ears in granaries, while millet grains are kept in sacks inside the concessions.

Table 3 : Agricultural equipment known and used by pastoralists in millet production

Agricultural practices	Agricultural equipment	Known (%Yes)		Used (%oui)	
		Mean	standard deviation	Mean	standard deviation
Plot preparation	Rake	97	16	92	27
	Cutter	96	20	88	33
	Axe	97	16	92	27
Seedling	Seeder	94	23	22	42
	Stake	94	24	10	30
Weeding	Hoe	97	16	81	39
	daba	98	15	86	35
Harvest	Cutter	95	22	86	35
	Knife	97	16	85	36
Threshing and shelling	Pestle and mortar	98	15	91	28
	Threshing machine	82	38	11	32
Storage	Bags	93	26	39	49
	Granary	97	16	91	29

Source (nos enquêtes)

Table 4 : Agricultural methods known and used by pastoralist in millet production

Agricultural operations	Agricultural methods	Known (%Yes)		Used (%Yes)	
		Mean	standard deviation	Mean	standard deviation
Preparation of the plots	Burning	94	25	58	49
	Clearing	97	17	83	37
Sowing	Manual	97	16	89	31
	Mechanized	95	22	7	25
Weeding	Manual	98	14	92	27
	Mechanical	69	46	19	39
Fertilization	Cattle parking	95	22	92	42
Threshing/stripping	Manual	98	15	91	28
	Mechanical	82	38	11	32
Storage	Closed environment	98	14	90	30
	Open area	93	26	13	33

Source : Autors

3.1.4 Yield and income from millet production

The average millet yield obtained by households is estimated at 815 kg/ha with a maximum of 1.940 tons. Millet production in Ferlo has a number of functions: (i) as a food source for the household; (ii) as a source of income, with an average annual income of 123,605 CFA francs per household; (iii) as an exchange function: millet is exchanged in the form of barter with rice

and groundnuts; and (iv) as a function of livestock capitalization: income from millet cultivation allows households to reduce the volume of livestock destocking. Also, thanks to the income from millet cultivation, households purchase livestock to increase their numbers.

Table 5 : superficie, rendement et revenu généré par le mil au niveau ménage

Caractéristiques	Mean	Standart deviation	Min	Max
Area (ha)	2,64	1,21	0,5	6
Yield (kg/ha)	815	461	-	1 940
Income (FCFA)	123 605	101 696	-	665 000

Source : Autors

3.1.5 Contraints

The constraints inventoried that limit the production of millet-based cropping systems are multiple and varied, and essentially concern biotic constraints (diseases, insects, weeds), abiotic or environmental constraints (soil, water, nutrients) and socio-economic constraints. Downy mildew caused by a fungus Sclerospora graminicola and smut caused by Tolyposporium penicillariae are the main biotics of millet. Insects are almost present in all the plots monitored. However, cantharids such as Cantharis fusca were the most frequently mentioned by farmers because of the damage they cause to the ears. The irregularity and poor distribution of rainfall and wind erosion are cited by most pastoralists as abiotic constraints. Difficult access to seeds and chemical fertilizers distributed by the government because of the zone's isolation, as well as the lack of agricultural equipment and materials, are the main socio-economic constraints cited by most pastoralists.

3.2 Discussions

3.2.1 Sociodemographic description

The study revealed that in the zone it is mostly men who are heads of household. The limited number of female heads of household reflects the reality of the country in general and the Ferlo zone in particular, where tradition, religion, and ethnicity mean that the man is the de facto head of household. In addition, marital status is strongly influenced by the Fulani ethnic group and the Muslim religion. In fact, marriage represents a divine consecration and an obligation for the Fulani and Muslims. In addition to conferring an important social status on the couple, it constitutes a means of protecting the woman. The average age of the respondents was 40 years and almost all were married, an appropriate and active demographic group for decision-making on agricultural operations and participation in the local economy. In the African tradition, age and marital status are highly influential characteristics for decision making such as crop type and variety, which has a direct impact on millet production pearl millet production. Souleymane (2016) showed that it is the farmers in the age group of 45 to 70 years that tend to adopt the new varieties of millet seeds.

The study showed that the size of households is 16 people, this may have implications on the execution of cultivation operations and the areas cultivated. This may have implications for the execution of cultivation operations and the area cultivated. Indeed, larger households have a larger labor force, which allows for faster cultivation operations and greater area cultivated. Most subsistence farming operations are carried out by family members (Ellis, 1993). Households with many family members can perform a variety of agricultural operations, especially during the harvesting and processing season when labor is

scarce (Mrema *et al.*, 2016). Large family households therefore have the advantage of being able to farm on larger areas. The study showed that most respondents are not educated, which may have implications for access to and use of improved seeds and good agricultural practices. According to Rouamba et al (2021), farmers with limited formal education are often reluctant to adopt new technologies and showed a strong tendency to rely on traditional knowledge and experience. Farmers with little or no education are generally passive, dependent on the information they receive, and are not proactive in participatory approaches to finding solutions (Rahman and Yamao, 2006).

3.2.2 Pearlet millet plots description

Almost all pastoralists use local varieties of souna millet. This result is explained by the fact that pastoralists live in remote areas that are difficult to access during the winter months. They often do not have access to extension services and are not in the loop to obtain new seed varieties. Bishaw (2004) points out that local varieties are often highly adapted to their agroecology, perform relatively well in marginal environments with minimal inputs, and have been selected for their culinary qualities appropriate for traditional food preparation. However, many of these varieties have low yield potential and lack uniformity compared to improved cultivars selected for yield. Rouamba *et al.* (2021) showed that in the south-central and northern regions, 80 and 97% of farmers, respectively, were growing local varieties, due to limited research support for millet compared to other major crops such as maize and rice. In Niger, a study conducted by Souleymane (2016) showed that 55% of farmers surveyed did not know the popularized millet varieties. The same study showed that 77% of producers do not use the popularized millet varieties because of the availability of improved millet seed. Adoption of improved varieties is limited by the cost of seed and lack of access to seed by local farmers. In addition, improved varieties often do not meet culinary quality criteria (Omanya, 2007).

3.2.3 Agricultural practices contraints

The study showed that in the sylvopastoral zone of the Department of Ranérou, millet is grown in the hutment fields, particularly in the areas where cattle and small ruminants are kept. This choice by pastoralists is explained by the fact that the hutment fields benefit from soil fertility management through the use of animal manure (Muller *et al.*, 2015). In addition, parking animals in the fields around the huts also makes it easier to monitor the animals. The majority of millet cultivation in the zone is justified by the fact that the millet plots located in the areas where the livestock are kept maintain good fertility. In addition, the size and low density of the area mean that pastoralists have no space constraints for other crops. Millet is grown both as a pure monoculture and in association with other crops, unlike other millet-growing areas in the country where loss of land fertility and space constraints mean that millet is grown in association with cowpeas and sorghum (Diangar et al., 2004).

Farmers allocated between one and three hectares of land to millet production. The low area cultivated in the area can be explained by the fact that pastoralists give more priority to livestock production and by the adverse effects of climate change, constraints on access to agricultural inputs and equipment, and poor research support (Sall et al., 2010). In Africa, small farms of less than 2 ha represent 80% of all farms (Nagayets, 2005). The lack of chemical fertilizer can be justified by the use of organic manure for livestock, but also by its high cost and inaccessibility due to the difficulties of accessing the area during the winter. In the zone, millet remains the dominant crop, as it is the staple food of households. The low level of use of improved seeds is justified by the inaccessibility and poor distribution of these seeds in the zone. The average millet yield obtained by households is estimated at 815kg/ha, which is slightly higher

than the national average of 811 kg/ha (ANSD, 2014). This level of yield can be explained by the good quality of the soil. Indeed, the crop plots are mostly planted in fallow soils fully covered with organic manure. In addition, there is little pest pressure. Lack of access to financial resources, land tenure policies, and the high cost of fertilizer exacerbate the shortage and lack of fertilizer inputs. Suboptimal fertilizer use by farmers in marginal environments has also been reported across Africa (Lubadde, 2016). Land scarcity, lack of access to extension services, lack of land tenure leading to lack of access to financial credit, and high labor costs have previously been reported as constraints to pearl millet production (Dawud et al., 2017; Lubadde, 2016).

4. Conclusions

Millet is the staple food of households in the sylvopastoral zone of the Matam region. It occupies a significant portion of the cultivated area. However, its production is still traditional, with almost no use of improved seeds or chemical fertilizers. Also, access to agricultural equipment is problematic, as evidenced by the low level of mechanization of cultivation operations, which are often manual. Despite these constraints, yields are equivalent to the national average. The environment for millet production also remains difficult, given the constraints of access to rural infrastructure. Given the importance of millet in the food security of pastoral households, support measures need to be developed by the political authorities to overcome the constraints. This will include facilitating access to agricultural inputs and equipment and providing training for producers. Promoting millet cultivation in the Ferlo region can help build a genuine cereal food security strategy in Senegal.

5. References

ANSD. 2014. Recensement général de la population, de l'habitat, de l'agriculture et de l'élévage.

BA Birahim. 2015. Evaluation socio-économique de l'impact des unités pastorales réalisées par le PRODAM dans le Ferlo de la région de Matam. Mémoire de niveau Master. Ecole nationale supérieure d'agriculture, Thiés, Sénégal.

Badiane AN. 1988. Courbe de réponse à des doses croissantes de fumier (Thilamkha), essai de travail du sol (Sole III nord, CNRA de Bambey), essai de régénération des sols diémane : résultats 1987. ISRA, CNRA, Bambey.

Banik P, Sasmal T, Ghosal PK. et Bagchi DK. 2000. Evaluation of mustard (Brassica compestris var.Toria) and legume intercropping under 1:1 and 2:1 row-replacement series systems. Journal Agronomy and Crop Science.

DAPSA. 2015. Direction de l'Analyse et de la Prévision des Statistiques Agricoles. Sénégal. Revue conjointe du secteur agricole.

Diangar S, Fofana A, Diagne M, Yamoah CF. et Dick RP: 2004. Pearl millet-based intercropping systems in the semiarid areas of Senegal. African Crop Science Journal, Vol. 12. No 2.

Govindaraj M, Shanmugasundaram P, Muthah AR. 2010. Estimates of genetic parameters for yield and yield attributes in elite lines and popular cultivars of India's pearl millet. African Journal of Agricultural Research, 5(22): 3060-3064.

Haussmann BIG. 2007. Données récoltées dans la base de données du Programme de sélection du mil à l'ICRISAT.

Haussmann B., Boubakar A., Boureima SS et Vigouroux Y. 2006. Multiplication and preliminary characterization of West and Central African Pearl Millet Landraces. SAT ejournal / ejournal.icrisat.org. Vol 2.

Initiative Prospective Agricole et Rural (IPAR). 2017. Etude sur la consommation des céréales de base au Sénégal. Rapport de recherche.

Ndoye AT., Gupta SC. 1987a. La culture du mil face aux contraintes de l'agriculture intensive au Sénégal. *In :* International pearl millet workshop, 7-11 avril 1986. ICRISAT.

MAER. 2001. La culture et la production du mil et du sorgho au Sénégal : Bilan-diagnostic et perspective.

Muller B, Lalou R, Kouakou P, Soumaré MA, Bourgoin J, Dorégo S, Sine B. 2015. Le retour du mil sanio dans le Sine : Une adaptation raisonnée à l'évolution climatique, p 377-401. In Les sociétés rurales face aux changements environnementaux en Afrique de l'Ouest, Conférence ESCAPE, 29-30 janvier 2015, Université Pierre et Marie Curie, Paris

Norman DW. 1974. Rationalizing mixed cropping under indigenous conditions: the example of northern Nigeria. Journal of Development Studies.

Saïdou A. 2011. Etude moléculaire, évolution et caractérisation de gènes impliqués dans l'adaptation du mil [Pennisetum glaucum (L.) R. Br.] aux changements climatiques. Thèse de doctorat, Montpellier SupAgro, Montpellier

Sall M, Gafsi M, Bonnaissiux A. 2010. Les systèmes de production dans la région de Kolda : Dynamique des innovations à travers l'aviculture villageoise. Montpellier, France

Smith IF. 1996. Sorghum and millets: Proceedings of the Symposia. International Association for Cereal Science and technology, Vienna, 171197.

Upadhyaya HD, Reddy KN et Gowda CLL. 2007. Pearl millet germplasm at ICRISAT genebank-status and impact. SAT ejournal / ejournal.icrisat.org. Vol 3.

Souleymane A. 2016. Adoption des semences améliorées du mil et de niébé dans le département de Damagaram Takaya, Région de Zinder. Mémoire de fin d'études. Université Abdou Moumouni, Faculté d'Agronomie.

Ellis, F. 1993. Peasant Economics: Farm Households in Agrarian Development; Cambridge University Press: Cambridge, UK, Volume 23. 26

Mrema, E.; Shimelis, H.; Laing, M.; Bucheyeki, T. 2016. Farmers' perceptions of sorghum production constraints and Striga control practices in semi-arid areas of Tanzania. Int. J. Pest Manag, 63, 146–156. [CrossRef]

Rahman, M.Z.; Yamao, M. 2006. Farmers' Attitudes towards Participatory Resource Management for Sustainable Farming Development: A Study from Bangladesh; Hiroshima University: Hiroshima, Japan, pp. 632–639

Omanya, G.; Weltzien, E.; Sogodogo, D.; Sanogo, M.; Hanssens, N.; Guero, Y.; Zangré, R. 2007. Participatory varietal selection with improved pearl millet in West Africa. Exp. Agric., 43, 5–19. [CrossRef]

Nagayets, O. 2005. Small farms: Current status and key trends. In Proceedings of the Research Workshop Wye College, Wye, UK, 26–29 June; p. 14.

Dawud, M.A.; Angarawai, I.I.; Tongoona, P.B.; Ofori, K.; Eleblu, J.S.; Ifie, B. 2017. Farmers' Production Constraints, Knowledge of Striga and Preferred Traits of Pearl Millet in Jigawa State, Nigeria. Glob. J. Sci. Front. Res. D Agric. Vet, 17, 1–7

Lubadde, G.; Tongoona, P.; Derera, J.; Sibiya, J. 2016. Production determinants of the pearl millet cropping system in Uganda and implications to productivity. J. Agric. Sci, 8, 97–111. [CrossRef]

Rouamba, A.; Shimelis, H.; Drabo, I.; Laing, M.; Gangashetty, P.; Mathew, I.; Mrema, E.; Shayanowako, A.I.T. 2021. Constraints to Pearl Millet (Pennisetum glaucum) Production and Farmers' Approaches to Striga hermonthica Management in Burkina Faso. Sustainability, 13, 8460. https://doi.org/10.3390/ su13158460

Centre de Recherche Economique et Social. 2016. Adoption et impacts de l'utilisation de semences de qualité et de paquets technologiques améliorés de mil diffusés dans le bassin arachidier, le Sénégal oriental et la haute Casamance' Rapport final-CRES.