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CUSTODIAN FARMERS OF BAMBARA GROUNDNUT AND SORREL SEEDS IN MOSSI AREA OF BURKINA FASO: PROFILE, DIVERSITY AND CONSERVATION METHODS

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ABSTRACT

The conservation and preservation of landraces genetic resources are of utmost importance in securing sustainable food security, especially in the face of significant global changes. This study aimed to identify and profile custodian farmers dealing with the preservation of two neglected and underutilized crops, Bambara groundnut/ (*Vigna subterranean*) and sorrel (*Hibiscus sabdariffa*), and explore their conservation strategies in Burkina Faso. Through gender-disaggregated focus group discussions, 68 custodian farmers were identified across 11 villages, with a majority being female. Individual semi-structured interviews were then conducted to gain insights into the seed conservation techniques employed by these farmers. The study revealed that custodian farmers employed various techniques, such as utilizing cooking pot, canaries or ash, to conserve seeds. Seed exchange emerged as a common practice among custodian farmers, playing a significant role in enriching seed diversity and fostering social cohesion within local communities. Among the identified custodian farmers, 40 were conserving Bambara groundnut seeds, while 28 were custodians of sorrel seeds. They range in age from 30 to 105, and some of them have owned their landrace for over 80 years. Nineteen (19) landraces of Bambara groundnut and six (06) landraces of sorrel were identified across the villages. Overall, these findings underscore the necessity for further research to better comprehend the factors influencing the distribution and maintenance of traditional landraces as well as the diversity of conservation methods used. They also emphasize the importance of developing effective conservation strategies that engage local communities to ensure global food security.

Keywords: *biodiversity conservation, custodian farmers, crop diversity, orphan crops, Burkina Faso*.

INTRODUCTION

Conserving the genetic diversity of crops is crucial to ensuring food security for rural populations and promoting agricultural sustainability. The quest for increased agricultural productivity through intensified farming practices has led to a preference for monoculture and the genetic enhancement of a limited number of species and varieties (Maetz, 2013; Bhandari et *al*., 2017; Baa-Poku et *al*., 2020). Consequently, there has been a noticeable decrease in crop diversity, with the potential negative impacts further exacerbated by climate change (FAO, 2010). Climate change threatens the conservation of agricultural species as a whole, but it poses an even greater risk to neglected and underutilized species (NUS). These NUS, however, hold significant importance in the diet and socio-cultural life of rural communities and have proven to be more resilient in their local environments compared to exotic species (Lagacé et *al*., 2015).

Among these NUS, Bambara groundnut (*Vigna subterranea*) and sorrel (*Hibiscus sabdarifa*) are particularly noteworthy due to their significant agronomic, economic, and nutritional importance in Burkina Faso.

Vigna subterranea (L.) Verdc. is a leguminous crop species belonging to the *Papilionaceae* family (Baudoin and Mergeai, 2001). It is believed to have originated from Africa, possesses drought tolerance and requires minimal inputs for cultivation. Generally, Bambara groundnut cultivation is carried out as monoculture, however, it can also be grown in association with other crops, especially cereals such as millet, maize, sorghum, fonio, cotton, cowpea, okra, peanuts, cassava, sesame and hibiscus (Ouédraogo et al., 2013; Ouoba et al., 2016). The crop is not commonly affected by diseases and pests within its growing area, although it can be susceptible to different diseases (such as fungal and viral ones) and attacked by insects and nematodes under certain conditions (Nadembèga, 2016).

Hibiscus sabdariffa L. belongs to the Malvaceae family. The species of the Hibiscus genus are distributed in six sections, with *Hibiscus sabdariffa* belonging to the Fucaria section. According to Murdock (1959), West Africa is the centre of origin of Hibiscus sabdariffa. Many authors (Wilson and Menzel, 1964; Boulanger et al., 1984; McClintock and El Tahir, 2004) support Murdock's hypothesis by stating that *Hibiscus* in the Fucaria section, including *Hibiscus cannabinus* and *Hibiscus sabdariffa*, are native to sub-Saharan Africa. Commonly known as Guinea sorrel, it is mainly grown during the rainy season for its leaves, calyces, and seeds. Its cultivation in the dry season in market gardens is mainly aimed at providing leaves used as vegetable condiments (Ouangraoua et al., 2021). Guinea sorrel cultivation faces several problems, including diseases and pests. *Hibiscus sabdariffa* is susceptible to most diseases affecting cotton and okra, which are all in the same family, Malvaceae (McClintock and El Tahir, 2004).

The long-term conservation of seeds of these two neglected crops remains a significant challenge for farmers in Burkina Faso. Some of these farmers stand out for their commitment and ability to conserve a large diversity of traditional seeds of these NUS, including rare and/or endangered species/varieties. They are also the custodians of the intergenerational endogenous knowledge associated with the cultivation, conservation and use of these neglected species. The characterization of these custodian farmers and the conservation methods they use, and identifying the associated knowledge, could help to develop innovative conservation methods in order to improve farmers' resilience to climate change.

Through a combination of focus group discussions and semi-structured individual interviews conducted in 11 villages in Burkina Faso, this study aims (i) to identify farmers who are recognized by the community for their distinct commitment to cultivating a wide range of diverse and rare crop landraces of Bambara groundnut and Sorrel, (ii) to characterize these unique farmers and gain insights into their profiles, (iii) to document the landraces of Bambara groundnut and sorrel held by these custodian farmers, and (iv) to document the methods employed by them for conserving traditional Bambara groundnut and sorrel seeds.

MATERIAL AND METHODS

Study area

The study was conducted in four provinces in central Burkina Faso, including 11 villages (Table 1). The area is characterized by low rainfall and a short rainy season. According to the geographical distribution of ethnic groups, the study area is located in the homogeneous zone occupied by the Mossi ethnic group. Some villages (Koubri, Loumbila and Pabré) are close to Ouagadougou, the capital city, and are influenced by urbanization, while others are far from the capital and are typical of rural areas.

Table 1. Study sites.

Provinces	Departments	Villages
Kadiogo	Loumbila	Loumbila
	Koubri	Koubri
	Pabré	Pabré
Oubritenga	Ziniaré	Songpelcé
		Kolguiguessé
Bazèga	Kombissiri	Goundrin
	Saponé	Godin
Boulkiemdé	Pella	Pella
		Pelbilin
	Kokologo	Nidaga
		Meninga

Data collection

Two separate focus group discussions (FGDs) were organized in each village, one for men and one for women. The number of participants was 30-50 per focus group. During these FGDs, the concept of custodian farmers was explained to the participants as farmers who distinguish themselves from others through their commitment to conserving a wide diversity of crops, including rare landraces. Participants were then asked to suggest names of individuals whom they considered as custodian farmers. These discussions led to debates, resulting in the unanimous nomination of individuals by the FGD participants as custodian farmers.

The individuals proposed by the community were subsequently individually interviewed using a semi-structured interview approach conducted by pairs of interviewers. A pre-established individual survey questionnaire was employed to gather qualitative and quantitative data on various aspects, including: gender, age, religion, profession, education, whether the custodian farmer is a traditional practitioner or not, species maintained by each custodian farmer, seed conservation methods employed, duration of ownership of the conserved landraces, reasons for recognition by the community as custodian farmer, origin (allochthonous or indigenous) of the custodian farmer, seed conservation techniques used, mode of seed conservation, duration of conservation, cultivation of improved landraces or not and for what reason, seed replacement in case of loss, seed exchange. Prior to the formation of focus groups and individual surveys, consent was obtained from the village authorities through their signatures.

Data Analysis

Data analysis was conducted using R (version 4.1.0) statistical software, with descriptive statistics calculated for all variables including means, medians, standard deviations, frequencies, and percentages. Correlation analyses were carried out to explore associations between variables. Chi-square tests and analysis of variance were employed to investigate the relationships between different variables, with the significance level set at $p < 0.05$. Non-parametric Kruskal-Wallis ANOVA was used to determine the significance of differences, and multiple comparisons were conducted using the pairwise Wilcoxon test and adjusted according to the Holm method.

RESULTS AND DISCUSSION

Gender dynamics and education levels among custodian farmers

The study findings underscored the significant contribution of women as seed custodian farmers for minor crops in the studied area. Women played a crucial role in preserving the genetic diversity of sorrel and Bambara groundnut crops, demonstrating their active participation in sustainable agricultural practices and biodiversity conservation. The results revealed notable gender disparities among seed custodian farmers, with females constituting the majority at 75.4%, while males represented 24.6% of the total.

Education levels among seed custodian farmers were relatively low, with 94.2% identified as illiterate. This suggests potential challenges in accessing and applying modern agricultural knowledge and practices. However, a small proportion (5.8%) reported having attended school, indicating the potential influence of formal education on seed custodian practices.

For female custodian farmers, the mean age for those preserving the sorrel was 48.462 years, with a standard deviation of 7.875. The age range was from 30 to 68 years, with the majority falling within the interquartile range (Q1 = 43.0, median = 47.5, Q3 = 51.75). Among male custodian farmers, there were only two individuals preserving the sorrel species, with a mean age of 49 years and a small standard deviation of 1.414. The ages of these male guardians ranged from 48 to 50 years.

Although there is a global association between age and gender (chi-square test, $p = 0.002$), there is no significant difference observed within each species.

Bambara groundnut traditional Landraces

The custodian farmers use morphological characteristics such as colour, size, shape, or seed origin for the naming of traditional landraces. Based on the farmers' identification criteria (seed coat colour, seed size, plant lifecycle, and seed origin), a total of 19 landraces of Bambara groundnut were described by the custodian farmers across all villages. The most commonly encountered landraces are those whose description is based on seed coat colour. Custodian farmers give names to each landrace, but the same landrace can have different names in different villages. Conversely, different traditional landraces can have the same name in different villages. For example, the white-seeded Bambara groundnut (two seeds per pod) is called soum-kamana in the village of Songpelsé and raboega in the village of Pabré.

The mean age for female custodian farmers was 51.462 years, with a higher standard deviation of 14.564. The age distribution spanned from 30 to 103 years, with the central tendency shown by the interquartile range (Q1 = 42.25, median = 49.5, Q3 = 56.75). Among male seed custodians preserving the Bambara groundnut species, there were 15 individuals. Their mean age was 59.800 years, with a relatively larger standard deviation of 18.300. The ages ranged from 37 to 105 years, reflecting a wider spread of age among male custodians. Female seed custodians had a mean conservation duration of 30.154 years, with a slightly higher standard deviation of 17.417. The range spanned from 8 to 72 years, and the interquartile range showed that 50% of female custodians conserved the landrace for a duration between 24 and 33 years. Among male seed custodians preserving the Bambara groundnut species, the mean conservation duration was 19.867 years, with a larger standard deviation of 27.100. The conservation periods ranged from 7 to 114 months, and the quartile values indicated that 50% of male custodians conserved the landrace for a duration between 9 and 12 years. Concerning the duration of seed ownership, female seed custodians had an average ownership duration of 18.346 years, with a higher standard deviation of 17.283. The ownership periods varied from 3 to 80 years, and the interquartile range indicated that 50% of female custodians owned the landrace for a duration between 6.25 and

22 years. Among male seed custodians preserving the Bambara groundnut species, the mean ownership duration was 29.733 years, with a standard deviation of 20.869. The ownership periods ranged from 3 to 80 years, and the quartile values indicated that 50% of male custodians owned the landrace for a duration between 20 and 39.50 years.

Sorrel traditional Landraces

Six traditional landraces of sorrel were identified in the 11 villages based on the naming criteria. Two landraces were identified based on calyx size: the short calyx landrace called bii and the long calyx landrace called wegda in the Mooré language. Two types of landraces were also identified based on plant colour: green and red. The green landrace is called bit-pelga in the Mooré language, which can be translated into English as "white sorrel." The green landrace is also known as Pagb bii in Mooré, indicating that this landrace is mainly grown by females. This name also reflects the neglected status of this morphotype while the red morphotype, grown by both males and females is overused. As for the red landrace, it is called bit-miougou in Mooré, which can be translated into English as "red sorrel". Within this landrace, two variants are distinguished, namely the dark red calyx and the reddish calyx with a green base. The term bito in Mooré is used to refer to sorrel in general.

For female seed custodians conserving the sorrel species, the mean conservation duration was 31.692 years, with a standard deviation of 15.755. The conservation periods ranged from 8 to 60 years, and the interquartile range indicated that 50% of female seed custodians conserved the landrace for a duration between 24 and 36 years. In contrast, there were only two male seed custodians preserving the sorrel species, and their conservation duration was consistently 8 years.

The average duration of ownership among female seed custodians conserving the sorrel species was 13.962 years, with a standard deviation of 8.770. The duration ranged from 1 to 30 years, and the interquartile range suggested that 50% of female custodians owned the landrace for a period between 5 and 20 years. In the case of male seed custodians preserving the sorrel species, there were only two participants. Their mean ownership duration was 27.500 years, with a standard deviation of 3.536. Both male seed custodians owned the landrace for the same duration, with quartile values ranging from 26.25 to 28.75 years.

These findings shed light on the duration of landrace ownership among seed custodians, disaggregated by gender and species. The data revealed variations in the length of ownership, which could be influenced by factors such as cultural practices, seed availability, and local traditions. Further investigation is necessary to explore the underlying reasons for these ownership duration patterns and their implications for seed conservation efforts in Burkina Faso. Understanding gender dynamics within seed custodian farming is essential for developing inclusive strategies to support sustainable agriculture and biodiversity conservation.

Exploring the intersections of religion, seed conservation techniques, seed replacement, exchange, and ownership of custodian farmers.

The study highlights the active participation of individuals from different religious backgrounds in seed conservation efforts, with Animists, Christians, and Muslims identified as the main religious groups among seed custodian farmers. Christians constitute the largest group, accounting for 49.3% of seed custodians, followed by Muslims at 44.9%. This finding emphasizes the promotion of biodiversity conservation regardless of religious affiliation.

Diverse techniques are employed by farmers for seed conservation. The predominant techniques reported include the use of jerry cans (60.9% of farmers), clay pots (15.9%), and sacks (21.7%). These techniques ensure sturdy and secure storage, safeguarding seeds against external factors like moisture and pests. Notably, sorrel seeds are carefully separated based on landraces before drying and conservation, with some calyxes mixed with the seeds for landrace recognition. Ash is often used in conjunction with various containers such as cans, plastic bags, and canaries for storage.

The chi-square test reveals a significant association between education level and seed conservation technique ($P = 0.0002$). This finding highlights the influence of education in determining the choice of conservation methods.

Farmers exhibit a proactive approach to ensure crop production and maintain varietal purity, as 72.5% of them reported replacing seeds in case of loss. Seed replacement practices contribute to the preservation of desired traits and yield stability. Additionally, 34.8% of farmers engage in seed exchange for free, which fosters social networks and promotes the conservation and exchange of local seed landraces.

Examining the age and duration of seed conservation among different genders and crop landraces reveals interesting insights. Female custodian farmers for sorrel have a mean age of 48.462 years, while male guardians have a mean age of 49.000 years. For Bambara groundnut, female custodian farmers have a higher mean age of 51.462 years compared to 59.800 years for males. The duration of seed conservation ranges from 8 to 60 years, exhibiting variations based on gender and crop landrace.

Although traditional or local seed landraces dominate cultivation practices, a significant proportion of farmers (42%) reported cultivating improved seed landraces. The adoption of improved seeds can enhance crop productivity, disease resistance, and agricultural sustainability. Factors influencing the adoption include seed availability, accessibility, knowledge dissemination, and farmer training programs. Interestingly, no significant difference is found between cultivating improved landraces and seed replacement in case of loss ($p = 0.4$), shedding light on the motivations and challenges associated with cultivating improved landraces.

Exploring the dynamics of seed exchange among allochthonous and autochthonous farmers reveals that there is no significant association between farmers' origin and the practice of seed exchange ($p = 0.2748$), providing valuable insights into seed exchange practices in different farming communities.

The duration of seed conservation does not significantly vary based on the species ($P = 0.119$) or the conservation technique ($P = 0.15$). However, a significant

difference is observed in the duration of conservation based on gender (p = 3.451 x 10-5), even when analysed within each species (within sorrel: P = 0.018; within voandzou: P = 0.002). This gender-based difference highlights the role of gender in seed conservation practices.

CONCLUSIONS

The present study highlights the crucial role of custodian farmers in Burkina Faso in preserving and conserving neglected and underutilized crops, particularly focusing on Bambara groundnut (*Vigna subterranea*) and sorrel (Hibiscus sabdariffa). Female farmers were found to be the majority of identified custodians, actively participating in seed conservation initiatives through various techniques such as cooking pots, canaries, and ash. Seed exchange is also a common practice among them, supporting crop diversity and social cohesion within local communities. The discovery of multiple landraces held by custodian farmers across various villages emphasizes the need for further research into understanding factors influencing the distribution and perpetuation of traditional landraces and methods employed for their conservation. Effective conservation strategies that engage local communities are paramount for ensuring global food security. Future scientific pursuits should prioritize developing inclusive and sustainable approaches that provide unequivocal support to custodian farmers, facilitating the preservation of traditional crop varieties. Supporting and acknowledging the knowledge and practices of custodian farmers in the realms of seed conservation and crop diversity is essential for securing the future of agriculture not only in Burkina Faso but also globally.

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