

Status Report on *Piliostigma Reticulatum* (D.C.)

Hochst in Sahel Region of Maradi Niger

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Abstract

Piliostigma reticulatum (D.C.) Hochst is a plant belonging to the legume family. The population widely uses it as medicine, food, feed, and many others. This study aimed to enlighten the status of *P. reticulatum* in the Maradi region through an ethno-nutritional survey. Three localities in the region were concerned by the study, namely the city of Maradi, the rural commune of Sarkin Hausa (Mayahi department), and the Aguié department. A population of 920 people were interviewed, mostly constituted of Hausa ethnic group (89.5%). The respondents were classified according to gender with 36.2% female and 63.8% male. However, 55.5% of them were aged between 20 and 40 years old. The main activity of respondents was mainly agriculture (30%) followed by pupils/students (24.6%). This study shows that *P. reticulatum* 97.4% of the population in the study area surveys stated to recognize the plant. Furthermore, it was noted that 99% of the surveys that recognized the plant were \geq 40 years old. On the other hand, this wild plant is better known in rural areas (100% in the rural commune of Sarkin Hausa) than in urban areas (93.53% in the city of Maradi). In addition, the tree is better used in rural areas (99% in Sarkin Hausa) than in urban areas (73.23% in Maradi). It was found that *P. reticulatum* is an available tree throughout the study zone (92.7%). Indeed, 89.5% of respondents know that the tree is used either in human food or in animal feed and that these pods and seeds are the most used parts accordingly 27.9% and 15.3% respectively. Indeed, highly appreciated by this population, up to its usage in traditional medicine; thus, the study revealed that 35.3% of respondents disclosed that all organs of the plant are useful.

Keywords: *Piliostigma reticulatum*, ethno-nutritional, survey, Maradi, Sahel region

1. Introduction

Agricultural production is growing at a slower rate than population growth in the Sahel, reflecting a food deficit. To fill this deficit, rural farmers resort to food supplements, often of forest origin, through the consumption and/or sale of non-wood forest products, whether processed or not (Papež Kristanc et al., 2024; Zubair et al., 2023; Shrestha et al., 2020). Most non-timber forest species are highly nutritious as they are rich in protein and other nutrients through the consumption of their leaves, fruits, and nuts, thus contributing to food and nutritional security (Amadou et al., 2024, 2023; Murthy et al., 2020; Lucien, 2012). Plant food picking represent a small part of the human diet for most human societies. However, these gathered food plants and other "wild foods" play a crucial role in many food systems that can improve the resilience of the food system and diversify the quality of food (Kabir et al., 2023; Adesina et al., 2022). The plant *Piliostigma reticulatum* is generally a shrub (4 to 7 m) but can also be a tree of 8 to 9 m (Oumarou and Amadou, 2023). It is considered a woody food species because its leaves, and fruits (pods/seeds) are used in human food. For instance, its leaves are picked to acidulate cereal dough to keep it intact for at least three days; the leaves are pressed and their juice gives traditional vinegar. It is one of the most used species and is suitable for agroforestry (Oumarou and Amadou, 2023).

Because of these potentialities, its exploitation is increasing, including, among other things, using its pods as fodder and its seeds as human food (15,16). All parts of the plant are used in traditional pharmacopoeia (Boualam et al., 2021; Yelemou et al., 2009). It is a species found in a large part of the Sahelo-Sudanese zone and is known for providing many ecosystem services, socio-economic utilities, and treating several diseases

(Shrestha et al., 2020; Sanou et al., 2011). Several studies conducted in the Sahel region of Niger, Mali, Burkina Faso, Nigeria, and more had reported the use of *P. reticulatum* to cure many ailments (Ndour et al., 2024; Boualam et al., 2021).

Despite its importance in populations' daily lives, planting or sowing the species is not a common practice. However, *P. reticulatum* regenerates completely naturally and in an assisted manner. Indeed, Assisted Natural Regeneration (RNA) is well-known and practiced in rural areas (Bonou et al., 2022). RNA is the systematization of the regrowth and management of trees and shrubs from felled tree stumps, root systems, germinating seeds, or wooded thickets (Lawali et al., 2018). Indeed, since the 1980s, ethno-nutritionists and other researchers have been studying the role and importance of wild foods in the diet of many populations, as well as the role they can play in improving nutritional outcomes. According to some studies, the nutritional impacts can be significant (Borelli et al., 2020). Work carried out in western Kenya (Declerck et al., 2011) has demonstrated a link between functional agrobiodiversity and the reduction of anemia. In Niger, the population depends on vegetation for 40% of its livestock feed, pharmacopeia, and human food (Ali et al., 2016; Garba et al., 2017).

However, despite all these potentialities resistant to climatic hazards, this plant still attracts very little attention from researchers even though they should be better known to be more valued in a Sahelian country. On the other hand, the lack of information on processing, commercial prospects, the distribution channel, and the potential exploited, limits the consideration of processing activities of products from wild plants in general, by decision-makers and consequently hinders the possibilities of valorization and sustainability management of these resources (Rai et al., 2020; Dao et al., 2016). Given the renewed interest shown by local populations in this species, which seems adapted to the deterioration of climatic conditions, it is worthy of research on the plant studied. This is what prompts this work to take stock of *P. reticulatum* in three localities of Maradi region of Sahel Niger, namely the city of Maradi, the rural commune of Sarkin Hausa (Mayahi department), and the Aguié department.

It is a reality, to be noted that various studies (Rai et al., 2020; Lawali et al., 2018) have proven that greening is taking place in the Maradi Sahel region; gaining the rehabilitation efforts carried out through different efforts, including farmers, through the practice of assisted natural regeneration (RNA), which has allowed an increase in tree density and that gave the density from 2 or 3 trees per hectare on farms to 40, 60, or even more than 100 trees per hectare to date (Bagnian et al., 2013). The objective of this study is to conduct an ethno-nutritional quest investigation on the knowledge and use of *P. reticulatum* in the Maradi Sahel region.

2. Materials and Methods

2.1 Study Area

The study was conducted in the Sahel Niger, in the three localities of the Maradi region, namely the city of Maradi, the rural commune of Sarkin Hausa (Mayahi department), and the Aguié department, were chosen for the respondents.

2.2 Urban Commune of Maradi

The city of Maradi is located in the very center of the Niger territory and covers an area of 38,500 km², approximately 3% of the national territory. Maradi region is an agricultural zone in the country Niger which represents 25% of the national agrarian area (INS, 2018). It is bordered by the south of Nigeria along 150 Km. The climate of the Maradi region is of the semi-arid Sahelian type. It is characterized by three distinct seasons: a Harmattan season from November to the middle of March; a dry and hot season from March to May and a rainy season from June to October.

2.3 Rural Commune of Sarkin Hausa

The rural commune of Sarkin Hausa is located in the center South of Niger between 13° 50' 00" and 14° 0' 00" North latitude and 7° 20' 00" and 7° 40' 00" East longitude. It is 92 km from Maradi city, the capital of the region. The rural commune of Sarkin Hausa excelled in assisted natural regeneration with tree densities of more than 100 feet per hectare that increase with the distance of the fields from the villages (Dramé and Berti, 2008).

2.4 Department of Aguié

Aguié department covers an area of 2800 km² or 7.26% of the total area of the Maradi region, close to the Nigerian border along 70 Km. It is located between the meridians 7° 13' and 8° 9' East and the parallels 13° 13' and 13° 45' (INS, 2018).

2.5 Methodology

Type and period of study

This is a descriptive cross-sectional study on the state of knowledge and use of *P. reticulatum* in the Maradi region, Sahel region of Niger; it was carried out from October 2023 to February 2024.

2.6 Study Population

The survey concerned the populations of the three studied areas during the data collection period and those who agreed to answer the questionnaire. A population of 920 people was concerned, distributed as follows: 325 people from the city of Maradi, 325 people from the department of Aguié, and 270 from the rural commune of Sarkin Hausa. The choice of villages focused on villages where they have a high concentration of *P. reticulatum* in the rural commune of Sarkin Hausa. As far as the department of Aguié and Maradi city the urban area people were concerned by the study.

2.7 Inclusion Criteria

Any person (male or female) aged over ten (10) years in the survey area who met during the data collection period and agreed to answer the questionnaires was included in the study.

2.8 Exclusion Criteria

Any person, male or female, aged under ten (10) years and/or over 10 years who had not agreed to answer the questionnaires, was excluded from the study.

2.9 Data Collection

The survey was conducted using KoboToolbox data collection software. The information collected was related to knowledge of the plant, the different uses, and the availability of the plant. Field visits provided a general overview of the state of presence of *P. reticulatum* in the areas studied. As a collection technique, we conducted individual interviews with the participants, and a pre-survey was conducted to test the understanding of the questions asked. This made it possible to undertake the questionnaire.

2.10 Statistics Analysis

The data were analyzed using R 4.2.3, SPSS version 23, and Microsoft© Office 2016 software. The statistical software performed a multiple-component analysis and cross-tabulations between the variables. The figures and tables were formatted using Excel and Word. For the analytical results, the methods used were cross-tabulations of variables that could be dependent on independent variables (age, education level, profession, knowledge of the plant, and plant usage).

3. Results and Discussion

The respondents were mainly Hausa (89.5%) community ethnic groups in the Maradi Sahel region of Niger Republic; they are 36.2% female and 63.8% male, with 60.5% married people. According to the study, 55.5% of the population surveyed were age range between 20 and 40 years old and 7% were between 61 and 80 years old. The respondents' activities show that 30% had agriculture as their main activity, 24.6% were pupils/students and 5.2% said to had no fixed activity (Figure 1).

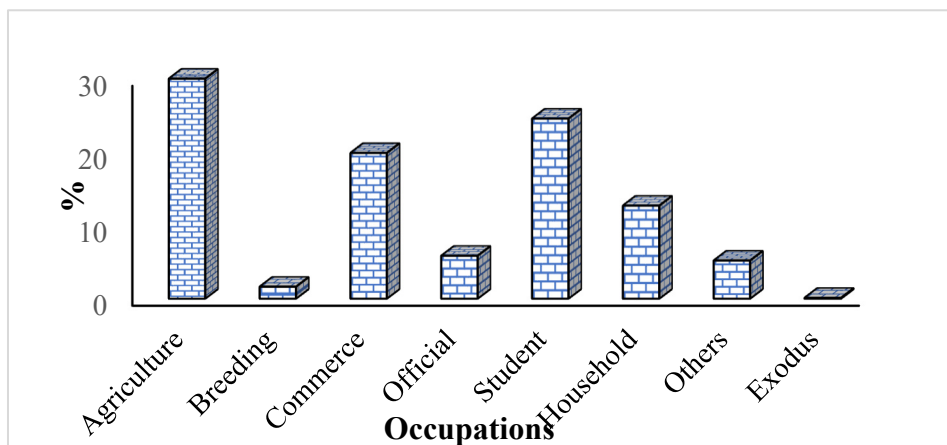


Figure 1. Distribution of respondents according to their main activity

The result disclosed that According to the data analysis, 97.4% of respondents claimed to know *P. reticulatum*. In the study conducted in Burkina Faso in 2007, in which the respondents were all adults reported that 100% knew *P. reticulatum* (Yelemou et al., 2009). This is therefore explained by the difference in the age of the respondents because even in the present study, 99% of respondents who were over 40 recognized the plant (Table 1).

Table 1. Distribution of respondents who are familiar with *P. reticulatum* according to age group

Familiar with <i>P. reticulatum</i>	Age (years)						
	≤ 20	21- 30	31- 40	41- 50	51- 60	61-70	≥71
Yes	15.10	36.20	19.40	16.30	05.90	03.70	03.50
No	41.70	41.70	12.50	04.20	00.00	00.00	00.00

Usually, a wild plant such as *P. reticulatum*, is much better known in rural areas than in urban areas as shown in Figure 2, with 100% of respondents from the rural community of Sarkin Hausa claiming to know the plant, compared to 93.53% from the city of Maradi. Though, the entire Maradi Sahelian region is a popular habitat for the plant; furthermore, it is well appreciated in rural areas because of its high potential for vegetative regeneration. Its multiplication by planting is rarely practiced in the region (Yelemou et al., 2008, 2009). It’s called by the environmentalists “A showcase of the practice of assisted natural regeneration”.

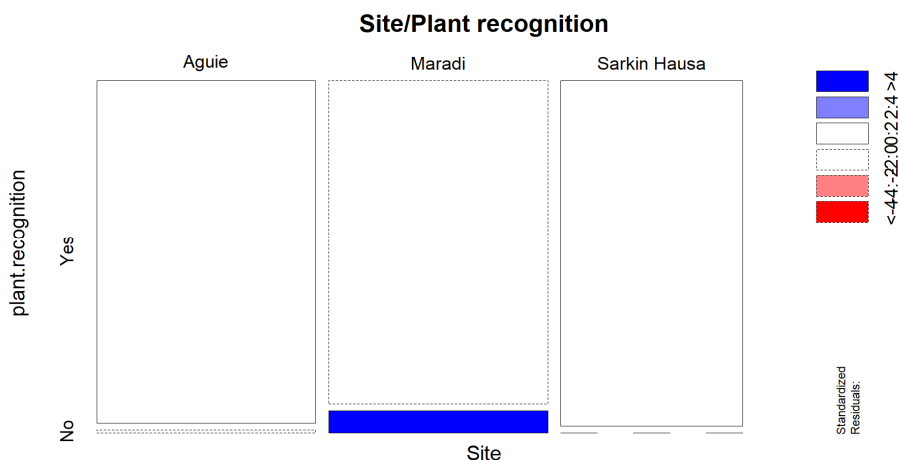


Figure 2. Distribution of respondents who know *P. reticulatum* according to their origin

As for the use of *P. reticulatum* in food, 45.2% of respondents said that it is used in human and animal feed. As a whole, 89.5% of respondents knew it was used in human food, animal feed, or both (Figure 3). Yelemou et al. (2009), reported similar results with 96.7% of respondents using the plant leaves as species; it is said that the lemon taste of the leaves is applied to acidified some Sahelian cereal flours in making food recipes such as locally popular cereal meal known as “tô” (Oumarou and Amadou, 2023; Kabir et al., 2023; Dosso et al., 2012).

These results corroborate those of Ayenew, 2019) in Ethiopia with 97.8% of respondents using *Piliostigma thonningii* as a food resource to fill food gaps during food shortages (Ny et al., 2022). *P. thonningii* is a species related to *P. reticulatum*. Morphologically, both shrubs reach 5–10 m in height, look similar, and can easily be confused. In Senegal; they have the same vernacular name "Nguiguiss" as in the Sahel of Niger "Kalgo or Bossey". However, *P. thonningii* is distinguished by a ferruginous pubescence under the pods and less split and larger leaves than those of *P. reticulatum*, and in traditional medicine, all parts of these shrubs are useful (Oumarou and Amadou, 2023; Ny et al., 2022; Rai et al., 2020).

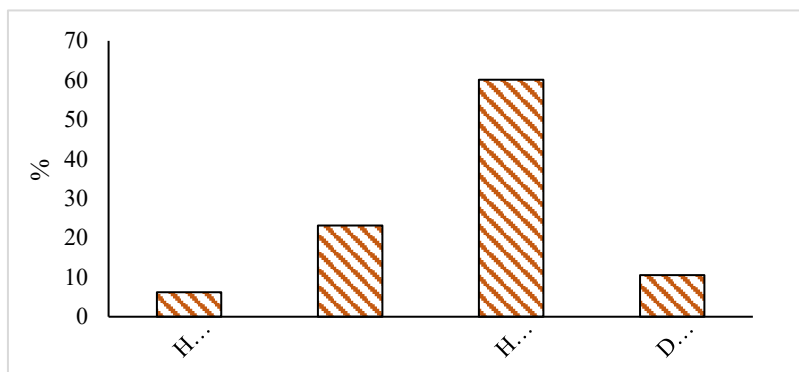


Figure 3. Use of *P. reticulatum* in human food and/or animal feed

On the other hand, Figure 4 shows that the pods of *P. reticulatum* are the most used organs (27.9%) followed by the seeds (15.3%) which are mainly consumed as fresh food then 35.5% of entire organs of the plant are used for food or traditional medicine. Similar results were revealed by the work of Yelemou et al. (2008) in the Sahel of Burkina Faso with 60% of respondents affirming that the seeds are edible, and 87% stated the use the fruits (pods/seeds) in the manufacture of potash. Furthermore, 85.7% use fresh leaves and dried fruits to feed goats, cattle, or sheep (Abdurrahman, 2015). Various studies have reported on the use, processing, and marketing of *P. reticulatum* pods in the same Sahel (Oderinde et al., 2022; Abdurrahman et al., 2018). In addition, studies on feeding small ruminants with *P. reticulatum* are reported (Abdurrahman, 2015, 2018; Dao et al., 2016) that the majority of respondents (66.02%) feed their animals with *P. reticulatum* leaves and pods, while 21.36% feed their animals with leaves alone and 12.62% feed their animals with pods only (Idowu et al., 2023; Abdurrahman, 2018).

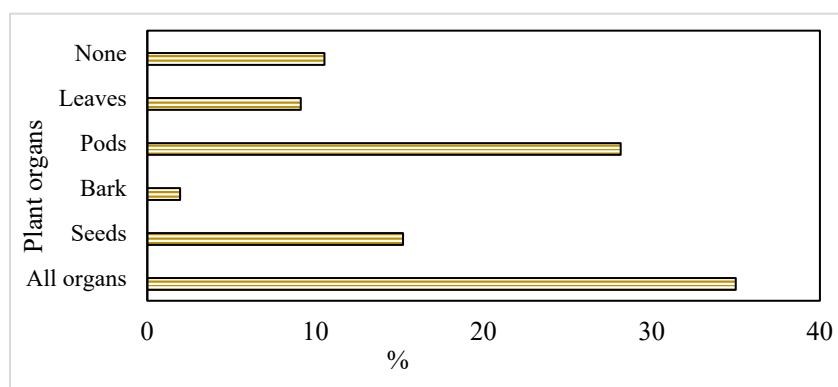


Figure 4. Usage of *P. reticulatum* organs

This work revealed that women use *P. reticulatum* more than men in the three communities of the Maradi Sahelian region and both rural and urban areas. Similarly, in the other Sahel region, women are in charge of processing and marketing *P. reticulatum* pods (Bazongo et al., 2023; Boualam et al., 2021; Jacobson, 2017). The study plant *P. reticulatum* is much more used in rural areas than in urban areas; in the rural community of Sarkin Hausa and the department of Aguié 99% reported using the pant; however, in the city of Maradi (73% %). Knowingly that Sarkin Hausa is a rural area, Aguié is a semi-rural whereas Maradi City is an urban area of the Maradi Sahelian zone in Niger where the plant is much available. The plant is available in all localities of Niger. In the study areas, 92.7% of respondents say that it is available in their locality and an additional 62% say that they harvest these products, such as pods/seeds as illustrated in Figure 5.

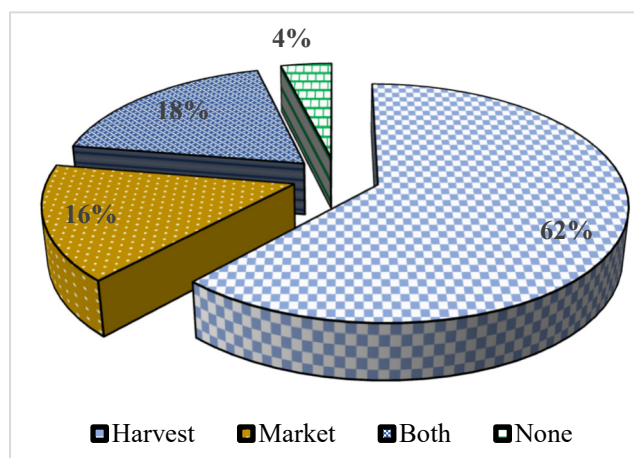


Figure 5. Mode of plant *P. reticulatum* supply in Maradi Sahelian zone

Multiple Component Analysis (MCA) on the entire data set, has shown to group 52.7% of information divided into dimension 1: 33.26% and dimension 2: 19.44% (Figure 6).

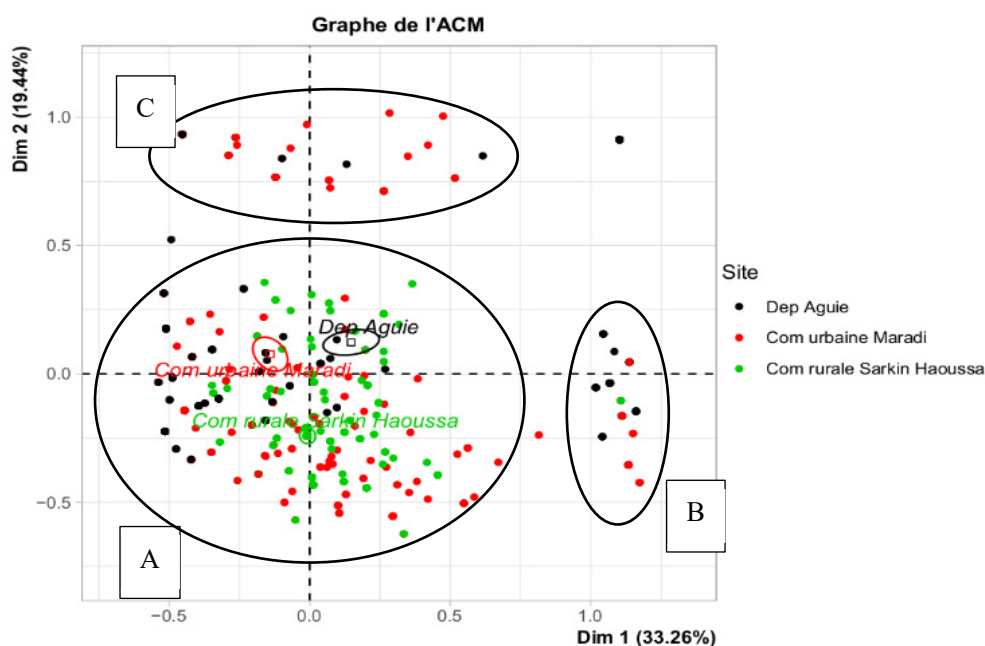


Figure 6. Multiple Component Analysis on the *P. reticulatum* species information

Moreover, the data collected in the three Sahel localities studied (Aguié, Maradi City, and Sarkin Hausa) are more or less similar except for a few respondents from Maradi City and Aguié (3.6%) who responded that they did not even know *P. reticulatum*. Moreover, Figure 6 shows three groups of individuals, among which group A represents individuals from the three localities of the study with more or less the same information on *P. reticulatum* species and who are in the majority. Followed by Group B representing those who have less information on *P. reticulatum* and whose answers are much more "I don't know", compared to all the questionnaires. Then, group C represents not only the ethnic minorities of the Sahel region of Maradi in Niger, among them the Arab, Kanuri, and Tuareg ethnic groups; in addition to those who said that only the seeds of *P. reticulatum* are used in human food. However, the MCA reveals that there is much more similarity in the answers about the respondents of Maradi City and Aguié on the one hand and the other hand, the respondents of Sarkin Hausa have much more knowledge on *P. reticulatum*; thus, it is the pole of the agroforestry density of this species in the region.

4. Conclusion

This study shows that the population of the Maradi Sahel region recognized and used *P. reticulatum* in its agroecological zone. Indeed, the majority of the respondents were Hausa community, which is the majority ethnic group in the Maradi region. However, different class groups of the population studied showed that the plant is important and used for animal feeding, human food, medicine, timber, and many more ecosystemic uses. The tree is better known and more used in rural areas than in urban areas, the pods/seeds of *P. reticulatum* are the most used parts. Indeed, the majority said that the plant is available in their locality, and the method of supply still harvesting. Thus, the plant is popular and all the organs are useful. Therefore, it is recommended to continue the practice of using and protecting this species in the zone studied that makes this tree available despite the environmental pressure.

5. Limitations

Using the survey on maybe limited Sahel parts though the epicenter of the *Piliostigma Reticulatum* species in the region might have been the limitation of the work.

6. Directions for Future Research

Studying the *Piliostigma Reticulatum* process products with the optimum conditions will enhance the use that leads to the protection of the species.

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