Journal Homepage: -www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH (IJAR)

Article DOI: 10.21474/IJAR01/22323
DOI URL: http://dx.doi.org/10.21474/IJAR01/22323

RESEARCH ARTICLE

DYNAMICS OF HERBACEOUS MASS DEGRADATION ON NATURAL RANGELANDS AND PEASANT INNOVATIONS FOR SUSTAINABLE MANAGEMENT OF PASTORAL RESOURCES IN THE NIGERIEN SAHEL

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Manuscript Info

Manuscript History
Received: 4 October 2025
Final Accepted: 6 November 2025
Published: December 2025

Key words:-
grazed ecosystems,forage herbs, pastoral crisis, Sahel

Abstract

The Sahelian steppe areas are ecosystems favorable to the development of herbaceous vegetation intended for livestock feed in extensive farming systems. This study aims to assess the dynamics of herbaceous biomass degradation and to identify farmers' innovations in managing pastoral crises. Investigations monitoring the dynamics of herbaceous biomass degradation and farmer's innovations in managing pastoral crisis were conducted in three eco-climatic areas in the central west of Niger.To do this, a 2,500 m² vegetation unit was delineated and protected in each eco-climatic area to monitor the dynamics of herbaceous mass degradation. The results highlight a rapid degradation of herbaceous vegetation in all eco-climatic areas starting in December, with a capacity ranging from 0.05 to 0.15 TLU/ha/year(Tropical Livestock Units).Transhumant shepherds, livestock owners, and pastoral civil society are the main actors involved in the sustainable management of grazing ecosystems. Operators have developed strategies for managing pastoral crisis, even though some innovations exacerbate problems related to pastoral land. For sustainable and efficient management of sahelian grazing ecosystems, pastoral and agropastoral farmers must be fully involved both upstream and downstream in programs to optimize pastoral resources.

Introduction:-

In the Sahel, biogeographical areas primarily intended for pastoral use stretch over more than 6,000 km in length and between 420 to 600 km in width (Hessa et al., 2024). The use of these biophysical environments is a means of security (Idrissou et al., 2019) and of optimizing livestock productivity in extensive farming systems (Guindo et al., 2025). The grazed Sahelian ecosystems offer a variety of spontaneous forage herbaceous plants with good pastoral value, favored by livestock (Diawara et al., 2020).In the natural areas of Niger, pastoral farming is a resource that

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helps address food security challenges and improve the socio-economic and cultural living conditions of the population (Sitou and Mouctari, 2025). This pastoral farming provides 70% of the milk and more than half of the meat from cattle and small ruminants (Assouma et al., 2019). It is also the main source of young animals for other farming systems (ranching systems, sheep and cattle fattening, peri-urban systems, etc.) (Thébaud and Corniaux, 2019). With a rich and diverse herd in terms of species and breeds, Niger has a comparative advantage in livestock farming in the West African sub-region (SDDEL, 2013). Livestock production activities are practiced by more than 87% of the Nigerien's population (Idrissa et al., 2020). It is a sector that provides income for the State and local governments (Wanogo et al., 2025). The contribution of livestock farming to Niger's Gross Domestic Product (GDP) ranges between 11 and 14% which justifies the creation of the Regional Center of Excellence in Livestock Farming in Niger (Gouro and Ly, 2014).

Over the past three decades, the increase in livestock and the resulting overgrazing, combined with climate variability, have been the pressure factors responsible for the degradation of rangelands. Degradation is defined as a decrease in the pasture's ability to produce good-quality forage that is palatable to livestock (Amegnaglo et al., 2018).However, this complex phenomenon significantly undermines the productivity of these biophysical environments (Alhassane et al., 2018; Souley et al., 2018; Sitou et al., 2019) and increases the vulnerability of pastoralists and agropastoralists (Soumana et al., 2012; Garba, 2017). Yet, they possess endogenous knowledge about the mechanisms of degradation in pastoral areas (Bodé, 2017).Also, this local knowledge, little studied by scientists in Niger (Soumana et al., 2012; Idrissa et al., 2020), is not often taken into account in programs for the development, restoration, and management of pastoral areas. The overall objective of this work is to contribute to the understanding of the phenomenon of the degradation of grasslands and of farmer's innovations in managing pastoral crisis. Specifically, it aims to (i) assess the dynamics of grassland degradation according to the eco-climatic areas of the Nigerien Sahel, (ii) inventory the level of involvement of key actors in the management of pastoral resources, and (iii) determine farmer's innovations in pastoral crisis management.

Materials and Methods:-

Presentation of the study area:-

This study was conducted at the level of grazed ecosystems in three eco-climatic areas of the Central West of Niger. These areas were chosen based on the rainfall gradient on one hand, and the presence of natural pastures, the consent of the herders, and the accessibility of the area on the other. They include the agricultural area of Boboye (Fabidji-BirniN'Gaouré sector), the agropastoral area (Dan Kassari-Allela sector), and the pastoral area (Tebaram-Bambaye sector) (Figure 1).Boboye is a Sahelo-Sudanese area with both agricultural potential, covering an area of 4,423 km². Its climate is characterized by a long dry season of 8 months (from October to May) and a short rainy season of 4 months (June to September) (Djibo et al., 2020). The average rainfall ranges from 600 mm in the North to 800 mm in the South (Halidou et al., 2020). The relief of Boboye is essentially dominated first by the large valley of the DallolBosso, which crosses the area from north to south for a length of about 155 km and spans 10 to 20 km in width. Then, the plateaus of 'Zigui' in the East and 'Fakara' in the West (Dan Guimbo et al., 2016). Finally, the Niger River crosses the southern part of Boboye over a length of about 80 km (Djibo et al.,2018). The vegetation is characterized by two types of savannas. On the plateaus, there is a shrub savanna dominated by combretaceae and a discontinuous herbaceous layer. In the Dallol, there is a tree savanna, with the composition of large trees varying from south to north (Dan Guimbo et al., 2016).

The Dan Kassari-Allela area is a Sahelian area with an agropastoral vocation, where average rainfall is 450 mm in the north and 550 mm in the south. Its relief consists of plateaus, plains, hills, and pastoral lowlands. The distribution of vegetation allows for the identification of rich and available lowland vegetation from June to November (6 months out of 12), wooded and shrubby steppes that are more or less grassy, and tussockyshrublands on the plateaus of the Terminal Continental (Sitou al., 2020). It is also an area rich in passage corridors and resting areas for mobile livestock systems. Additionally, thanks to its border with the Federal Republic of Nigeria, transhumant herders heading toward the coast stay in this area.

The Tebaram-Bambaye sector is an area primarily dedicated to pastoral activities. Its climate is a mix between Sahelian and Saharan types, with an average rainfall of 350 to 450 mm per year. The vegetation consists of striated bush on the plateaus but is relatively diverse along the valley edges and in lowlands (Sitou et al., 2021). Livestock farming is the main activity for utilizing the pastoral resources of this sector. All animal species raised in Niger (sheep, goats, cattle, camels, horses, etc.) graze together over the vast pastoral areas of the zone (Sani et al., 2020).

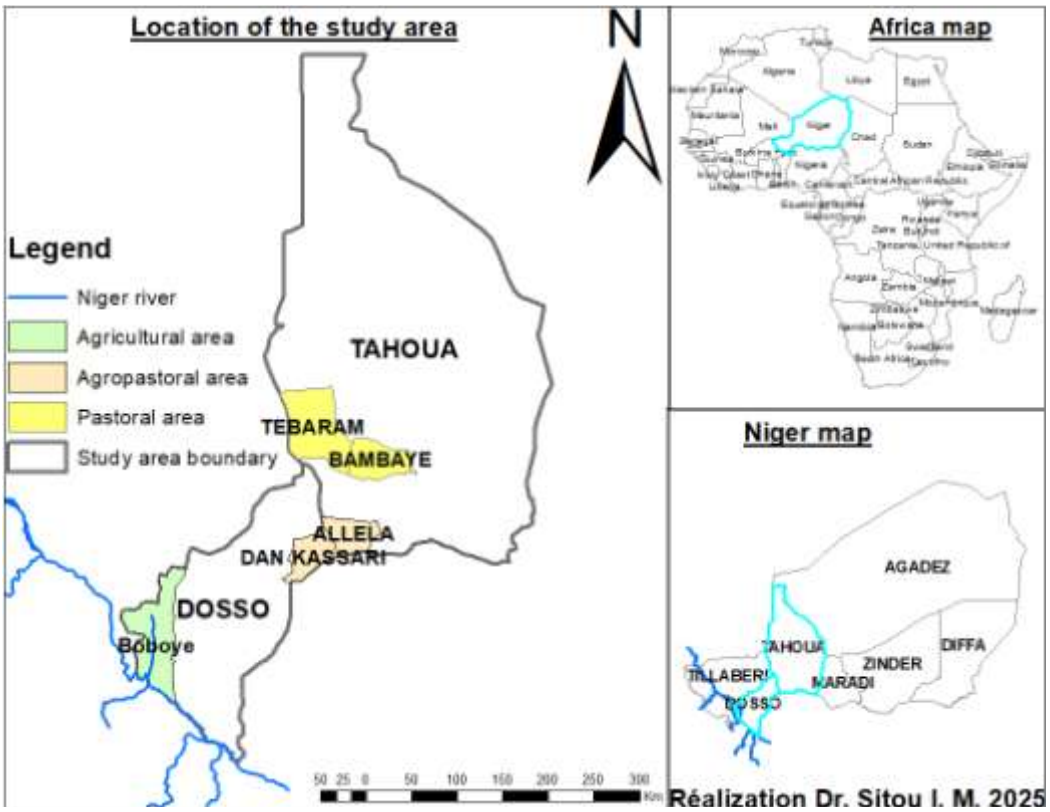

Figure 1 :Location of the study area

System for monitoring the dynamics of herbaceous mass degradation:-

A system for monitoring the dynamics of herbaceous biomass degradation during the 8 months of the dry season was set up. In the vegetation unit of each eco-climatic area, a vegetation unit of 2,500 m² (50m x 50m) was delineated and georeferenced for this monitoring. Measurements were taken every 3 months per eco-climatic areaduring the study period. The purpose of this monitoring is to determine at what time of the year the herbaceous biomass is no longer available for animal feeding.

Sampling and pastoral surveys:-

A simple non-probability sampling (taking into account the availability of operators, their consent, and the accessibility of grazed ecosystems during the wintering season) along the eco-climatic gradient of central-west Niger was carried out. Survey forms focus groups were administered to herders exploiting natural pastures with at least 15 years of experience. These data collection tools were administered to one hundred and fifty (150) pastoral and/or agro-pastoral herders (50 herders were surveyed in Boboye, 50 in the Dan Kassari-Allela sector and 50 in Bambaye-Tebaram).In addition, the heads of technical services (of the land, agriculture, livestock, and environment commissions) were interviewed. The indicators sought mainly concern (i) the herder's assessment of the dynamics of grassland degradation, (ii) the various levels of involvement of these actors in the management of pastoral resources, (iii) the peasant strategies for the adaptation of pastoralists and agro-pastoralists, (iv) the peasant's suggestions for improving the productivity of grazing areas in order to identify the related potentials and constraints.

Data processing and analysis:-

The monitoring sheets for the dynamics of herbaceous mass degradation and the pastoral survey focus groups being pre-coded, all collected information was entered into an Excel spreadsheet to create a database. This same spreadsheet was used to calculate the citation frequencies of the species using the formula below.

$$CF = \frac{Si}{N} x100$$

CF being the citation frequency of species i, Si being the number of times that species i was mentioned by the respondents and N being the total number of farmers surveyed.

Results:-

Dynamics of the degradation of herbaceous biomass during the dry season according to eco-climatic areas:-

The results of monitoring the dynamics of herbaceous biomass over the 8 months of the dry season highlight a decline in the carrying capacity of the pastures from September (end of the rainy season) to June (beginning of the next rainy season). This decline in herbaceous biomass is observed in all three eco-climatic areas. However, in the agricultural area, there is a noticeable high pressure on the pastures resulting from the usual movement of transhumant herders from the North towards the coast (Figure 2).

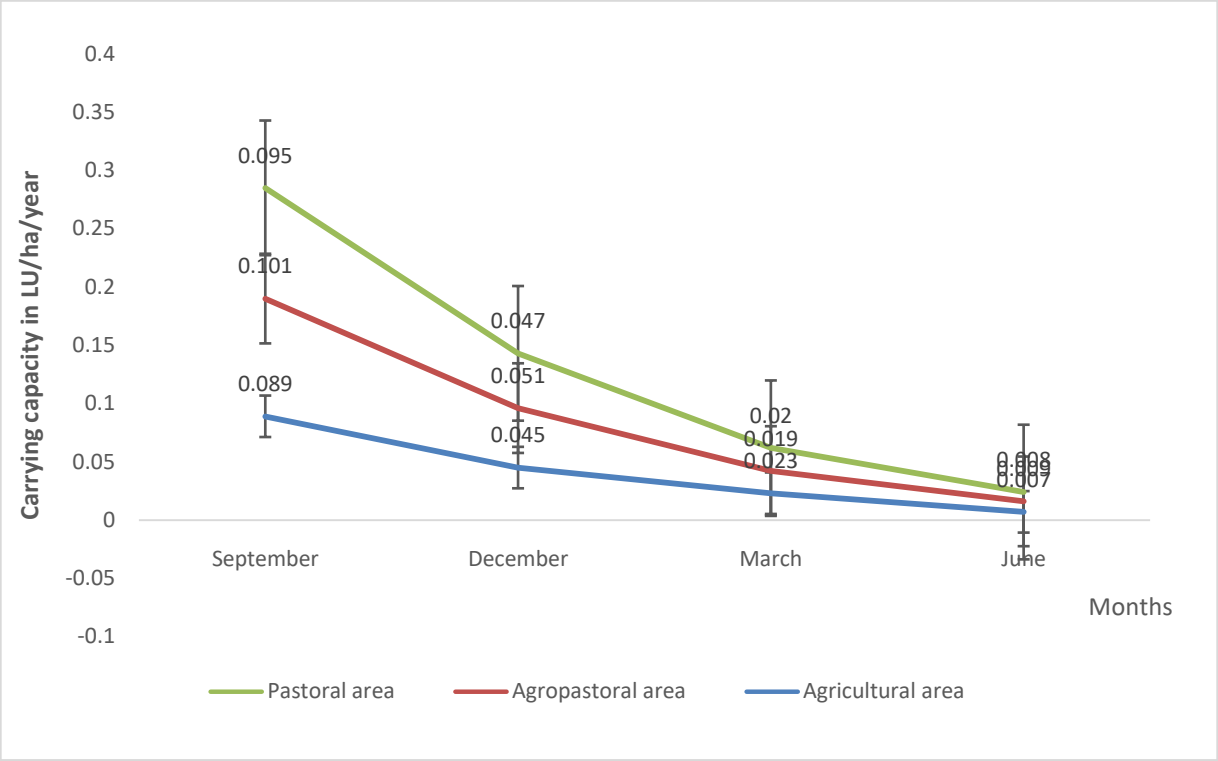

Figure 2 : Dynamics of herbaceous biomass during the dry season

The analysis of this figure allows us to conclude that from the month of December, herders and agropastoralists in all eco-climatic areas are forced to follow transhumance routes due to the depletion of available pastoral resources (water, herbaceous vegetation).

Implications of key stakeholders involved in the management of pastoral resources:-

The different actors and their levels of motivation in the management of pastoral resources have been analyzed (Figure 3). These include the animal owners, the shepherds leading the animals to the pastures, the pastoral civil society, the agents of the State technical services (environment and livestock services), as well as the agro-pastoralists (farmer-herders or simply sedentary).

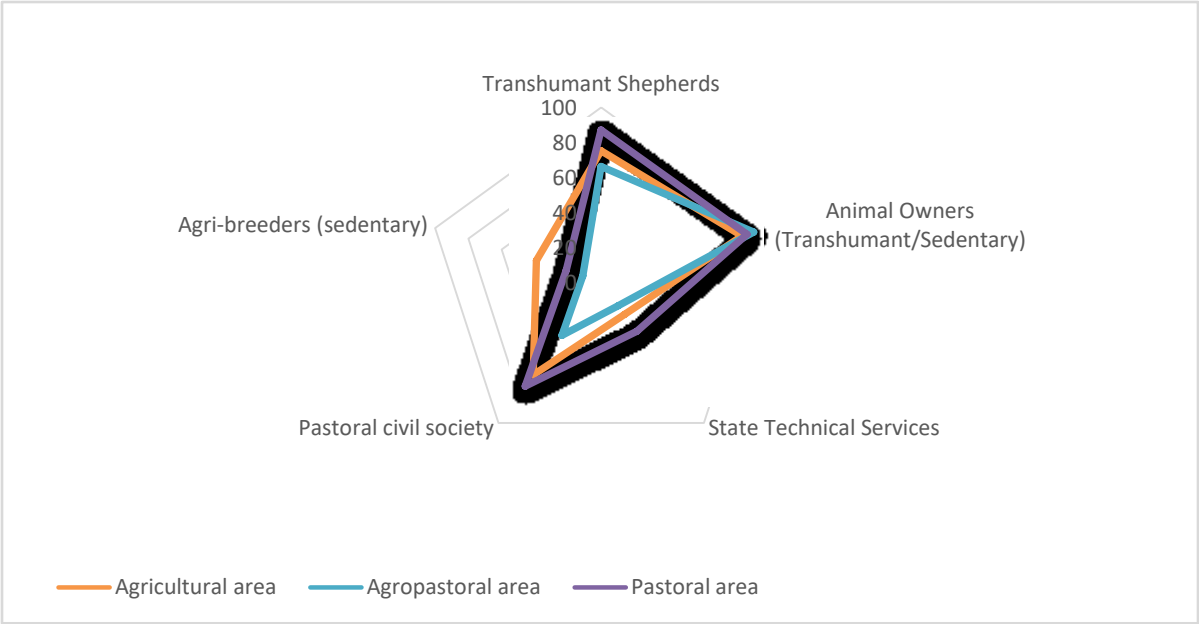

Figure 3 : Involvement of the different stakeholders in the management of pastoral resources

The analysis of Figure 3 highlights three main actors in the management of pastoral resources with an involvement of about 80% (animal owners, shepherds, and pastoral civil society). The other actors are only involved when necessary (involvement ranging from 0 to 30%).

Peasant innovations in pastoral crisis management:-

Several strategies have been developed by pastoral and/or agropastoral breeders to mitigate the forage deficit resulting from the degradation of natural pastures. Unfortunately, some strategies leave a negative ecological footprint (cultivation of pastoral areas and passage corridors). Figure 4 shows the citation frequencies (CF) of these strategies according to eco-climatic areas.

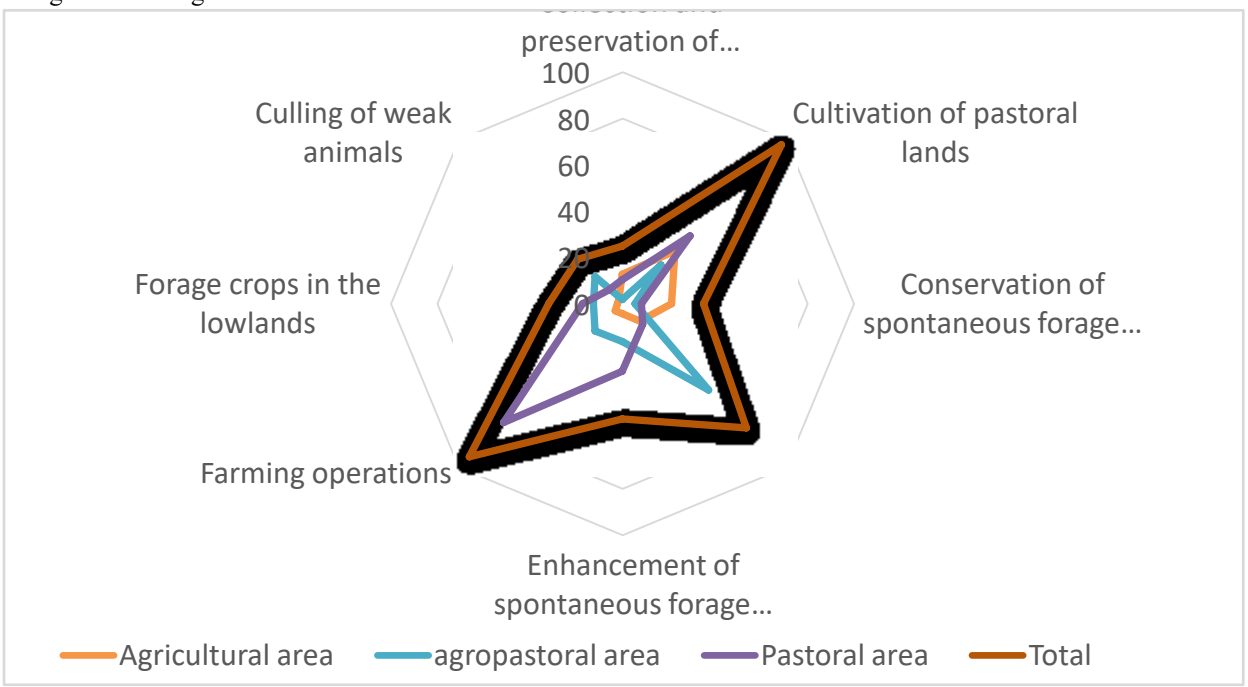

Figure 4 : Peasant strategies for adaptation to pastorals crisis

The analysis of this figure highlights innovations in the management practices of pastoral and agro-pastoral herders across all three eco-climatic zones to cope with poor pastoral seasons. However, the percentage of herders who use certain effective adaptation strategies, such as forage crops (2.13%, 12.5%, and 17.24%) and especially the destocking of malnourished animals (2.13%, 16.67%, and 8.33%), remains low in the agricultural, agro-pastoral, and pastoral zones, respectively.

Discussion:-

It is important to note that in the Sahel, the bulk of spontaneous forage grass production occurs between July and September (Diawara et al., 2018). It is the forage available during this short period that decreases over the nine months of the dry season due to several factors (Ilunga et al., 2025). The results obtained in this study show that the degradation of herbaceous biomass is much more significant in agricultural areas, with a stocking rate of around 0.05 Tropical Livestock Units (TLU) compared to agropastoral areas, which have 0.13 TLU, and pastoral areas with 0.16 TLU. These results are similar to those found by Diawara et al. (2020), who state that in the Sahel, the degradation of the herbaceous layer, dominated by annual plants, occurs during the long dry season.The results of this study highlighted the main actors who make sustainable management of grazed ecosystems the cornerstone of their priorities. These are the livestock owners, who can be either transhumant or sedentary herders. It is important to note here that there are also animal owners who do not take their livestock to pasture. These include officials and traders working in major cities of the country such as Niamey, Agadez, and Tahoua. After the livestock owners come the transhumant herders as well as actors within pastoral society. However, the State technical agents, who should normally be at the forefront, hide behind the false pretext of insufficient operating resources to explain their low involvement (0% in the agropastoral zone). These results corroborate those found by Sani in 2025 in the rural commune of Gadabedji in Niger.

Facing chronic forage deficits due to the degradation of grazing areas, pastoral and/or agro-pastoral farmers have developed various strategies allowing them to be resilient. However, some strategies leave negative ecological footprints (cultivating areas designated for natural pastures and forage crops in lowland agricultural areas) as they increase competition for pastoral land (Ndiaye et al., 2025). Similar results were found by Abdou et al. (2020), who studied livestock farmers' perceptions of climate change and adaptation strategies to environmental constraints in the Filingué commune in Niger.

Conclusion:-

The present study aimed to contribute to the understanding of the phenomenon of degradation of herbaceous biomass and peasant innovations in pastoral crisis management. The results show that from the month of December, the available herbaceous biomass fluctuates between 0.05 and 0.15 LU/ha/year. This low availability of herbaceous biomass in all eco-climatic areas forces herders and agro-pastoralists to follow transhumance routes. It clearly emerged that there is weak involvement of the farmer-herders and the technical service in the management of pastoral resources. Also, over time, herders have developed strategies allowing them to be resilient in the face of climate hazards. For better involvement of technical services, the state must provide them with suitable vehicles and cover fuel costs. Finally, it would be desirable to involve the operators of grazed ecosystems both upstream and downstream in sustainable management programs, as they have valuable empirical strategies that are still relevant today.

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