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Pastoralism and biodiversity in Burkina Faso and Niger: A review

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Abstract. Burkina Faso and Niger are two landlocked countries in Sahelian West Africa. Pastoralism is one of the most important livelihood strategies in both countries and can play a central role in biodiversity conservation. This paper analyses the state of research on the relation between pastoralism and biodiversity in Burkina Faso and Niger. It draws upon a systematic review of 36 documents identified through the Web of Science. Literature analysis shows that the effects of pastoralism are rather mixed as they are context-specific and depend on many factors such as grazing intensity and livestock species. In general, pastoralism has a negative effect on plant species diversity, especially in terms of abundance, but with distinct effects on woody (trees and shrubs) and herbaceous species. Pastoralism can also impact the diversity of wild fauna. On the other hand, while there is a general trend towards the erosion of indigenous livestock genetic diversity, due inter alia to cross-breeding, pastoralism and traditional knowledge of pastoral communities result fundamental in the conservation of local, indigenous livestock breeds. Further research is needed to promote sustainable management of pastures and grasslands that ensures biodiversity conservation while preserving pastoral communities' livelihoods in Burkina Faso and Niger.

Keywords. agro-pastoralism, plant diversity, animal diversity, genetic diversity, species diversity, Sahel, West Africa.

Pastoralisme et biodiversité au Burkina Faso et au Niger : une revue de la littérature

Résumé. Le Burkina Faso et le Niger sont deux pays enclavés d'Afrique de l'Ouest sahélienne. Le pastoralisme est l'une des stratégies de subsistance les plus importantes dans les deux pays et peut jouer un rôle central dans la conservation de la biodiversité. Cet article analyse l'état des recherches sur la relation entre le pastoralisme et la biodiversité au Burkina Faso et au Niger. Il est basé sur une revue systématique de 36 documents identifiés via le Web of Science. L'analyse de la littérature montre que les effets du pastoralisme sont plutôt mitigés car ils sont spécifiques au contexte et dépendent de nombreux facteurs tels que l'intensité du pâturage et les espèces de bétail. En général, le pastoralisme a un effet négatif sur la diversité des espèces végétales, notamment en termes d'abondance, mais avec des effets distincts sur les espèces ligneuses (arbres et arbustes) et herbacées. Le pastoralisme peut également avoir un impact sur la diversité de la faune sauvage. D'autre part, alors qu'il existe une tendance générale vers l'érosion de la diversité génétique du bétail indigène, due entre autres aux croisements, le pastoralisme et les connaissances traditionnelles des communautés pastorales sont essentiels à la conservation des races de bétail indigènes et locales. Des recherches supplémentaires sont nécessaires pour promouvoir une gestion durable des pâturages et des prairies qui assure la conservation de la biodiversité tout en préservant les moyens de subsistance des communautés pastorales au Burkina Faso et au Niger.

Mots-clés. agro-pastoralisme, diversité végétale, diversité animale, diversité génétique, diversité des espèces, Sahel, Afrique de l'Ouest.

I - Introduction

Burkina Faso and Niger are two landlocked countries in Sahelian West Africa. Both countries are in the low human development category (UNDP, 2019) and affected by multiple forms of

malnutrition (FAO et al., 2018; USAID, 2018b, 2018a). Burkina Faso (BF) and Niger also should fill the gap in terms of sustainable development and the implementation of the Sustainable Development Goals (SDGs) (Sachs et al., 2017). In 2018, 83.5% of the population in Niger and 70.6% in BF lived in rural areas (World Bank, 2021). Agriculture is a leading sector for the economy of BF and Niger. According to the World Bank's data, agriculture contributes to 28.6% of GDP in BF and 39.6% in Niger, while employment in agriculture is at 75.9% in Niger and 28.6% in BF. While the share of land under permanent meadows and pastures in agricultural land is 49.59% in BF and 61.76% in Niger, their share in the land area is 21.93% in BF and 22.72% in Niger (FAOSTAT, 2021). Therefore, pastoralism is one of the most important drivers of land use in BF and Niger.

There is an ongoing academic debate on the role of pastoralism in biodiversity decline, especially in resource-poor regions such as the Sahel. Some scholars point out pastoralism as a major cause of land degradation and desertification (Boussaïd et al., 2018; Zerboni & Nicoll, 2019) and deforestation (Campbell et al., 2017; Mebirouk-Boudechiche et al., 2016), mainly because of overgrazing (Boussaïd et al., 2018; Zerboni & Nicoll, 2019). Meanwhile, other scholars reject the direct link between pastoralism and desertification (Blanco et al., 2015), and argue that pastoralism and agro-pastoralism are compatible with biodiversity conservation (Davis, 2005). In this context, the present paper analyses the state of research on the relation between pastoralism and biodiversity in BF and Niger; in particular, it sheds light on the relationships between pastoralism, on the one hand, and plant diversity, animal diversity and ecosystem diversity, on the other hand.

II - Methods

The paper draws upon a systematic review (Moher et al., 2009) of all documents indexed in the Web of Science (WoS). A search was carried out on 18 March 2021 using the following Title-Abs-Key search query: (*pastoralism OR pastoralist OR pastoral OR grazing OR rangeland OR pasture*) AND (*diversity OR diverse*) AND (*Burkina OR Niger OR "West* Africa" OR Sahel*). The initial search yielded 137 documents. Three eligibility criteria were considered during the selection of documents to be included in the systematic review: geographical coverage (viz. document deals with Burkina Faso and/or Niger); thematic focus (viz. document deals with both pastoralism and biodiversity); and document type (viz. only research articles, book chapters or conference papers were selected; reviews, letters to editors, commentaries and/or notes were discarded). Following the screening of titles, 27 documents were excluded as they do not refer to BF or Niger; documents covering wider geographical areas (e.g. West Africa, Sahel, Sub-Saharan Africa) were kept for further analysis. Further 25 documents were excluded following the scrutiny of abstracts as they do not meet at least one of the eligibility criteria. In particular, articles that deal with the diversity of insects and arthropods were excluded. Additionally, 49 documents were discarded following the analysis of full-texts. Therefore, only 36 documents met all the eligibility criteria and were included in the systematic review (Table 1).

Table 1. List of the selected documents.

Year	Documents number	References
2019	3	Leßmeister et al. (2019); Naah and Braun (2019); Sanou et al. (2019)
2018	2	Sanou et al. (2018); Zliobaite et al. (2018)
2017	4	Naah and Guuroh (2017); Tindano et al. (2017); Vall et al. (2017); Volpato et al. (2017)
2016	3	Bocksberger et al. (2016); Rasmussen et al. (2016); Zinsstag et al. (2016)
2015	5	Abdussamad et al. (2015); Brugière et al. (2015); Diarisso et al. (2015); Sanon et al. (2015); Traoré et al. (2015)
2013	1	Mueller (2013)
2012	1	Sawadogo et al. (2012)
2011	1	Ayantunde et al. (2011)

Year	Documents number	References
2009	2	Hiernaux et al. (2009); Savadogo et al. (2009)
2008	4	Kiem et al. (2008); Klop and Prins (2008); Savadogo et al. (2008); Traoré et al. (2008)
2007	1	Devineau and Fournier (2007)
2006	3	Jamnadass et al. (2006); Kiema and Sanon (2006); Thiollay (2006)
2005	1	Mortimore and Turner (2005)
2003	2	Madsen et al. (2003); Söderström et al. (2003)
1999	2	Devineau (1999); Hiernaux and Gérard (1999)
1998	1	Hiernaux (1998)

III - Results and Discussion

Different scholars dealt with the diversity of grasses and fodder trees in pastures and rangelands in BF and Niger. Madsen et al. (2003) identified 131 common vascular plant species in two reference sites located in traditionally managed agro-pastoral landscapes of the Sahelian and Sudanean zones of Burkina Faso, while Naah and Guuroh (2017) identified 135 species of forage plants in the area ranging from northern Ghana to central Burkina Faso. Naah and Braun (2019) point out that agro-pastoralists in northern Ghana and southern-central Burkina Faso exhibited extensive local ecological knowledge (LEK) on habitat types, forage species diversity, abundance trends, and ecological drivers. Furthermore, Naah and Guuroh (2017) show that both ethnicity and environmental harshness (e.g. aridity) can markedly shape the body of local ecological knowledge of agro-pastoralists on forage plants in Ghana and Burkina Faso. However, local knowledge is not always validated by and consonant with modern science as shown by Abdussamad et al. (2015) in the case of genetic variation and colour phenotypes of dromedaries in the Nigeria-Niger corridor.

Many scholars highlight that pastoralism and grazing reduce species abundance and/or richness, although a distinction between herbaceous and woody species is necessary in this regard. Sanou et al. (2018) argue that intensive grazing resulted in a reduction in species diversity and a change in species composition with a decrease in the richness of perennial grasses. The effect of pastoralism on species richness and abundance is particularly true for herbaceous species (Leßmeister et al., 2019; Savadogo et al., 2009). In their analysis of vegetation changes over the past decades in savannah ecosystem in south-eastern Burkina Faso, Leßmeister et al. (2019) found no change in species composition and richness of woody vegetation but their abundance decreased; meanwhile, there was a considerable change in the species composition of herbaceous vegetation and species richness increased; in particular, grazing leads to a decrease in the abundance of fodder herbaceous species preferred by the livestock. Hiernaux (1998) found no clear relationships between species response to grazing (in terms of species composition and spatial distribution) and palatability in Sadore (Niger). Referring to Burkina Faso, Mueller (2013) warns that *"In many areas, tiger bush vegetation had completely disappeared or had been dramatically reduced over the last 50 years probably as a result of increased anthropogenic pressure and grazing. Still existing tiger bush stands are often degraded"* (p. 153) and in Kotchari area (south-eastern Burkina Faso), while Savadogo et al. (2012) show that pastures located outside the protected area (W National Park) tend to be the most degraded with problems in trees regeneration and a decrease of perennial herbaceous species. However, the impact of pastoralism depends on grazing intensity (Leßmeister et al., 2019; Sanou et al., 2018). Hiernaux et al. (2009) argue that changes in grazing pressure, land use, and soil fertility triggered changes in species composition with a strong reduction in diversity from rangelands to fallows in Fakara region (Niger).

While many scholars highlight the negative effects of pastoralism on biodiversity, Zinsstag et al. (2016) point out the positive role of pastoralism in the conservation of biodiversity and put *"it*

appears that pastoral social ecological systems are hotspots of cultural and biological diversity. They are multifunctional in that they generate diversified sources of income and contribute to sustained natural resource management" (p. 693). In this respect, Devineau and Fournier (2007) argue that cattle herding does not affect herbaceous species richness in Sudan-type savannah (Bondoukuy, western Burkina Faso) and that there is no clear evidence of lower species richness due to this anthropogenic disturbance. Similarly, Jamnadass et al. (2006) suggest that grazing has not caused a loss of the genetic diversity of wild forage species in western Niger. Traoré et al. (2015) found that grazing was associated with more tree species and stem density in the Sudanian woodland of Burkina Faso and recommend revising the current regulation that prohibits grazing to accommodate herders' interests. Likewise, Savadogo et al. (2008) argue that in the Sudanian savannah-woodlands of Burkina Faso, over a 10-year period (1994-2003), grazing tended to favour perennial grasses diversity.

Pastoral activities have also an impact on wildlife (Brugière et al., 2015; Zliobaite et al., 2018). As a matter of fact, pastoralism can create competition with wild animals and, consequently, affect their diversity and abundance (Brugière et al., 2015; Zliobaite et al., 2018). For instance, Brugiere et al. (2015) suggest that pastoralism (especially mobile, transhumant pastoralism) may explain the extinction pattern of large predators (viz. lions, cheetahs, and wild dogs) in Western and Central Africa. Livestock species also compete with wild large herbivorous mammals (Zliobaite et al., 2018). Pastoralism can also affect the populations of birds in West Africa (Söderström et al., 2003; Thiollay, 2006); for instance, Thiollay (2006) postulates that hunting, and habitat degradation and fragmentation, mainly due to intensive cattle grazing and woodcutting, have contributed to a decline of the passerine bird community in the Sudanian belt of Burkina Faso.

Pastoral activities have also an impact on the diversity of domesticated animals. Many articles point out that indigenous livestock genetic resources are being eroded. One threat to indigenous livestock breeds is represented by uncontrolled mating. For instance, Abdussamad et al. (2015) highlight that dromedaries in the Nigeria-Niger corridor exhibit a high genetic diversity, which might be due to the continuous gene flow with other dromedary populations during transhumance. The erosion of the local livestock genetic resources goes hand in hand with that of the traditional, indigenous knowledge associated with local, indigenous breeds. For instance, Volpato et al. (2017) argue that the demise of pastoral livelihoods represents a serious threat to piebald (painted) camels across the Sahara and Sahel. According to Ayantunde et al. (2011), *"Pastoralism is not only a livestock-based livelihood strategy but also a way of life with socio-cultural norms and values, and indigenous knowledge revolving around livestock"* (p. 30) and any programme for the conservation of animal genetic resources or their improvement should consider the diversity of goals and preferences among livestock keepers (Tindano et al., 2017).

IV - Conclusions

This paper provides a comprehensive analysis of the literature dealing with the relation between pastoralism and biodiversity in Burkina Faso and Niger. In general, the scholarly literature shows a negative impact of pastoralism on plant diversity (in terms of richness, abundance and composition) and animal diversity (wild herbivorous mammals, predators as well as birds) in Burkina Faso and Niger. However, the literature analysis suggests that the effects of pastoralism are rather mixed; they are context-specific and depend on many factors (e.g. grazing intensity, livestock species). Effects on plant diversity differ between woody (trees and shrubs) and herbaceous species. There is a general trend towards the erosion of indigenous livestock genetic diversity due to uncontrolled mating and cross-breeding, but pastoral communities' traditional knowledge is fundamental for the conservation of local livestock breeds. Therefore, the present literature is far from being conclusive which highlights the need for future studies on pastoralism-biodiversity nexus. The review clearly shows the importance of science-informed and evidence-based tailored management of pastures and grasslands in

Burkina Faso and Niger to balance the twin imperatives of biodiversity conservation and pastoralism development.

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