Pro-ARIDES

Programme Agroalimentaire pour la Résilience Intégrée et le Développement Economique du Sahel

Strategic Study Action-Research

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Pastoralism in the Sahel: Contexts, complexities and curatives

A Case study from Niger

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This strategic study is part of the Pro-ARIDES programme's Action Research agenda. Pro-ARIDES is implemented by a consortium of four core partners (SNV, CARE, WUR, KIT) and a range of local partners, including six research partners. The study was conducted and coordinated by Wageningen University & Research (WUR, Netherlands), in collaboration with the Institut National de la Recherche Agronomique du Niger (INRAN, Niger) and the KIT Institute (KIT, Netherlands).

The findings, interpretations and conclusions expressed in this report are entirely those of the authors. They do not necessarily represent the views of Pro-ARIDES or any of the organisations involved in its implementation.

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Cette étude stratégique fait partie de l'agenda de Recherche-Action du programme Pro-ARIDES. Le Pro-ARIDES est mis en œuvre par un consortium avec quatre partenaires centraux (SNV, CARE, WUR, KIT), et une gamme de partenaires locaux, dont six partenaires de recherche. L'étude a été menée et coordonnée par Wageningen University & Research (WUR, Pays-Bas), en collaboration avec l'Institut National de la Recherche Agronomique du Niger (INRAN, Niger) et le KIT Institute, (KIT, Pays-Bas).

Les résultats, interprétations et conclusions exprimés dans ce rapport sont entièrement ceux des auteurs. Ils ne représentent pas nécessairement le point de vue de Pro-ARIDES ou de l'une des organisations impliquées dans son exécution.

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SUMMARY

There are multiple concerns regarding the sustainability and resilience of pastoral systems in the Sahel. These include demographic pressure, climate change, policy responses to utilisation of natural resources for livestock, increasing difficulty in accessing pastoral zones due to expansion of cultivated land, and deteriorating security conditions. Addressing these concerns is essential to enhancing the resilience of pastoral systems in the region and the livelihood of pastoral and agropastoral households, which is one of the objectives of Pro-ARIDES (Programme Agroalimentaire pour la Résilience Intégrée et le Développement Economique du Sahel). Given the importance of pastoral production systems to food security and livelihood in the project intervention areas in Burkina Faso, Mali and Niger, and in the Sahel in general, it is necessary to study the current trends in pastoral production systems and how the security challenge has impacted the resilience of the systems, food security and livelihoods of pastoral and agropastoral households. This study first focused on Niger as a case study and will later be extended to the other project target countries, Burkina Faso and Mali. The overall goal of this study was to have a better understanding of the evolution of pastoral production systems in the Sahel in view of the changing security landscape and the relevance of Pro-ARIDES interventions for the pastoralists, with a focus on Niger.

This study was conducted in five out of seven intervention 'communes' of Pro-ARIDES in the Tahoua region in Niger, namely Bangui, Galma and Sabonguida in Madaoua department, Dogaraoua commune in Malbaza department, and in Tsermaoua in Birni N'Konni department. To address the objectives of this study, data collection was conducted through household survey, focus group discussion and key informant interviews. Key results showed that the herd size of female-headed households was significantly lower than that of male-headed households. The results further showed that sex had a negative impact on food security status in the late dry season, which implies that female-headed households are likely to be in a worse food security situation compared to the male-headed households.

Generally, results from this study confirm that the challenge of food security is most critical in late dry and wet seasons for the pastoral and agropastoral households. The dominant livestock production system was extensive, though a significant proportion of the respondents also practiced transhumance. Results of regression analysis showed that commune (location), ethnic group, and cattle herd size had a significant positive effect on the duration of transhumance, whereas area of land cultivated had negative effects. Results further showed that the incidence of conflict over natural resource use was generally low in the study sites. Damage to crops, expansion of crop fields into grazing areas, and livestock routes were the most important causes of conflict. Results also showed that access to services by pastoralists and agropastoralists is still a big challenge. From the results, natural resources are still largely governed by traditional rules (oral or written) and the challenge with this is enforcement. So, strengthening the local conventions is important to improve access by the pastoralists. The most important effects of insecurity on pastoral and agropastoral systems were increased animal theft, reduced livestock mobility, changes in transhumance routes, and changes in grazing itineraries to avoid bandits. Addressing security challenges requires multifaceted measures with strong involvement of local communities in any national government initiatives. In general, the results on various questions on the evolution of pastoral systems and the security challenge tend to be context-specific, which requires customised curative measures.

To enhance resilience of pastoral and agropastoral households in the project areas, Pro-ARIDES interventions should be targeted to facilitate access to services, including virtually absent credit, strengthening of the local conventions governing natural resource use and management, capacity building in participatory conflict management, best animal husbandry practices, and training of community animal health workers. Given the context-specificity of many pastoral-related issues from

the results of this study, discourse on pastoralism should avoid over-generalisation. In addition, efforts should be made by Pro-ARIDES to tailor interventions to local contexts. Also, similar study should also be conducted in Burkina Faso and Mali, as the local contexts may be different on various pastoral issues when compared to the study sites in Niger.

Keywords: Pastoralism, Food security, Natural resource governance, Conflict management, Sahel

RÉSUMÉ

La pérennité et la résilience des systèmes pastoraux au Sahel sont menacées par de nombreux facteurs. Parmi ceux-ci figurent la pression démographique, le changement climatique, les réponses politiques à l'utilisation des ressources naturelles pour le bétail, la difficulté croissante d'accéder aux zones pastorales en raison de l'expansion des terres cultivées, et enfin la détérioration des conditions de sécurité. Il est essentiel de répondre à ces préoccupations afin de renforcer la résilience des systèmes pastoraux dans la région et d'améliorer les moyens de subsistance des ménages pastoraux et agropastoraux, ce qui est l'un des objectifs du programme Pro-ARIDES (Programme Agroalimentaire pour la Résilience Intégrée et le Développement Économique du Sahel). Compte tenu du rôle essentiel joué par les systèmes de production pastorale dans la sécurité alimentaire et comme moyen de subsistance dans les zones d'intervention du projet (Burkina Faso, Mali et Niger) et dans le Sahel en général, il est nécessaire d'étudier les tendances actuelles des systèmes de production pastorale, mais aussi l'impact des problèmes de sécurité sur la résilience des systèmes, la sécurité alimentaire et les moyens de subsistance des ménages pastoraux et agropastoraux.

Cette étude s'est d'abord intéressée au cas du Niger et sera ensuite étendue aux autres pays cibles du projet, le Burkina Faso et le Mali. L'objectif général était de mieux comprendre l'évolution des systèmes de production pastorale au Sahel compte tenu de l'évolution du contexte sécuritaire et de la portée des interventions du Pro-ARIDES pour les éleveurs. Cette étude a été menée dans cinq des sept communes d'intervention du Pro-ARIDES dans la région nigérienne de Tahoua, à savoir Bangui, Galma et Sabonguida (département de Madaoua), Dogaraoua (département de Malbaza) et Tsermaoua (département de Birni N'Konni). Afin d'atteindre les objectifs fixés, la collecte de données a été réalisée par le biais d'enquêtes auprès des ménages, de discussions de groupe et d'entretiens individuels avec des personnes ressources.

Les principaux résultats ont montré que la taille du cheptel des ménages dirigés par une femme était nettement inférieure à celle des ménages dirigés par un homme. Les résultats ont en outre mis en évidence que le genre avait un impact négatif sur la sécurité alimentaire à la fin de la saison sèche, ce qui signifie que les ménages dirigés par une femme sont plus susceptibles de faire face à une insécurité alimentaire que les ménages dirigés par un homme. De manière générale, les résultats de cette étude confirment que la sécurité alimentaire des ménages pastoraux et agropastoraux est particulièrement menacée à la fin des saisons sèches et humides. Le système de production animale dominant était l'élevage extensif, même si une proportion importante des personnes interrogées pratiquaient également la transhumance. Les résultats de l'analyse de régression ont montré que la commune (emplacement), le groupe ethnique et la taille du cheptel bovin avaient un effet positif significatif sur la durée de la transhumance, tandis que la superficie des terres cultivées avait un effet négatif. Les résultats ont également montré que l'incidence des conflits liés à l'utilisation des ressources naturelles était généralement faible dans les sites étudiés. Les dommages causés aux cultures, l'extension des champs cultivés dans les zones de pâturage et les routes empruntées par le bétail étaient les principales causes de conflit. Il est également ressorti que l'accès aux services par les éleveurs et

agropasteurs reste un défi majeur. Il apparaît que la gestion des ressources naturelles est encore largement soumise à des règles coutumières (orales ou écrites) et que leur application ne va pas de soi. Il est donc important de renforcer les conventions locales afin de faciliter leur accès aux éleveurs. Les effets les plus importants de l'insécurité sur les systèmes pastoraux et agropastoraux sont l'augmentation des vols de bétail, la mobilité réduite du cheptel, les changements dans les routes de transhumance et les changements dans les itinéraires de pâturage pour éviter les bandits. Pour relever les défis sécuritaires, il est nécessaire de prendre une série de mesures impliquant fortement les communautés locales dans chaque initiative mise en place par le gouvernement. De manière générale, le contexte de chaque région conditionne les résultats obtenus en matière d'évolution des systèmes pastoraux et de défis sécuritaires, ce qui nécessite des mesures ciblées.

Afin de renforcer la résilience des ménages pastoraux et agropastoraux dans les zones du projet, les interventions de Pro-ARIDES devraient viser à faciliter l'accès aux services, notamment au crédit qui est pratiquement inexistant, à développer les conventions locales régissant l'utilisation et la gestion des ressources naturelles, à renforcer les capacités dans le domaine de la gestion collaborative des conflits, à promouvoir de meilleures pratiques d'élevage et à former des techniciens communautaires spécialisés en santé animale. Compte tenu des spécificités contextuelles de nombreuses questions liées au pastoralisme mises en évidence par cette étude, le débat sur le pastoralisme devrait éviter toute généralisation excessive. Pro-ARIDES gagnerait à adapter ses interventions aux contextes locaux. Une étude similaire devrait également être menée au Burkina Faso et au Mali, où les contextes locaux peuvent différer de ceux observés au Niger.

Mots clés : pastoralisme, sécurité alimentaire, gestion des ressources naturelles, gestion des conflits, Sahel

ABBREVIATIONS

AREN	Association pour la Redynamisation de le L'Elevage au Niger
CARE	Cooperative for Assistance and Relief Everywhere
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GLM	General Linear Model
INRAN	Institut National de la Recherche Agronomique du Niger
KIT	Institut Royal des Tropiques
NGO	Non-governmental Organization
Pro-ARIDES	Programme Agroalimentaire pour la Résilience Intégrée et le Développement Économique du Sahel
SNV	Organisation néerlandaise de développement
TLU	Tropical Livestock Unit
WUR	Wageningen University & Research

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1 INTRODUCTION

*The **Programme Agroalimentaire pour la Résilience Intégrée et le Développement Économique du Sahel (Pro-ARIDES)** aims to strengthen resilience and improve the livelihoods of smallholder farms and agropastoral households in the Sahel drylands (Sudano-Sahelian zone of Burkina Faso, Mali and Niger), where climate variability, land pressure, and insecurity threaten rural livelihoods.*

Pro-ARIDES promotes climate-smart agriculture, sustainable land and water management, inclusive market systems, and improved local governance. It seeks to enhance farmers' and pastoralists' adaptive capacities, improve access to inputs and services, and support inclusive business models, while ensuring gender equality, youth employment, and social cohesion.

A distinctive feature is its strong focus on learning, evidence-based decision-making, and scaling. It combines action research (RA), monitoring-evaluation-learning (MEL), and knowledge management to generate evidence, inform policies, and foster systemic change across the Sahel region.

The programme is funded by the Dutch Ministry of Foreign Affairs and the Danish Cooperation Agency, and implemented by a consortium consisting of SNV (lead partner), CARE Netherlands, Wageningen University & Research (WUR) and the Royal Tropical Institute (KIT), closely working with local governments, research institutions, producer organisations, civil society, and private actors in the three countries. Pro-ARIDES is running from 2021 to 2025, with a second phase of scaling planned for 2026–2030.

During the action research process of Pro-ARIDES, strategic themes emerged from interactions with stakeholders, which partner organisations and donors recognised as important for the success of the programme and for the development of the second phase of the project. One of these themes selected for 2025 was: 'The inclusion of pastoralism in the programme and its contribution to resilience/food security of pastoralist and agro-pastoralist households.' This study was commissioned to address this identified theme to contribute to learning and co-development of knowledge on resilience of (agro)pastoral systems in the Sahel.

In this study, we follow the definition of pastoralism by FAO (2001) as an agricultural production system characterised by mobility of animals, with more than 50% of household gross revenue (i.e. the total value of marketed production plus the estimated value of subsistence production) from livestock or livestock-related activities (FAO, 2001). This definition covers transhumance pastoralism, which involves seasonal (regular or irregular) movement of the herds between well-defined territories, and agropastoralism (transhumance pastoralism combined with crop cultivation), which are the two dominant pastoral systems in Pro-ARIDES intervention areas.

2 CONTEXT

2.1 Pastoralism in the Sahel

Pastoralism plays important socio-economic roles in national and rural development in the Sahel (Ayantunde et al., 2011). Livestock contributes between 10 to 20% of national GDP in many Sahelian countries, and up to 40% of agricultural GDP (Amole et al., 2022). In Niger and Mali, the livestock sector is often second only to crops in economic weight. Live animals, hides, skins, and dairy are among the top non-mineral export products in these countries. Cross-border livestock trade generates hundreds of millions of USD annually, especially between Sahelian producers and coastal consumer markets (Nigeria, Ghana and Côte d'Ivoire).

Nomadic and transhumant pastoralism sustain the livelihoods of 25–40 million people, providing income, food, and cultural identity in rural areas with few alternatives (FAO, 2001). For example, livestock serve as a store of wealth for rural households moving in and out of the cash economy as market conditions fluctuate. Moreover, livestock products are important sources of protein in both urban and rural diets, with demand for milk and meat increasing dramatically as household incomes rise above the subsistence level. Livestock manure and traction are also seen as key parts of processes of agricultural intensification in agropastoral systems.

Pastoralism in the Sahel is characterised by high seasonal mobility, largely driven by the availability of grazing resources and water (Ayantunde et al., 2011; Benjaminsen and Ba, 2021). It promotes optimal utilisation of spatially heterogeneous availability of forage and water resources. Mobility also prevents degradation as it allows herdsmen to move their animals around and thus balance the stocking rate with the availability of rangeland resources. For example, the Fulani pastoralists take advantage of seasonal differentiation in rangeland conditions, through long-distance grazing movements along a north–south axis. Generally, mobile pastoralism is considered the most appropriate production system in drylands, because moving the herds opportunistically is the best way to exploit the highly variable availability, in space and time, of pasture and water resources.

However, there are multiple and interrelated concerns regarding the sustainability and resilience of pastoral systems in the Sahel.

First, there is concern over the ability of pastoral systems to accommodate growing human populations within the constraints of the resources available in dryland agro-ecosystems (Ayantunde et al., 2011; Benjaminsen and Ba, 2024). Rapid population growth has been blamed for demand-induced resource scarcity.

Second, there is the anxiety that pastoral production systems may not be sustainable because of the possible negative interactions between livestock and the land and water resources on which they depend. This concerns the over-exploitation of natural resources through the overstocking of grazing areas, which is a genuine concern given the growing livestock population in the Sahel, the increased ownership of livestock by farmers in the Sudano-Sahelian zone, and the encroachment of pastures by crop farming.

Third, there is apprehension over the appropriateness of policy responses to utilisation of dryland resources for livestock production (Benjaminsen and Ba, 2024) in view of the widespread negative perception of pastoralism by decision-makers in West Africa. Generally, in the Sahel, state policies tend to favour settled crop farming at the expense of mobile and flexible livestock production, which undermines not only pastoralists' access to land but also livestock keeping as an economic activity in general (Benjaminsen and Ba, 2024). Along this line of marginalisation of pastoralists in the national or local development policies and investment, pastoral resource management patterns have been

seriously reshaped, undermining pastoralists' livelihoods and contributing to degradation of their environment (Bonfoh et al., 2016).

Fourth, the deteriorating security situation due to jihadist insurgency in the Sahel is increasingly restricting herd mobility and has contributed to weaponisation of farmer-herder conflict (Berger, 2023). This security challenge is affecting a significant part of the Pro-ARIDES intervention areas in Burkina Faso, Mali and Niger. Related to the security challenge, the incidents of animal theft by armed groups, and the killing of herders are increasingly becoming common in the areas as the Fulani pastoralists are sometimes targeted by the bandits to steal their animals.

Fifth, the increasing difficulty of accessing grazing areas or pastoral zones due to a significant increase in the herds of sedentary people implies increased competition for grazing resources and water.

Sixth, many pastoralists have become salaried herders as much of the livestock herded are owned by absent owners such as government officials. This has reinforced concern about the sustainability of pastoral systems in the Sahel. Related to this concern is the erosion of livestock asset base to support pastoral livelihoods with decline in per capita livestock holdings in many pastoral communities (Ayantunde et al., 2011).

Seventh, there is a concern of climate change and variability in Sahel, which can negatively impact on herd mobility. For example, the severe droughts in the 1970s and 1980s in the Sahel led to the decimation of livestock herds, particularly cattle, and sedentarisation of many pastoralists to grow cops after they lost their herds (Zougmore et al., 2016). The narrative on climate change concerns is always linked to increased desertification in the Sahel, leading to resource scarcity, which may lead to conflict. The climate-desertification-conflict narrative on the Sahel consists of two elements: that climate change leads to drought and desertification, which in turn lead to scarcity, and that this scarcity causes migration and the emergence of new conflicts, or triggers existing, latent conflicts (Benjaminsen and Ba, 2021). Since it is largely rainfall that drives the dynamics of Sahelian ecosystems, global warming might, in the long run, lead to desertification – if it reduces rainfall. However, there is a general uncertainty on rainfall trends in the Sahel from the results of climate change models, while there is general agreement on higher average temperatures (Benjaminsen and Ba, 2021).

2.2 Evolution of Pastoralism in the Sahel

Pastoralism has long been a hallmark of the socio-economic and cultural landscapes of Sahel and West Africa, sustaining the livelihoods of over 20 million people (Turner and Schlecht, 2019). Pastoral systems in the Sahel have evolved significantly in the past six decades from highly mobile systems to increasingly sedentarised systems. This evolution of Sahelian pastoral systems is marked by adaptations to demographic pressure, a changing climate, and to government policies and initiatives to sedentarise the pastoralists (Thebaud and Batterbury, 2001). The history of evolution of pastoral systems includes migration and adaptation to drought, followed by increased competition for resources (grazing and water resources), and recent challenges like insecurity and climate change. Recurring drought is inherent to pastoral systems, and strategies to cope with it—aimed at saving herds and recovering rapidly from the crisis—include temporary migrations to southern and more humid areas, loans of animals, seasonal emigration to coastal countries for the purpose of wage labour and, in some cases, crop farming (Thebaud and Batterbury, 2001).

According to Thebaud and Batterbury (2001), adaptations of pastoralists to environmental conditions have changed since the Sahelian droughts of the 1970s, and particularly since the additional dry years of 1983–85. These adaptations are strongly linked to the complexity of activities to ensure access to resources; to conflicts and co-operation between ethnic groups; and to the role of the State in enhancing or constraining pastoral livelihoods. As a result of these adaptations, the occupational specialisation of the pastoralists as livestock keepers has also evolved, with an increasing number of

pastoralists growing crops in what is referred to as agropastoral systems, while some have migrated to peri-urban areas to to work as hired herders or in non-livestock-related sectors due to the decimation of their herds. This conversion to agropastoral economies where agriculture played an increasing role has meant some convergence of agropastoral systems, causing increasing competition for agricultural land and for pastures (Bassett and Zueli, 2000). On the other hand, farming communities have diversified into livestock ownership, to minimise their exposure to agronomic risks, thus blurring the traditional occupational specialisation by ethnicity. The increasing ownership of livestock by the crop farmers and growing crops by the pastoralists have led to increased competition for land and pastures. As a result, the transhumant pastoralist herds are no longer as welcome in some southern Sahelian regions for their contributions to soil fertility—through corralling their animals on harvested fields—as farmers tend to keep the crop residues for their own animals.

2.3 Pro-ARIDES Interventions

The overall objective of Pro-ARIDES is to contribute to resilience, food security and incomes of farming households in the Sudano-Sahelian zone of Burkina Faso, Mali, and Niger, through efficient institutions and decentralised organisations able to provide services, manage natural resources and land, and improve local economic development.

In achieving this objective, the programme targets farming, pastoral and agropastoral households and farming organisations in the Sudano-Sahelian zone of Burkina Faso, Mali and Niger in its interventions. Pro-ARIDES supports the adoption of climate-smart agriculture and the sustainable management of land and water resources, while fostering inclusive market systems and strengthening local governance. The programme aims to build the adaptive capacities of farmers and pastoralists, expand their access to inputs and services, and promote inclusive business models, with particular attention to gender equality, youth employment, and social cohesion. Due to the security situation in the Sahel and the mobility of pastoral communities, there have been limited interventions by the project regarding pastoral production systems and livelihoods.

Given the importance of pastoral production systems to food security and livelihood in the project intervention areas and in the Sahel in general, it is necessary to study the current trends in pastoral production systems and how the security challenge has impacted the resilience of the systems, food security and livelihoods of pastoral and agropastoral households.

3 OBJECTIVES OF THE STUDY

The overall goal of this study is to have a better understanding of the evolution of pastoral production systems in the Sahel in view of the changing security landscape and the relevance of Pro-ARIDES intervention for the pastoralists, with a focus on Niger as a case study. The specific objectives of this strategic study were:

- **O1.** To document the current state of pastoral production systems - herd dynamics, livestock ownership and management, mobility, and feed resources.
- **O2.** To assess the effects of the changing security landscape on pastoral production systems, food and nutrition security of pastoral households, changing policy and institutional contexts, and natural resource governance (access, control, use and benefit sharing), including power relations among key actors, and farmer-herder conflict.
- **O3.** To evaluate the relevance and effects of Pro-ARIDES interventions on natural resources and land management, value chains, income generation from livestock, social inclusion, and participation of pastoralists in local governance, including land tenure security, based on the pastoralists' perspective of the project.
- **O4.** To make recommendations on potential project interventions for the improvement of pastoral production systems.

The underpinning hypothesis for this study was that insecurity impacts negatively on (agro)pastoral production systems through restricted livestock mobility and access to natural resources, which can weaken the resilience of agropastoral households and food security. Specific research questions this study addressed were:

- **RQ1.** What are the trends of security challenges in the study site and the effects on agropastoral production in terms of livestock mobility, access to natural resources, particularly pastures and water, and household food security?
- **RQ2.** What are the measures to mitigate the negative effects of insecurity implementable by the agropastoral communities?
- **RQ3.** How do the Pro-ARIDES current interventions contribute to enhancing the resilience of (agro)pastoral households in the study area?

This study focused on Niger as a case study and can later be extended to the other project target countries, Burkina Faso and Mali.

4 MATERIALS AND METHODS

4.1 Study sites

This study was conducted in five out of seven intervention 'communes' of Pro-ARIDES in the Tahoua region in Niger, namely Bangui, Galma and Sabonguida in the Madaoua department, Dogaraoua commune in the Malbaza department, and in Tsermaoua in the Birni N'Konni department. A commune is the smallest administrative unit in Niger and dates from the decentralisation policies of the early 2000s. The selection criteria for these communes included accessibility, and dominance of pastoral or agropastoral production systems. The study areas are located between the isohyets of about 300 mm to 600 mm (Figure 1), though occasionally the annual precipitation can exceed 600 mm or can fall below 300 mm. The climate is of the Sahelian type, marked by two main seasons. The dry season lasts 7 to 8 months, from November to May. During this period, hot and dry winds from the Sahara Desert blow, the most dominant of which is called harmattan, from the northeast to southeast. This hinders normal living conditions on the southern fringe of the desert. The rainy season is relatively short, from June to September. The average temperatures in the area vary between 32° and 12°C in December and 42° and 28°C in May. The vegetation is dominated by annual Gramineae and annual dicotyledonous species, and woody species. The herbaceous species found in the study sites and in the Tahoua region in general include *Cenchrus biflorus, Tribulus terrestris, Dactyloctenium aegyptium, Alysicarpus ovalifolius, Eragrostis tremula, Aristida mutabilis, Ctenium elegans, Cencrhus preurii, and Brachiaria lata* (Ousseini et al., 2023). The main plant species included *Acacia albida, Acacia nilotica, Acacia raddiana, Acacia seyal, Balanites aegyptiaca, Bauhinia rufescens, Piliostigma reticulatum, Tamarindus indica, Ziziphus mauritania, Guiera senegalensis, Acacia senegal, and Combretum micrantum* (Ousseini et al., 2023).

The annual herbaceous biomass (kg DM/ha) of rangelands in the study sites varied markedly from 1,270 to 3,475 between 1999 and 2024 and was consistently above the average for the region (Figure 2).

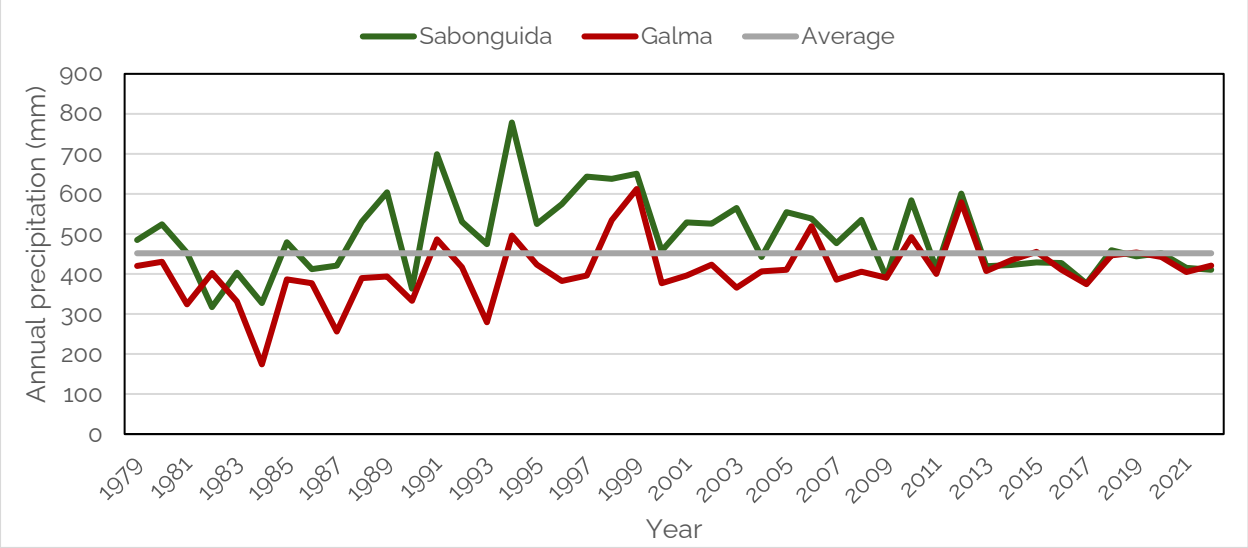

Figure 1: *Annual precipitation from 1979 to 2022 in Sabonguida and Galma communes in Madaoua department in Tahoua region, Niger - Data source: La Direction Nationale de la Météorologie du Niger.*

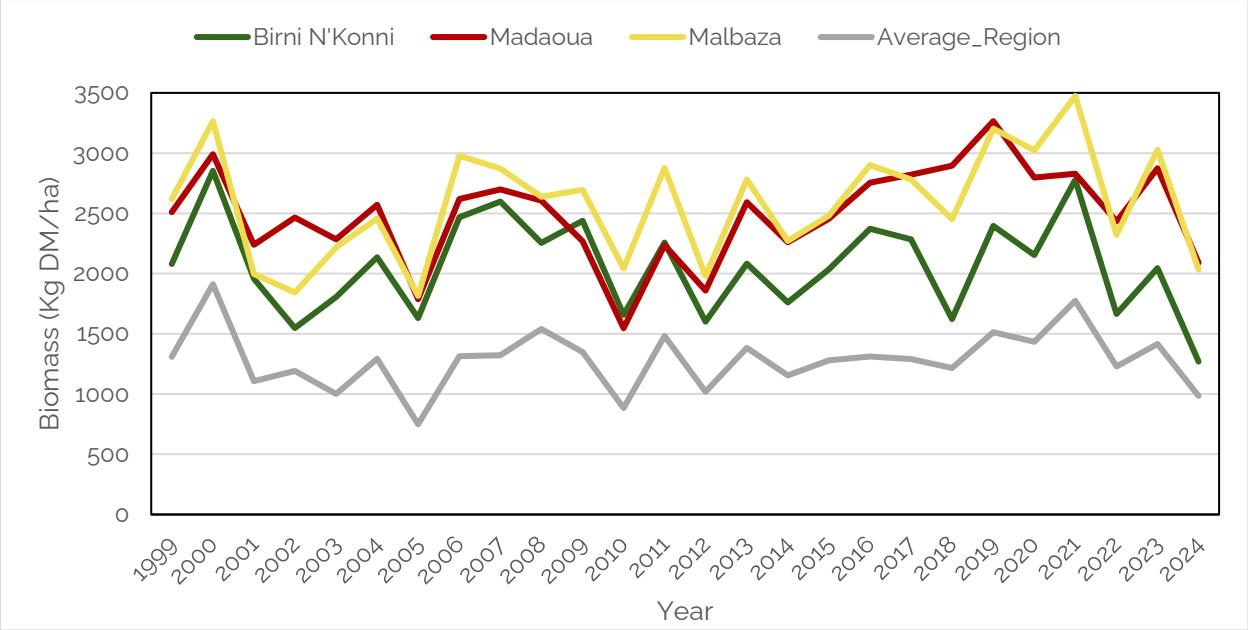

Figure 2 : Annual herbaceous biomass of rangelands from 1999 to 2024 in Birni N'Konni, Madaoua and Malbaza departments and the average for the Tahoua region - Data Source: Action Contre la Faim (ACF) https://data.humdata.org/dataset/acf_biomass_west-africa_vector - Accessed 27 May 2025).

4.2 Data collection and analysis

In this study, a household survey was conducted in five communes in the Tahoua Region, namely Bangui, Galma and Sabonguida in Madaoua department, Dogaraoua commune in Malbaza department, and in Tsermaoua in Birni N'Konni department. In each commune, at least 20 pastoral and agropastoral households were randomly selected and interviewed (household heads) for the household survey (Table 1) on the current state of pastoral and agropastoral production, and the effects of the changing security landscape and climate change on the production systems. The household survey also covered access to services by pastoralists and agropastoralists, household food security status, livestock mobility, perceptions on natural resource governance, and social inclusion in the community.

Table 1 :Information on participants interviewed per commune for different surveys – household survey, focus group discussion and key informant interview in Tahoua region, Niger

Department	Commune	Household survey (number of respondents)	Focus group discussion (number & participants)	Key informant interviews (number of respondents)
Malbaza	Dogaraoua	21	3 (about 8 per group)	5
Birni N'Konni	Tsermaoua	28	3 (about 8 per group)	6
Madaoua	Bangui	42	4 (about 10 per group)	6
	Galma	64	3 (about 15 per group)	7
	Sabonguida	40	4 (about 11 per group)	6
Total respondents for household survey		195		

The households selected were drawn from the baseline household lists compiled by the Pro-ARIDES programme. The selected households were currently involved in day-to-day management of their

herds to separate from pastoralists who have settled down in peri-urban areas who are no longer involved in herd management. At least two focus group discussions were held in each commune to explore the effects of changing security landscape on livestock mobility, natural resource governance including relations among key actors, and farmer-herder conflict. The perception of the pastoralists and agropastoralists of the relevance of Pro-ARIDES programme interventions was also discussed in the focus group.

The key informant interview focused on the effect of changing security situation on pastoral and agropastoral production, strategies to enhance resilience of the systems, and the perception of the pastoralists and agropastoralists on the relevance of Pro-ARIDES interventions. The key informants interviewed were those who have strong experience in (agro)pastoral systems in the Sahel and come from the governmental institutions, including local government authorities, pastoral and agropastoral networks, Non-Governmental Organizations (NGO) working on pastoral issues, and community associations. The surveys were conducted in May 2025. The survey tools were first pre-tested, and the enumerators were trained before the administration of the semi-structured questionnaires. The household survey questionnaire was transferred to the Kobo toolbox format so that the enumerators could collect the data digitally. The focus group discussion and key informant interview data were collected manually.

Data analysis was performed with SAS 9.4 (Statistical Analysis System (SAS) Institute, 2016) using Means and Frequency Procedures for descriptive statistics. The general linear model (GLM) procedures for variance and regression analyses were used to assess whether there were relationships between household herd size and practice of transhumance production system for cattle, sheep or goat. The logistic procedures for binary response were used to predict the probability of practicing transhumance production system based on the socio-economic profiles of the respondents such as age, sex, ethnicity, duration of residence in the community, household size and herd size as independent variables. Duncan tests were used for comparison of means across study sites (communes) of quantitative variables such as age, household size, duration of residence in the community, area of land owned and rented, and herd size. The level of significance was set at $P < 0.05$, unless otherwise indicated.

4.3 Limitations of the applied methodology

The methodology used in this study, namely a household survey through interviewing the household heads, focus group discussion and key informant interviews, is associated with common limitations of qualitative research. The limited scope of the methodology implies that the findings are often specific to the context. This might partly explain the results of the study, which are largely contextual in nature. Another limitation also related to the qualitative research methodology is the absence of standardised procedures, for example, in the interview of the household heads, which might not eliminate enumerators' bias. To avoid this, the enumerators were trained and provided with guidelines on how to conduct the interviews. The group effect and domination by a few participants in the focus group discussion might have influenced the responses on some issues. Related to this is the social desirability bias, which could influence participants' responses in the focus group discussion. To minimise the possible effect of group domination by a few participants and social desirability bias in the focus group discussion, the facilitator intervened from time to time to allow most participants to express their views. Another limitation of the applied methodology is the risk of participants withholding information, especially on sensitive issues like causes and effects of insecurity in the study sites. To address this challenge, the enumerators were selected from the region (Tahoua) who are fluent in the dominant local languages (Hausa and Fulfulde) of the respondents, as this is necessary to build trust and to facilitate interactions.

5 RESULTS AND DISCUSSION

5.1 Agropastoral and pastoral households

5.1.1 Socio-economic profiles

The means (± standard error) of age (years), years of residence in the community and household size of the respondents interviewed for the household survey in the study sites are presented in Table 2. The mean age of about 50 years of the respondents in this study is similar to the results from Moussa et al. (2023) from the study of typology of farming systems in the pastoral zone in the Tahoua region. The average ages of the respondents in Dogaraoua, Tsermaoua and Galma were significantly higher for males than for females (Table 3). The higher age of the male is generally the trend in most communities in rural areas of sub-Saharan Africa. There was no statistically significant difference in the mean ages of those interviewed in the five communes. Most respondents had resided in the study sites for at least 30 years. The respondents in Bangui had the highest household size of 11.14±0.73, which is significantly higher than respondents in the remaining four communes, where average household size ranged from 7.29±0.55 in Tsermaoua to 9.14±1.02 in Dogaraoua. Household size is important in terms of labour for cropping and livestock activities, for example, herding of livestock.

Table 2. Means (± standard error) of age (years), years of residence and household size of the respondents interviewed for the household survey in the study sites

Commune	Age	Residence	Household size
Dogaraoua	49.71±2.26^{a}	30.38±3.61^{c}	9.14±1.02^{b}
Tsermaoua	49.89±2.55^{a}	49.50±2.60^{a}	7.29±0.55^{b}
Bangui	53.38±2.07^{a}	42.76±3.23^{ab}	11.14±0.73^{a}
Galma	47.34±1.75^{a}	40.61±1.95^{ab}	7.97±0.44^{b}
Sabonguida	50.10±2.35^{a}	39.78±3.58^{b}	8.93±0.57^{b}

Values in the same column with different superscripts are significantly different (P<0.05)

Table 3. Means (± standard error) of age (year) of the respondents interviewed for the household survey by sex for each commune in the study sites

Commune	Male	Female
Dogaraoua	53.50±3.22^{a}	46.15±2.69^{b}
Tsermaoua	52.82±2.83^{a}	39.17±3.43^{b}
Bangui	53.81±2.78^{a}	52.60±3.04^{a}
Galma	49.57±1.92^{a}	35.30±2.77^{b}
Sabonguida	49.14±2.85^{a}	52.33±4.25^{a}

Values in the same row with different superscripts are significantly different (P<0.05)

At least 80% of all the respondents in the household survey were married (Figure 3). This is expected as household heads were interviewed. Except in Bangui commune, where two respondents were single, there was no single respondent in any other communes. All the households interviewed were either pastoral or agropastoral as the survey focused on pastoral and agropastoral systems. From the results on the types of households interviewed presented in Figure 4, 71%, 29%, 48%, 70% and 38% of the households in Dogaraoua, Tsermaoua, Bangui, Galma and Sabonguida, respectively, were pastoral. In three of the five communes where the study was conducted, the agropastoral households accounted

for more than 50% of the respondents. The results reaffirm the growing trend of pastoralists in West African Sahel settling down to cultivate crops in addition to livestock husbandry. This has been the trend since the severe droughts in the early 1980s, which decimated the herds of many pastoralists. Hence, growing crops in addition to livestock husbandry has been one of the adaptation strategies of the pastoralists to climate change and variability (Zougmoure et al., 2016). The dominant ethnic group in the study sites is the Fulani (Figure 5), as pastoralism in the West African Sahel is dominated by them (Ayantunde et al., 2011). In the Galma and Sabonguida study sites, the Tuareg ethnic group was reported to practice pastoralism or agropastoralism. The Tuaregs have been reported as one of the major pastoralist ethnic groups in the Sahel (Oxby, 2011).

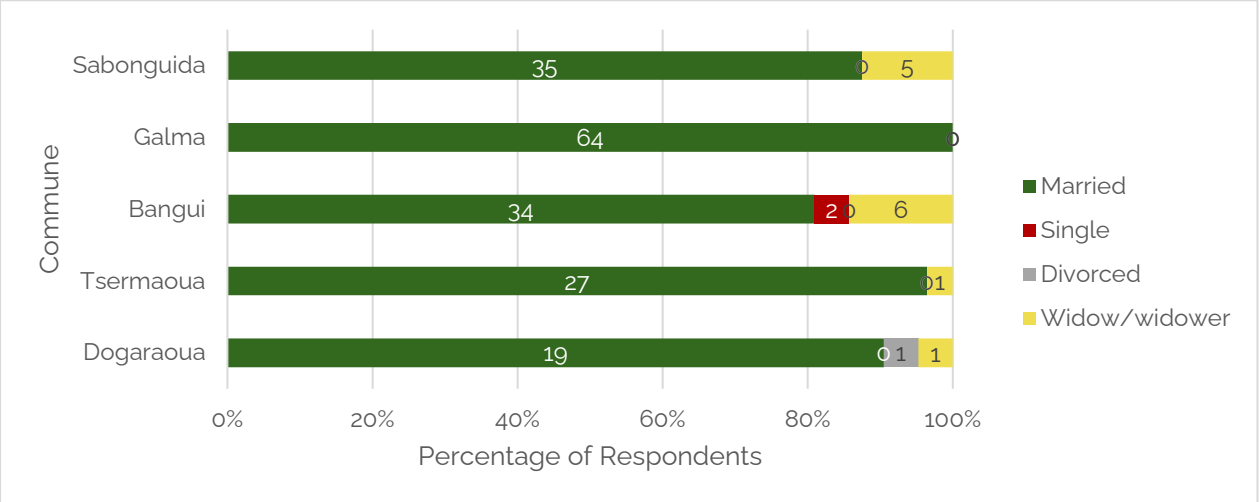

Figure 3. Marital status of the respondents of the household survey in the study sites (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

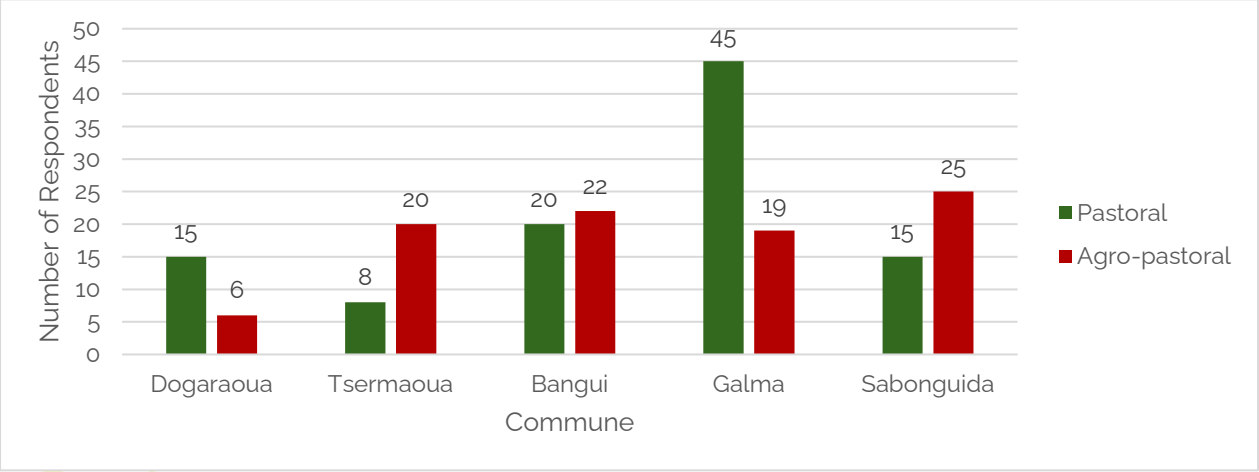

Figure 4. Types of households interviewed in the household survey in the study sites.

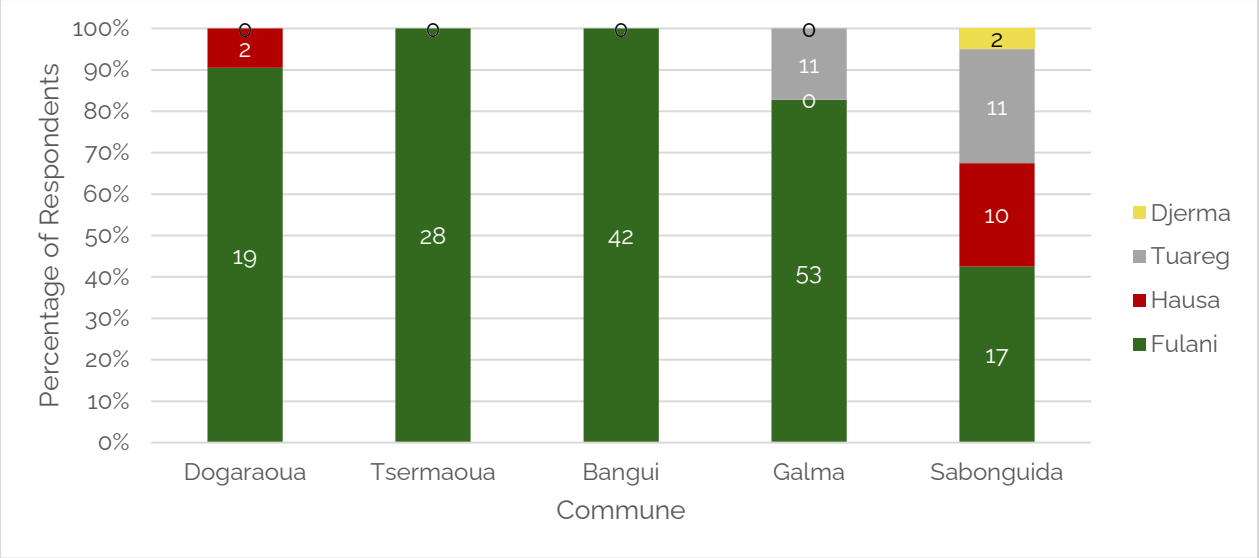

Figure 5. Ethnic groups of the respondents of the household survey in the study sites (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

In all the study sites, at least 40% of the respondents were illiterate, that is, they could not read or write (Figure 6). Between 11 and 47% of the respondents in the study sites had Koranic education, meaning they were literate in Arabic. Four respondents in Bangui and four in Sabonguida had primary school education, while one respondent in Tsermaoua and one in Sabonguida had secondary school education. The results confirm a general low level of formal education among the pastoralists and agropastoralists in this study, which agrees with results reported by Moussa et al. (2023) in a study on pastoral and agropastoral households in the Tahoua region. The low level of formal education has implications in terms of dissemination of knowledge on best animal husbandry practices by the extension services and in terms of adoption of agro-technical technologies, as reported by Umutoni and Ayantunde (2024), who found that formal education had a positive impact on awareness and use of improved livestock feed technologies among agropastoral households in Niger. Moreover, Lunacek (2023) reported that in Niger, participation in pastoral networks or associations is often limited to people from pastoralist families who have received formal schooling. The challenge with representation of the pastoralists by those who received formal schooling is that, due to prolonged absence from the daily life of herding, their logic, aspirations and attitudes towards change and development can diverge significantly from those of their relatives practicing mobile pastoralism. The general low level of education among the pastoralists has attracted policy interventions of governments in the Sahel by introducing mobile education for the children of nomadic and transhumant pastoralists, such as open distance learning in the family environment, using accessible technology (e.g. radio) and temporary contact with a teacher, as a way to follow the national curriculum in order to provide access to further schooling. Another learning approach for the children of mobile pastoralists is network schools, where the pupils change schools according to the places where the camp moves. These were tested recently (Dyer and Echessa, 2019), with the aim to provide access to fixed formal schools while a child is moving with the family.

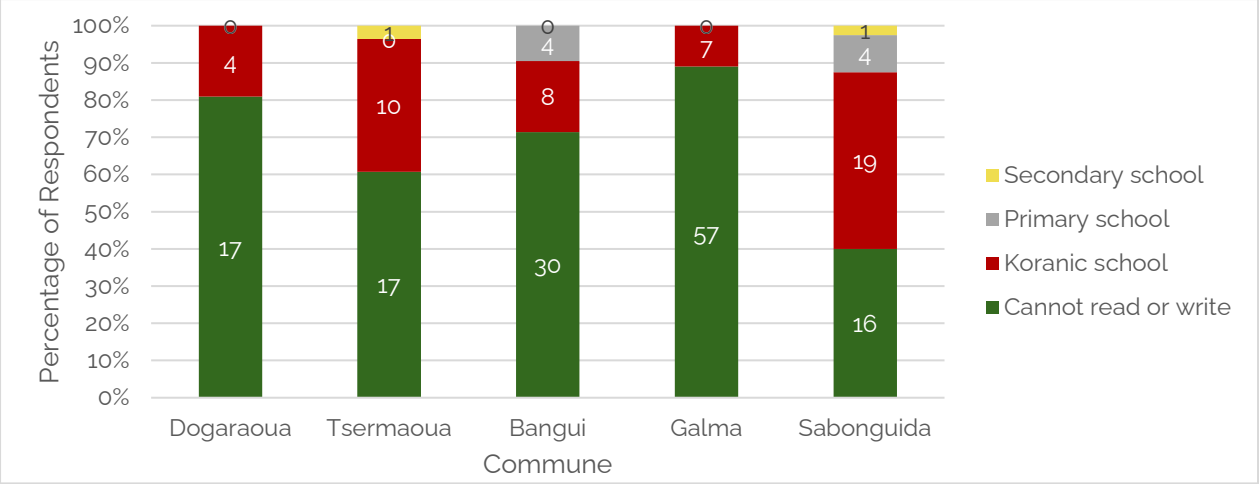

Figure 6. Education level of the respondents of the household survey in the study sites (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

The primary activities and occupations or means of livelihood of the respondents were animal husbandry and mixed crop-livestock farming (Figure 7), which reflects the types of households interviewed in the survey. In Dogaraoua, about 52% of the respondents reported livestock commerce as their primary activity, which was not the case in any other study site. However, this does not mean that these respondents are no longer engaged in animal husbandry. Instead, they spend more time in livestock trade, particularly buying animals from different villages for sale at the livestock markets. Some of them also serve as intermediaries for livestock owners to sell their animals. The principal sources of revenue of the respondents reflect their primary activities (Figure 8). These were from livestock, agriculture, crop and livestock commerce, in descending order. Other sources of revenue were from enterprises (non-agricultural and non-livestock commerce), and to a limited extent from remittances.

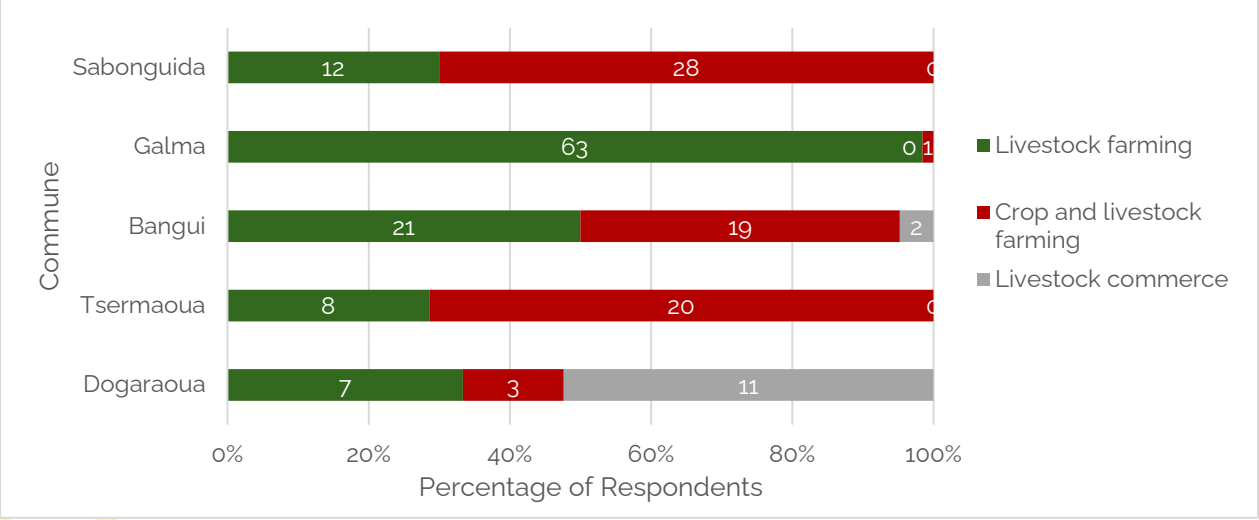

Figure 7. Primary activities of the respondents of the household survey in the study sites (number of respondents: Dogaroua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

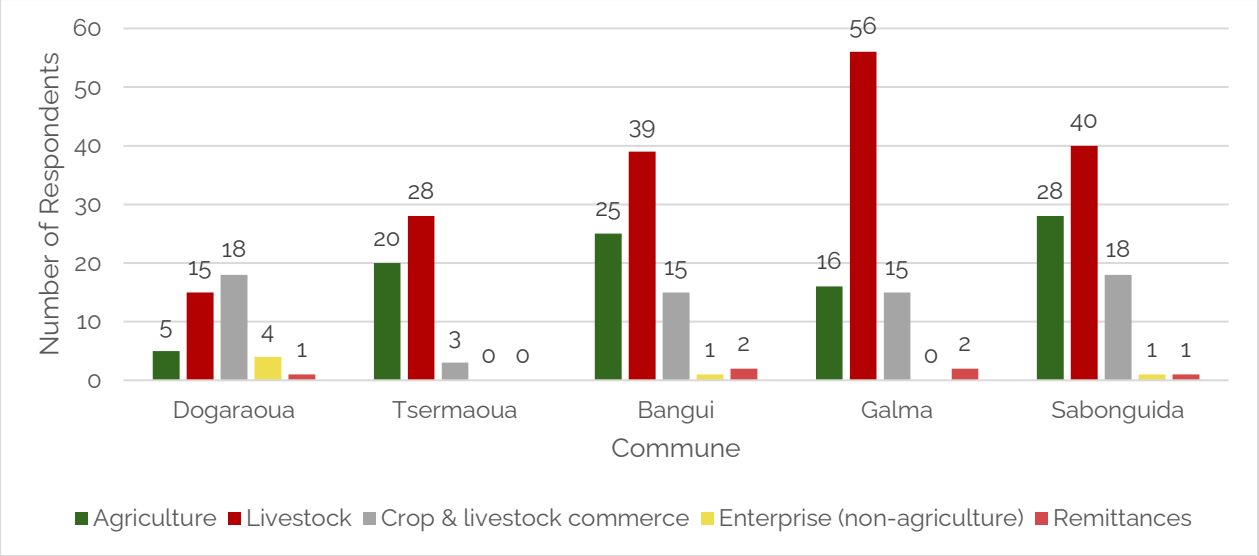

Figure 8. Principal sources of revenue of the respondents of the household survey in the study sites.

5.1.2 Assets

Results from the household survey showed that the average area of land owned for cultivation by the respondents ranged from 0.52±0.31 ha in Dogaraoua to 4.68±1.40 ha in Tsermaoua (Table 4). The area of land owned by the respondents varied significantly across communes. This suggests that land availability for cultivation is location specific. The areas of land rented for cultivation by the respondents in the study sites were significantly lower than the areas of land owned, and these also varied considerably across the study sites. The regression of area of land owned by the respondents on commune (study site), age, sex, ethnic group, residence and household size showed that respondents in Tsermaoua had a significantly larger area of land than other communes (Table 5). The regression analysis also showed that the area of land owned (land accumulated over the years) increased with age and that respondents of the Hausa ethnic group had a larger area of land for cultivation compared to other ethnic groups in the study sites (Fulani and Tuareg). The results of higher land area owned by respondents from the Hausa ethnic group are expected, as they are traditionally crop farmers, while the Fulani and Tuareg are traditionally livestock keepers. Despite the farming tradition of the Hausas, some Hausas in the study sites are engaged in livestock husbandry, which could be a livelihood diversification strategy.

Table 4. Means (±standard error) of land area owned and rented (ha), and household herd/flock size and herd/flock from outside the household (in TLU[a]) of cattle, sheep and goat in the study sites

Variable	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Land owned	0.52±0.31^{b}	4.68±1.40^{a}	1.50±0.22^{b}	1.11±0.19^{b}	1.78±0.35^{b}
Land rented	0.86±0.23^{a}	0.96±0.54^{a}	0.36±0.12^{b}	0.03±0.02^{b}	0.20±0.09^{b}
Cattle owned	6.83±1.59^{a}	6.45±1.72^{a}	8.07±0.96^{a}	6.06±0.71^{a}	8.44±1.82^{a}
Cattle from outside	1.03±0.55^{a}	1.35±0.38^{a}	1.19±0.44^{a}	2.42±0.85^{a}	1.93±1.04^{a}
Sheep owned	1.09±0.30^{a}	0.66±0.15^{a}	1.17±0.14^{a}	1.28±0.32^{a}	2.37±1.12^{a}
Sheep from outside	0.04±0.01^{b}	0.02±0.01^{b}	0.82±0.17^{a}	0.25±0.09^{a}	1.22±0.38^{a}
Goat owned	0.62±0.12^{a}	0.76±0.14^{a}	0.16±0.04^{b}	1.25±0.10^{a}	1.57±0.25^{a}
Goat from outside	0.03±0.01^{a}	0.12±0.07^{a}	0.03±0.01^{a}	0.30±0.10^{a}	0.19±0.06^{a}

[a]TLU (Tropical Livestock Unit is standard animal of 250 kg liveweight; Cattle = 0.7 TLU; Sheep/goat -= 0.1 TLU); Values in the same row with different superscripts are significantly different (P<0.05)

Table 5. Results of regression analysis of factors influencing area of land owned by the respondents in the study sites (R^2 = 0.1918).

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-1.50420	0.83735	30.79940	3.23	0.0740
Tsermaoua commune	3.53336	0.63439	296.07731	31.02	<.0001
Age	0.05310	0.01609	103.98093	10.89	0.0012
Hausa ethnic group	2.11606	0.92604	49.83556	5.22	0.0234

At least 50% of the respondents in each study site owned land for cultivation except in Dogaraoua, where only 19% owned land for cultivation (Figure 9). More respondents in Dogaraoua reported renting land (52%) than owning land, while 29% of the respondents did not own or rent land. The three crops commonly cultivated in the study sites were millet, sorghum and cowpea, according to the respondents (Figure 10). These results are expected as these three crops are the dominant crops grown in the Sahelian agro-ecological zone. Few respondents reported growing maize in Galma and Sabonguidan. Growing crops is one of the adaptation strategies of the pastoralists to deal with losses of their livestock herd due to droughts, and the trend will most likely continue due to climate change and variability in the Sahelian region.

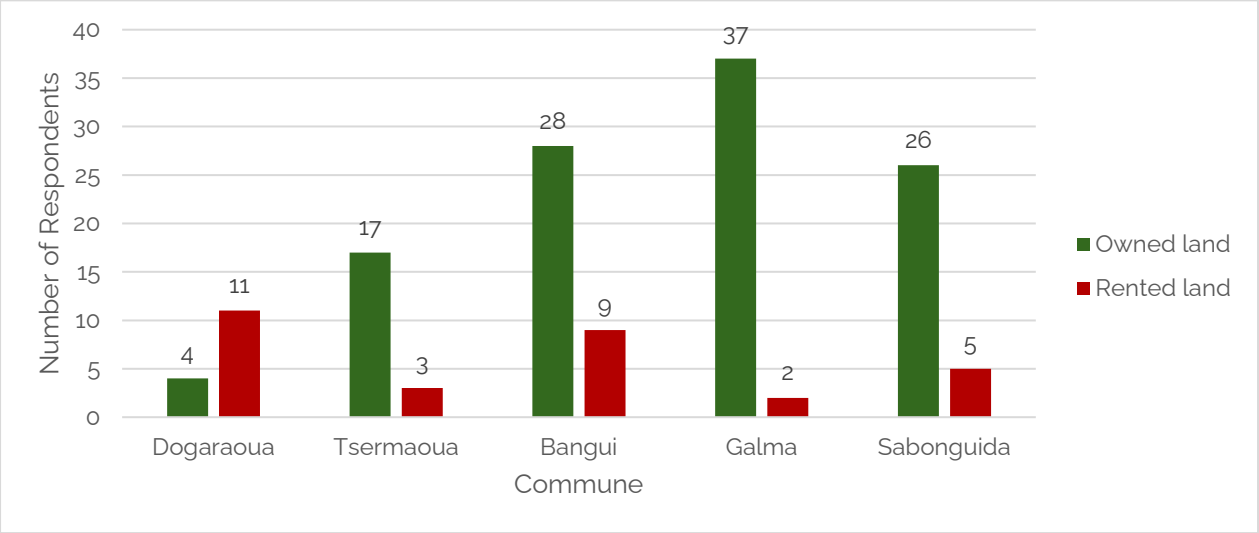

Figure 9: Number of respondents in the study sites who owned and rented land for cultivation in the study sites (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

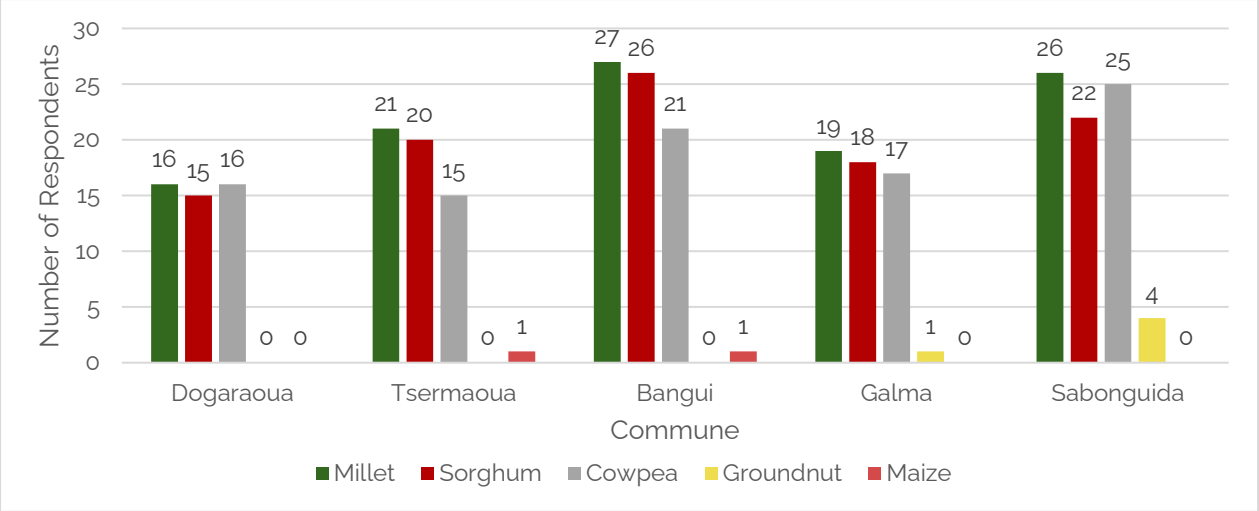

Figure 10: *Principal crops cultivated by the respondents in the study sites (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)*

The herd size of cattle owned by the respondents ranged from 6 to 8 TLU on average per household across the study sites (Table 4). There were no significant statistical differences in average cattle herd size across the study sites. It should be emphasised that data on herd size reported by pastoralists should be treated with caution, as they have been reported to conceal their actual herd size for different reasons (Ayantunde et al., 2000). However, the data could be interpreted as a reflection of the trends in terms of livestock ownership. The cattle herd also consisted of cattle from outside managed by the household, which ranged from 1.03±0.55 in Dogaraoua to 2.42±0.85 TLU in Sabonguida. Herding of cattle from outside the household by the pastoralists has been an emerging trend in the past three decades, partly due to the decimation of the pastoralists' herd by droughts and due to the growing trend of absentee owners, often urban elites who own herds but rely on hired herders to manage them (Unusa, 2012). The flock sizes of sheep and goat owned by the household were significantly lower than those of cattle, which confirms that cattle are the preferred animal of the pastoralists (Ayantunde et al., 2011) as the cultural status of a Fulani is linked to cattle herd size (Ayantunde et al., 2000). Traditionally, livestock keepers in pastoral and agropastoral systems have kept precautionary savings and self-insurance by building up assets (bigger herds) in good years to allow 'acceptable' levels of depletion in bad years. There is a strong motivation among pastoralists to accumulate large herds as a risk-reduction strategy, and it is widely assumed that pastoralists will build up herds to the highest levels in non-drought times (Ayantunde et al., 2011). Of course, the challenge with this is the tendency to have high cattle numbers that may be difficult to feed during the dry season, which is often characterised by feed scarcity.

The regression of household cattle herd size owned with age, sex, household size, ethnicity, education level, years of residence and size of land owned for cultivation showed that age, sex and household size had significant effects. According to the results, women owned significantly fewer cattle, while cattle herd size increased significantly with age and household size. For sheep and goats, regression analysis showed that ethnicity was the main factor influencing flock sizes. The results showed that respondents from the Tuareg ethnic group had significantly higher sheep and goat flock size than respondents from the Fulani and Hausa. For centuries, the Tuareg economy was based on camel herding and trans-Saharan trade, but nowadays, some Tuareg are nomadic (camel and sheep/goat herders) or semi-nomadic (combining herding with horticultural activities) (IFAD, 2022). The logistic regression for binary response showed that the likelihood of practicing transhumance production system for cattle and sheep by the respondents is determined solely by the herd size, which means the

higher the household cattle and sheep herd size, the higher the probability of practicing transhumance but there was no such trend for goats. The logic of going on transhumance when the household has a high cattle herd size makes sense in order to feed the animals, particularly during the dry season which is often marked by feed scarcity.

The most common origin of the cattle, sheep and goat in the household herd/flock was inheritance from parents and relations (Figure 11a, b and c), according to the respondents.

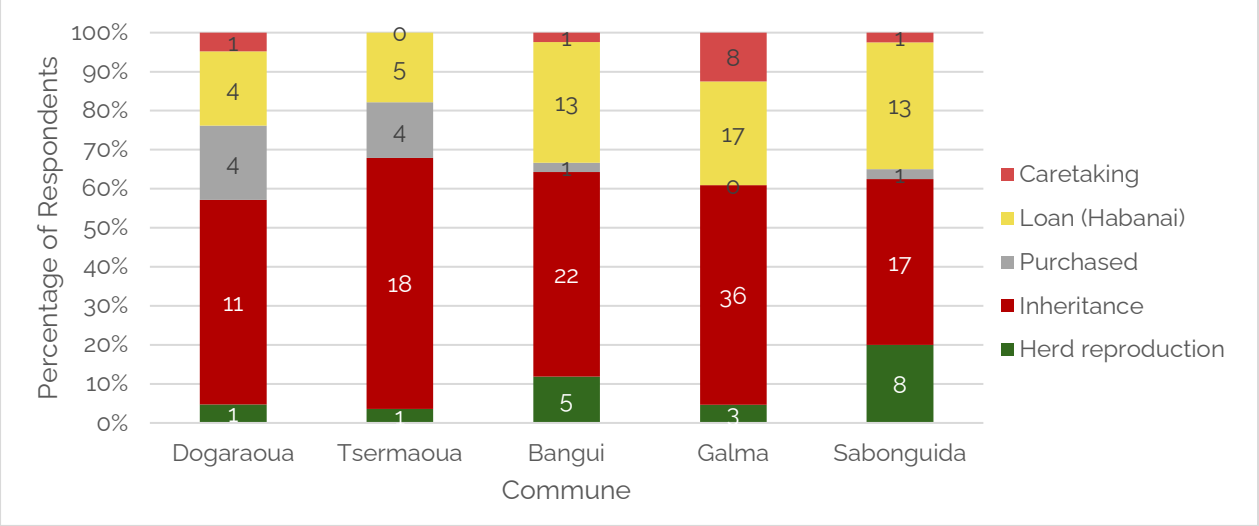

Figure 11a. Origin of the cattle in the household herd according to the respondents in the study sites

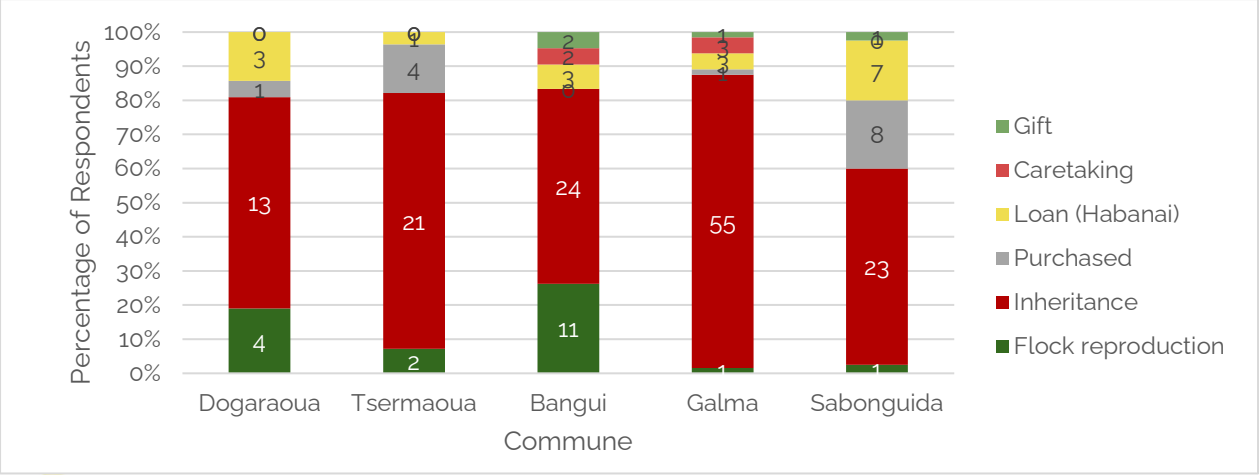

Figure 11b. Origin of sheep in the household flock according to the respondents in the study sites

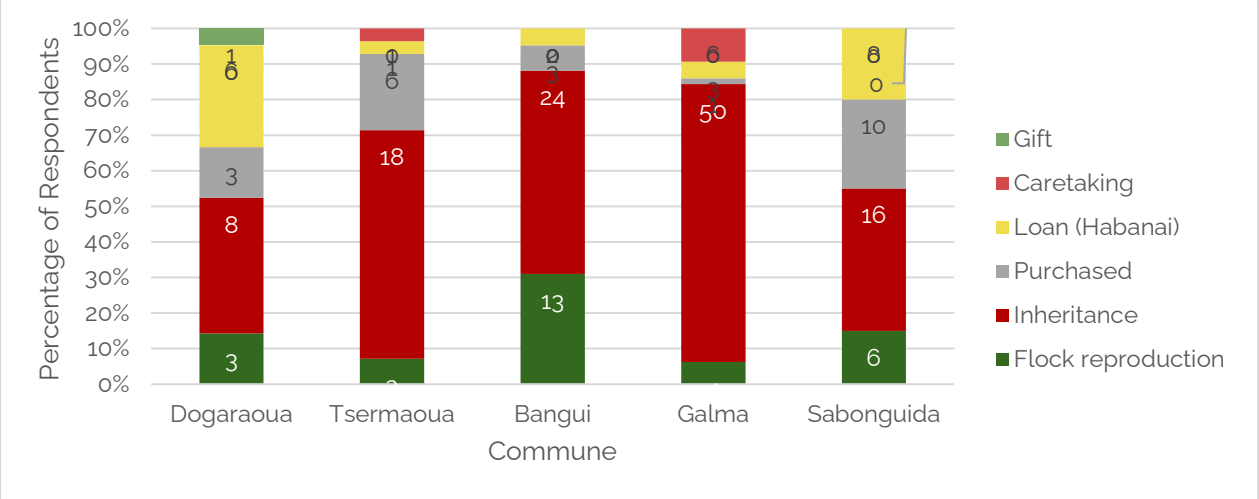

Figure 11c. Origin of sheep in the household flock according to the respondents in the study sites

Another common source of animals in the herd/flock is loan, which is called 'habanai' in Fulfulde. Habanai is a traditional loan arrangement among the Fulanis, which entails lending a pregnant cow or heifer to relations or friends (IFAD, 2022). Under this arrangement, the livestock keeper borrowing the lactating cow or heifer will keep the animal for two or three births before returning the cow to its owner. All calves that are born during the loan period belong to the loanee. This traditional credit facility is seen not simply as an economic loan but as a way to cement relations and friendships. Though it was originally meant for cows/heifers, it has extended to small ruminants and has extended beyond the Fulani. Other sources of household livestock herd/flock were herd reproduction, purchase and caretaking. For sheep and goats, some respondents also mentioned gifts as a source of animal in the household flock.

5.1.3 Food security

Results of questions on the household food security status showed that at least 60% of the respondents reported 'insufficient' or 'just sufficient' as food security status in all the study sites in both wet and late dry seasons (Figure 12). The reported food security status of the households was best during the early dry season, which is the harvest period. Between 35 and 60% of the respondents reported their food security situation as sufficient during this period. The results confirm that late dry season and the early part of the wet season are the critical periods for household food security in the Sahel (de Leeuw et al., 2020). For the pastoralists, the late dry season and early period of wet season correspond to a period of low feed resources for cattle and the consequent low milk yield. Given the importance of milk consumption in pastoralists' food consumption, the low milk yield impacts negatively on their food security status, as it has been observed that there is a positive association of milk consumption with the overall food security of pastoral households.

To address the food security challenge, nearly all the 195 households (except 3) reported purchase of food in the previous year (Figure 13).

The most common food types purchased by households were cereals, namely millet and sorghum, and cowpea. Some respondents reported the purchase of maize (Figure 14). The purchase of cereals by the pastoral households in the Sahel for consumption has been widely reported (Turner et al., 2021).

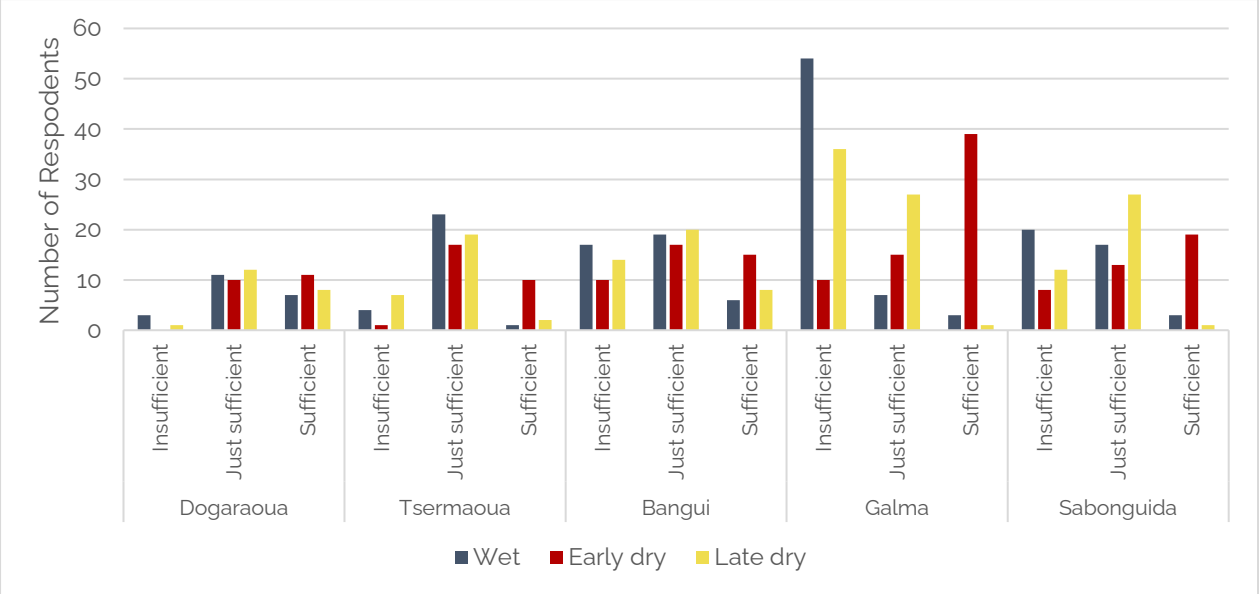

Figure 12: Household food security status across seasons as perceived by the respondents in the study sites

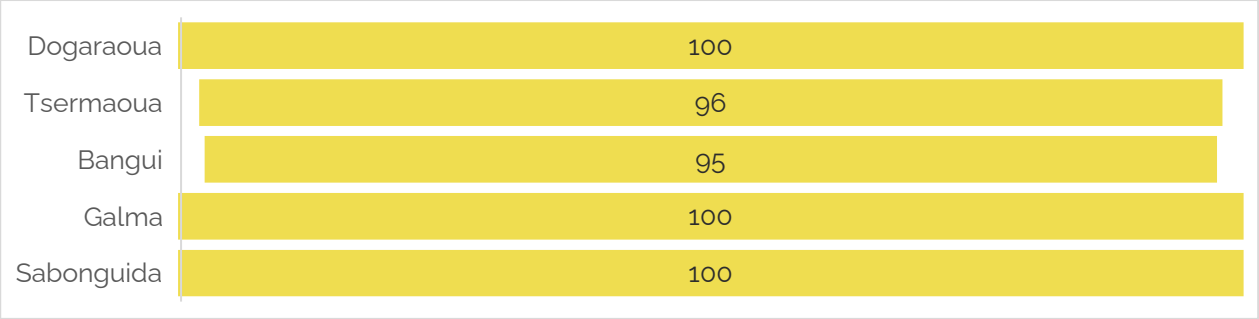

Figure 13: Percentage of respondents who bought food for household consumption in the previous year (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

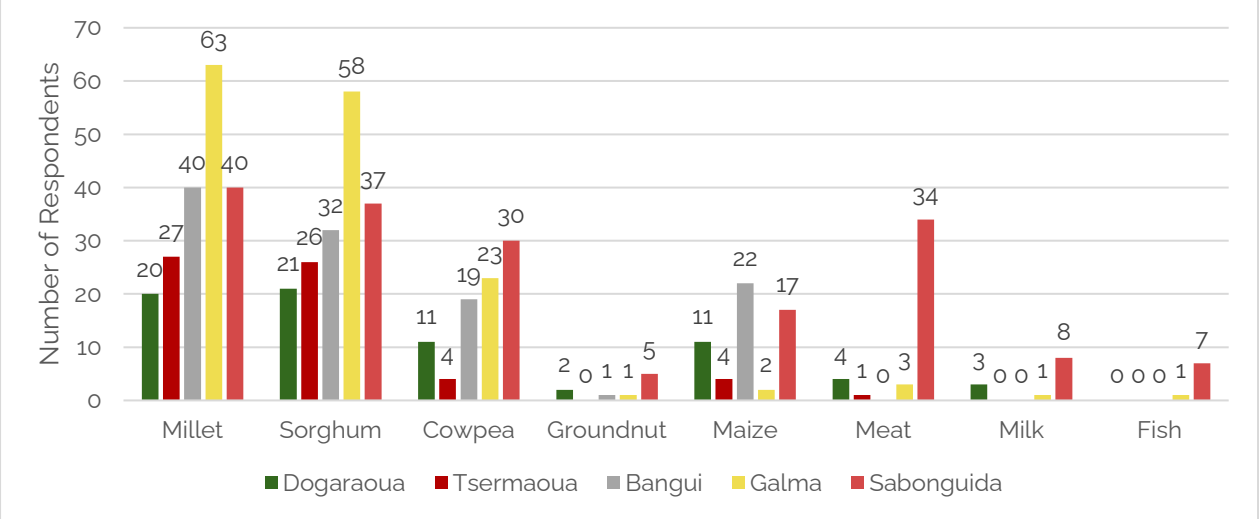

Figure 14: Food types purchased by the respondents in the study sites (number of respondents: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

Results of the monthly distribution of the purchase of food by the households varied by season and by study site (commune), as presented in Figure 15. The combined data of the study sites showed clearly that the months of the year when the purchase of food was more frequent were from March to August, which corresponds to the late dry season and wet season (Figure 16). The early dry season, which corresponds to the harvest season, was the period when the frequency of purchase of food by the household was lowest. Again, the results confirm the late dry season and wet season as a hunger period in the West African Sahel. For the pastoralists, this period corresponds to a season of forced sales of livestock to purchase cereal to avoid total loss through mortality (Ayantunde et al., 2011).

Table 6. Means (±standard error) of the number of meals per day for the household at different seasons and the number of months with insufficient food for the household in the study sites

Variable	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Wet season (Jun-Oct)	1.76 ± 0.18^{c}	2.46 ± 0.10^{b}	1.83 ± 0.11^{c}	2.03 ± 0.02^{c}	2.80 ± 0.12^{a}
Early dry season (Nov – Jan)	1.81 ± 0.19^{c}	2.54 ± 0.13^{b}	1.83 ± 0.08^{c}	2.41 ± 0.06^{b}	3.00 ± 0.11^{a}
Late dry season (Feb – May)	1.67 ± 0.19^{d}	2.36 ± 0.12^{b}	1.74 ± 0.08^{d}	2.03 ± 0.02^{c}	2.80 ± 0.12^{a}
Number of months with insufficient food	2.52 ± 0.33^{b}	2.86 ± 0.38^{b}	2.50 ± 0.44^{b}	4.16 ± 0.31^{a}	3.55 ± 0.27^{a}

Values with different superscripts across rows are significantly different (P<0.05)

The mean number of meals per day consumed by the household from the recall survey of the previous year's food consumption varied significantly across study sites (communes) but were not statistically different across seasons (Table 6). The average number of months with insufficient food for the household varied from 2.52±0.33 in Dogaraoua to 4.16±0.31 in Galma. The results suggest that the pastoral and agropastoral households in the study sites experienced 2 to 4.5 months of insufficient food in a year. Similar results as reported in this study of the hunger period of between 3 to 5 months have been reported by de Leeuw et al. (2020) for pastoralists in the West African Sahel.

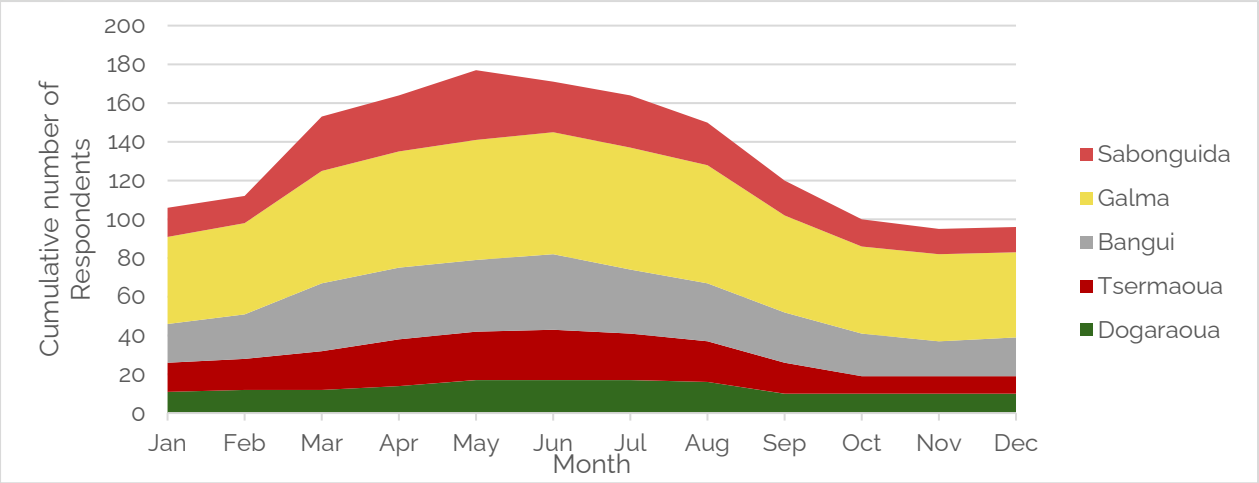

Figure 15: *Distribution of food purchases by the respondents per commune (study site) in the previous year*

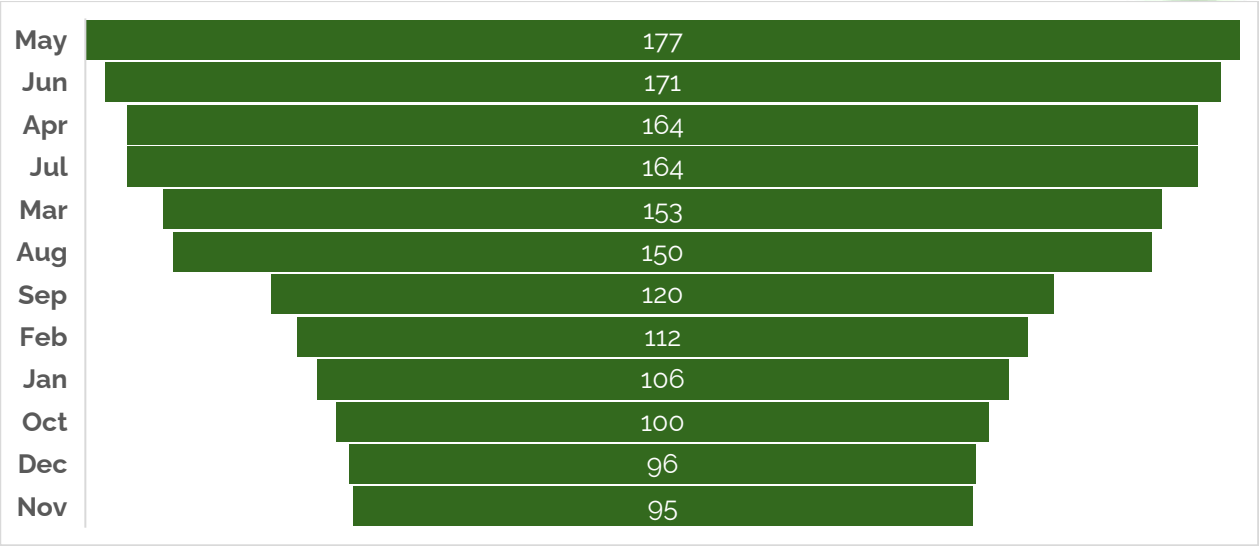

Figure 16: Distribution of food purchases by the respondents across the year for the combined data (n = 195).

From logistic regression of the probability of the security status of the respondents in the study site with independent variables namely commune, age, sex, ethnic group, education level, household size, household type (whether pastoral or agropastoral) and area of land cultivated showed that commune and household type were significant variables in the wet season, while commune, sex and area of land cultivated were the significant variables in the late dry season. None of the independent variables had any significant effect on the probability of food security status in the early dry season. These results in the wet season suggest that household food security is location-specific, as soil fertility and available grazing resources vary with location. The positive effect of household type as one of the determinants of the household food security status in the wet season confirms that diversification by growing crops by the pastoralists positively impacts household food security status. This adaptation strategy of pastoralists of growing crops in addition to animal husbandry has become the norm for the pastoralists in the Sahel (Zougmore et at., 2016). Diversification into off-season vegetable production could also be one of the measures to address food security challenges, especially in the late dry season. The results of logistical regression for the late dry season showed that, in addition to commune or location, sex had a negative impact on food security status in the late dry season. This suggests that female-headed households are likely to experience worse food security compared to male-headed households. These results are expected as female-headed households often have smaller herd sizes and smaller areas of land to cultivate. The positive effect of the area of land cultivated on food security status in the late dry season is also expected, as households with more land cultivated are likely to have higher crop harvests and consequently larger grain reserves to consume in the late dry season. Regression of number of meals per day consumed by the household with commune, age, sex, ethnic group, education level, household size, household type, area of land cultivated, and household herd size showed that commune and sex had effects in all seasons (wet, early dry and late dry seasons). These results suggest that the number of meals consumed per day per household is location-specific and that female-headed households consumed fewer meals than male-headed households. Turner et al. (2021) reported similar findings among agropastoral households in Burkina Faso, where women and children consumed fewer meals per day.

One of the measures to cope with food insufficiency by the pastoral and agropastoral households is to receive food aid. The results from this study showed that about 14%, 4% and 8% of the total respondents (total number of respondents is 195) received food aid in wet, early dry and late dry seasons,

respectively (Figure 17). The season with the lowest food aid was the early dry season, which further confirms that the food security status of the pastoral and agropastoral households is highest during this period. In addition to the crop harvest during this period, feed resources for livestock are generally abundant, supporting good animal production. These results of households receiving food aid also support the generally reported findings that the challenge of food security is most critical in late dry and wet seasons for the pastoral and agropastoral households (Turner et al., 2021). The questions on household food insecurity access showed that more than 50% of the respondents sometimes worried about the household not having enough food to eat, were unable to eat the food they wanted due to lack of resources in the past four weeks and had to eat a limited variety of food (Table 7). More than half of the respondents indicated that at least one member of the household had gone hungry for a whole day and night at least once in the past 4 weeks. These results suggest that the pastoral and agropastoral households in the study sites do face a food security challenge. Therefore, interventions that can improve their crop and/or livestock production will help to alleviate their worries about insufficient food for the households.

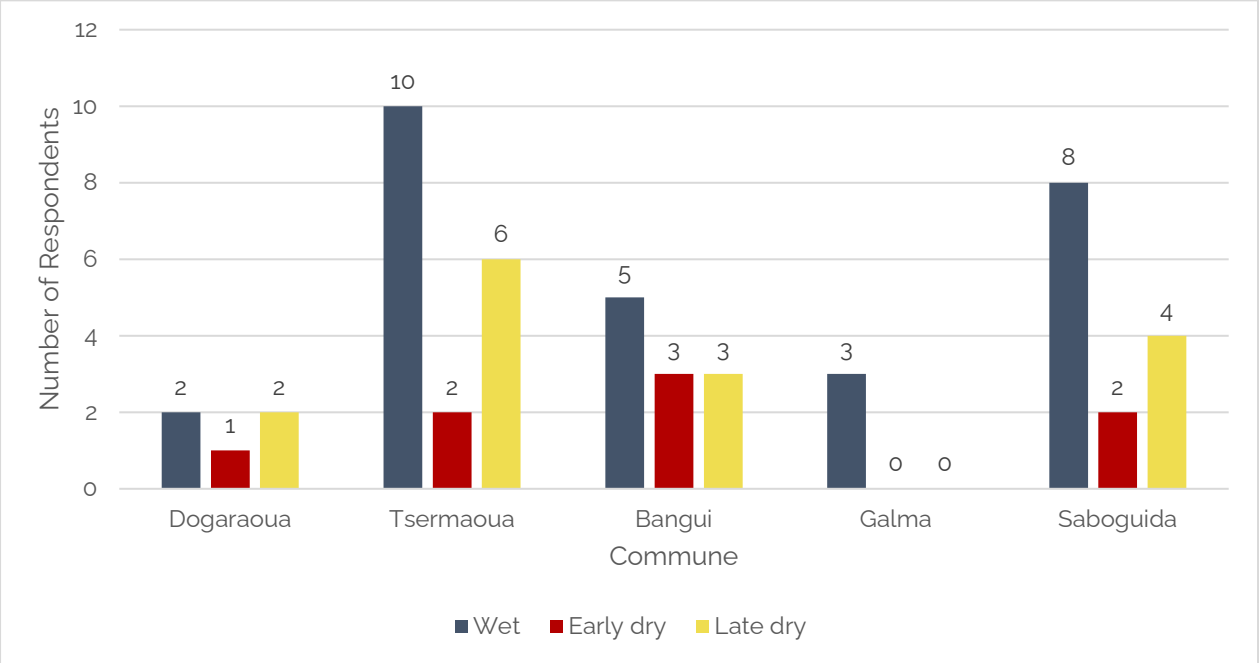

Figure 17: Number of respondents in the study sites who received food aid across seasons in the previous year.

Table 7. Number of respondents to questions on household food insecurity access in the study sites (n=195)

Question: During a typical month (in the past four weeks)	No	Yes		
		Rarely	Sometimes	Often
1. Did you worry that your household did not have enough food?	28	25	116	26
2. Were you or a household member unable to eat the food you preferred due to a lack of resources?	30	27	129	9
3. Did you or a household member have to eat a limited variety of food due to a lack of resources?	28	21	129	7
4. Did you or a household member have to eat food you really didn't want to eat because you didn't have the resources to obtain other food?	38	35	118	4
5. Did you or a household member have to eat a smaller meal than you thought you needed because there wasn't enough food?	31	26	130	8
6. Did you or a household member have to eat fewer meals per day because there wasn't enough food?	34	33	118	10
7. Have you ever experienced a food shortage in your household due to a lack of resources to feed yourself?	61	33	97	4
8. Have you or a member of your household gone to bed hungry at night because there wasn't enough food?	66	44	84	1
9. Have you or a member of your household gone an entire day and night without eating anything because there wasn't enough food?	83	26	85	1

5.1.4 Highlights of results on pastoral and agropastoral households

- Results from this study reaffirm the growing trend of pastoralists in West African Sahel settling down to cultivate crops in addition to livestock husbandry.
- There is a general low level of formal education among the pastoralists which agrees with other studies. This has implications in terms of the dissemination of knowledge of best animal husbandry practices by the extension services and projects.
- Areas of land owned increased with age, which reflects land accumulation over years.
- Female-headed households owned significantly lower volume of cattle than male-headed households.
- The livelihood of practicing transhumance production system for cattle and sheep is determined solely by household herd size.
- The reported food security status of the pastoral households was best during the early dry season, which is the harvest period.
- The average number of months with insufficient food for the household varied from 2.5 to 4 months, which is consistent with the often reported 3 to 5 months hunger period in the Sahel.

5.2 Pastoral Production Systems

5.2.1 Livestock production

The main livestock production systems for cattle, sheep and goat in the study sites were extensive, semi-intensive and transhumance (Figure 18a, b and c). Except for two respondents who reported an intensive production system for sheep rearing in Dogaraoua, this system was rare in the study sites. The rarity of the intensive livestock production system in the study sites confirms the low level of external inputs in these systems, a pattern that has also been reported for (agro)pastoral systems in the Sahel (Ayantunde et al., 2011). Regarding the reported practice of intensive sheep production system by two respondents, this is a new trend which focuses largely on sheep fattening for local markets or markets in the coastal countries, particularly Nigeria (Williams et al., 2006).

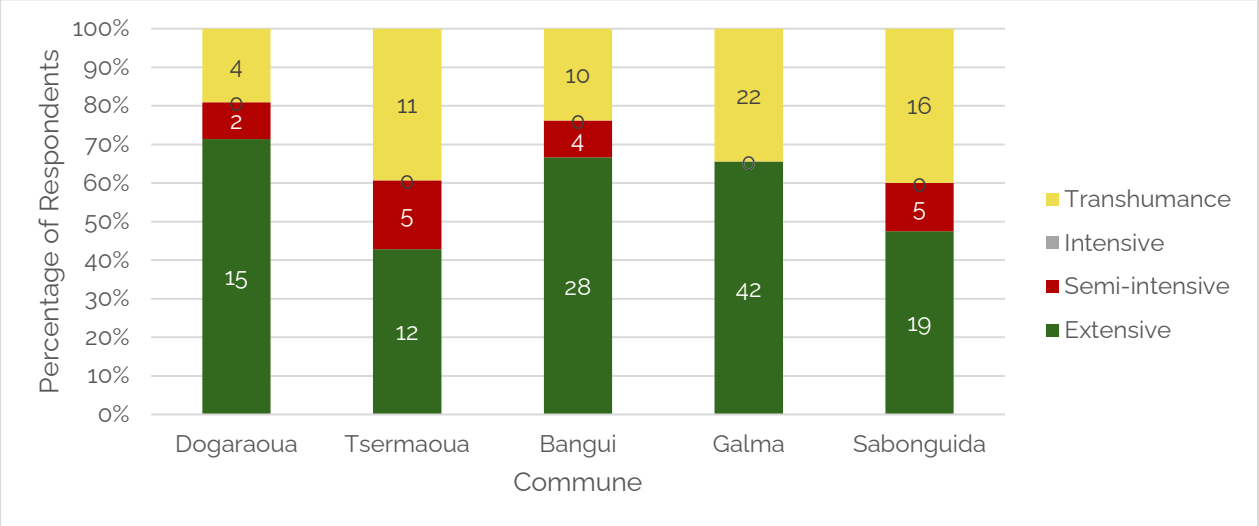

Figure 18a: Production systems for cattle according to the respondents in the study sites

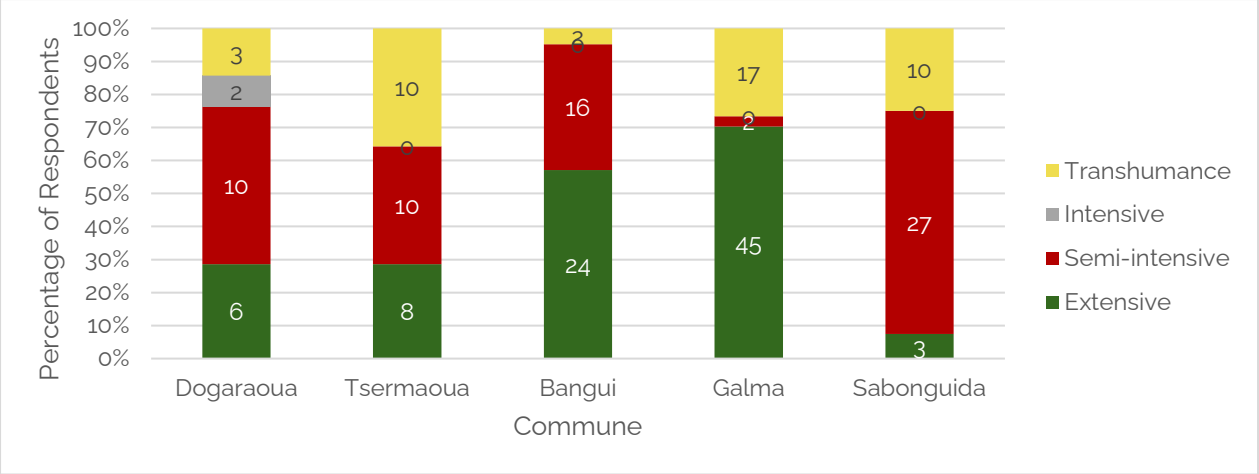

Figure 18b: Production systems for sheep according to the respondents in the study sites

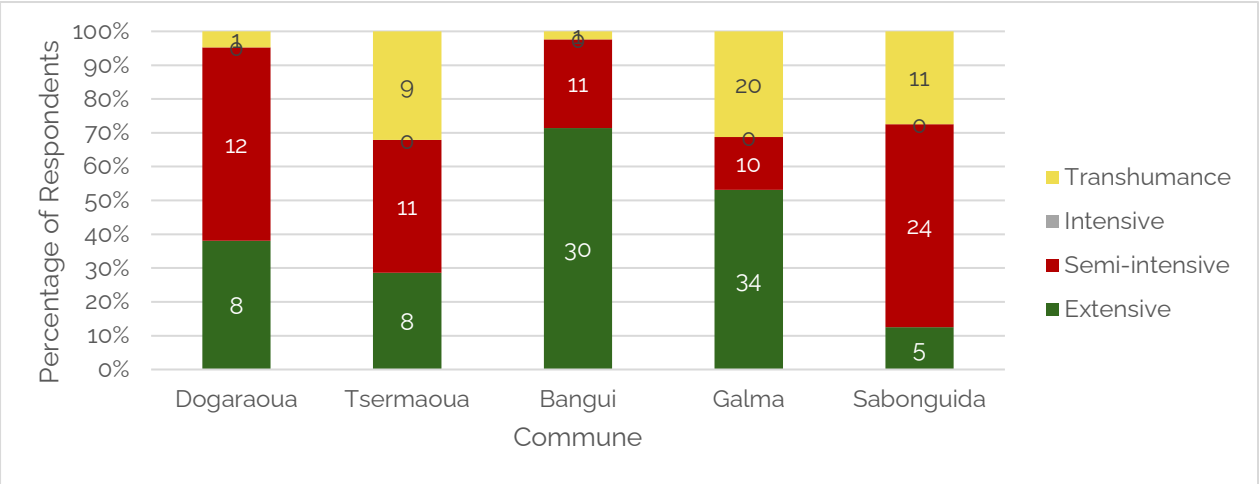

Figure 18c: Production systems for goat according to the respondents in the study sites

The reported major constraints to livestock production in the study sites were seasonal feed scarcity, a decline in grazing areas, water scarcity and unfavourable climatic conditions (Table 8). The major constraints mentioned by the respondents are similar to those reported in the region by Ayantunde et al. (2011), Higazi and Abubakar Ali (2018), and de Leeuw et al. (2020). The feed-related constraints are perennial in the Sahel, which necessitates herd mobility in search of pastures and water resources. The problem of insecurity was mentioned in the Dogaraoua, Tsermaoua and Bangui study sites. These three communes are situated relatively close to the border with Nigeria, compared to the other two communes, and might have been impacted by the growing concerns of the expansion of the security threat in the parts of Niger due to incursions by the armed group Boko Haram from Nigeria, the al-Qaeda-affiliated Jama'at Nusrat al-Islam wal-Muslimin (JNIM) and the Islamic State in the Sahel (IS Sahel), which have become more frequent since 2013 (FAO, 2021). This situation has greatly disrupted the livestock activities, in particular the sojourn and transit of herds into the traditional grazing areas. This has negatively affected the dynamics of cross-border transhumance. The insecurity problem has added to existing constraints to pastoral and agropastoral production systems in the Sahel.

Table 8. Major constraints to pastoral and agropastoral production systems according to the respondents in the study sites (number of respondents)

	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Scarcity of feed resources	10	10	9	16	35
Unfavorable climatic conditions	0	0	8	0	4
Decline of grazing areas	5	6	9	9	1
High costs of vet drugs and feed	0	0	1	0	0
Blockage of livestock corridors	2	6	0	2	0
Animal diseases	0	0	0	2	0
Insecurity and bandits	3	3	10	0	0
Problem of market participation	0	0	1	0	0
Lack of household labour	0	0	2	0	0
Water scarcity	1	3	2	35	0

5.2.2 Livestock feed resources

According to the respondents, the major feed resources in the study sites were pastures in and outside the community, crop residues (millet straw, sorghum straw, cowpea hay, groundnut haulm), shrub leaves/fruits, agro-industrial byproducts (cotton seedcake, millet bran, sorghum bran, wheat bran), and concentrates. Other feed resources reported were onion residues and cowpea husks (Figure 19). The feed resources mentioned are common in the Sahel, as reported by Amole and Ayantunde (2016) in their assessment of feed resources in Niger.

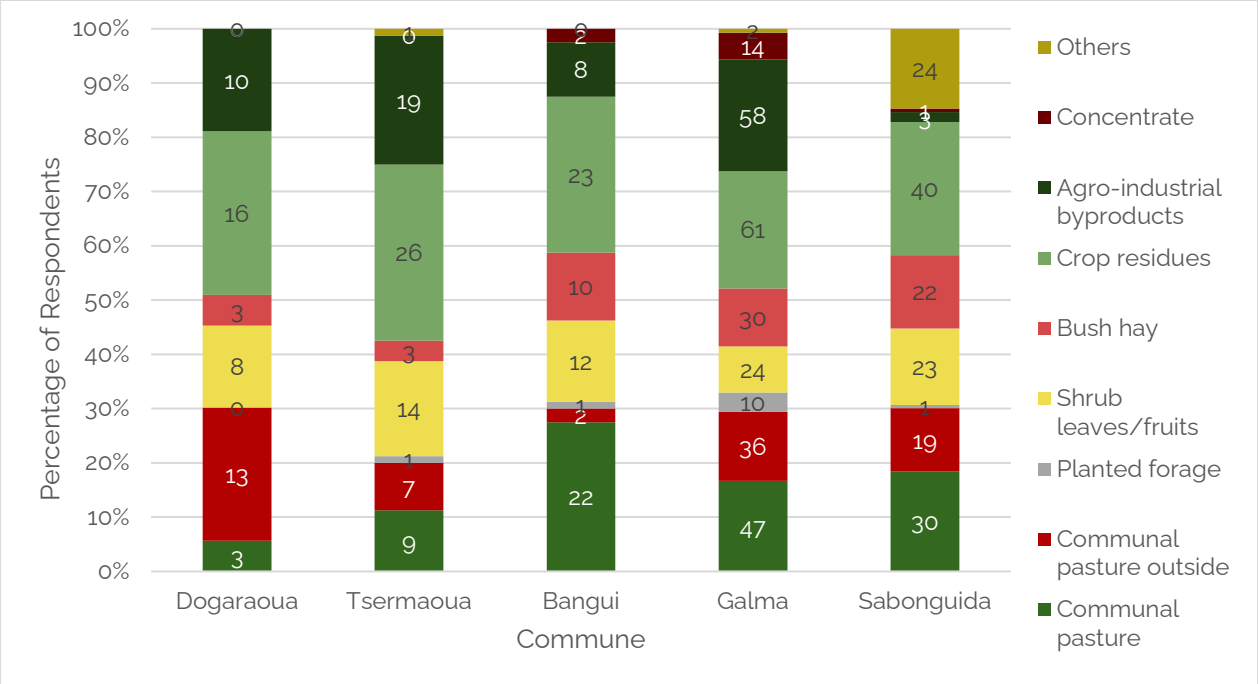

Figure 19: Feed resources in the study sites according to the respondents

The use of crop residues for feeding livestock was reported by more respondents across all study sites than any other feed resource, consistent with the observation by Ayantunde et al. (2018) of the increasing dependence on crop residues for animal feed in the Sahel. This is partly due to declining grazing areas with the expansion of crop fields. More respondents in Dogaraoua reported pasture from outside the community as a feed source than pastures from the community. This may suggest that the grazing resources within the community have declined so significantly that they have to depend on grazing resources outside the community. Planted forage was mentioned by a few respondents in all the communes except in Dogaraoua (Figure 19).

The availability of feed resources varied markedly by season (Figure 20) except for shrub leaves and fruits, agro-industrial byproducts, and concentrates, which are available year-round, although the extent of their use varied. Pastures are available during the wet season (June to October) and in the following month, November. The peak period when crop residues are available was in November after the harvest. The results further showed that the late dry season (April and May) and the beginning of wet season (June) were the most critical periods in terms of availability of feed resources. The scarcity of feed resources in the late dry season was confirmed by the respondents in their response to the question on the period of the year when feed shortage is most pronounced (Figure 21). Due to feed scarcity during the late dry season in the Sahel, herd mortality is often high in this period, especially where the households cannot afford to buy supplementary feeds to at least maintain the animals. During this period, it is common practice of many pastoralists and agropastoralists to undertake transhumance to the sub-humid and humid zones of West Africa in search of feed resources and water. Bridging the feed gap, especially in the late dry season, is critical to improving livestock production in the Sahel.

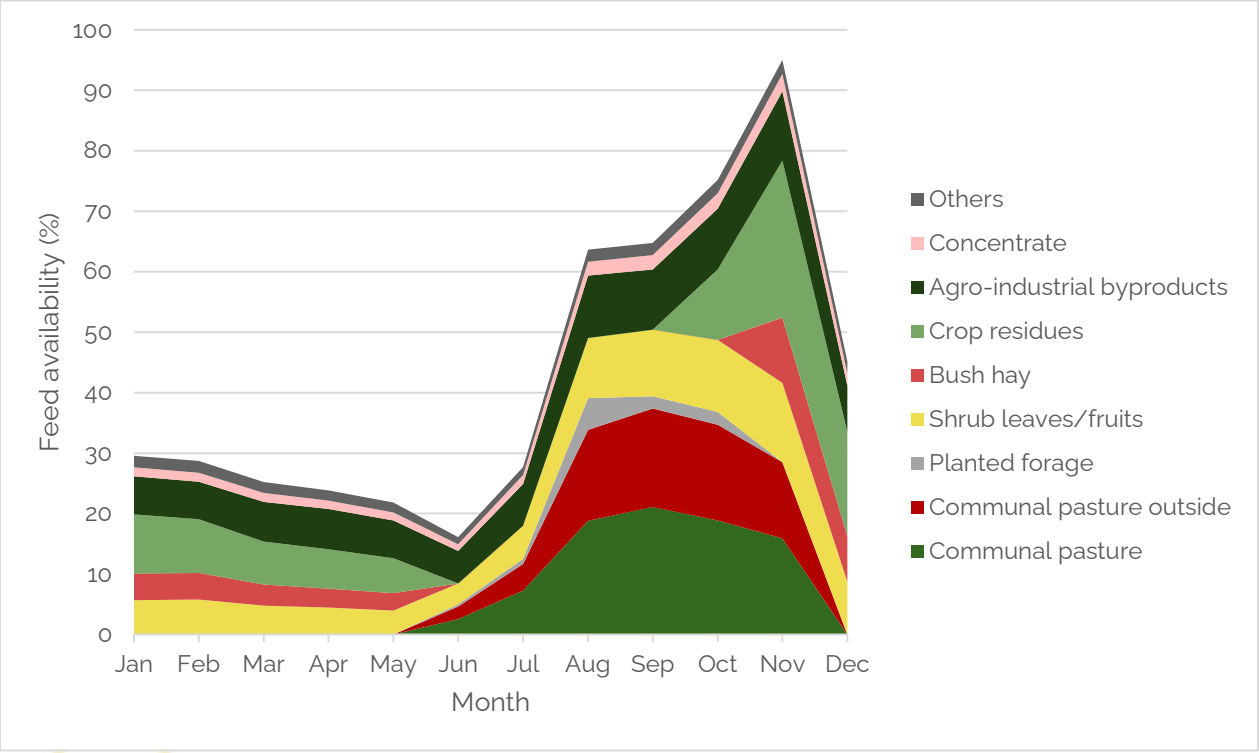

Figure 20: Feed availability across the year from different sources in the study sites (n=195)

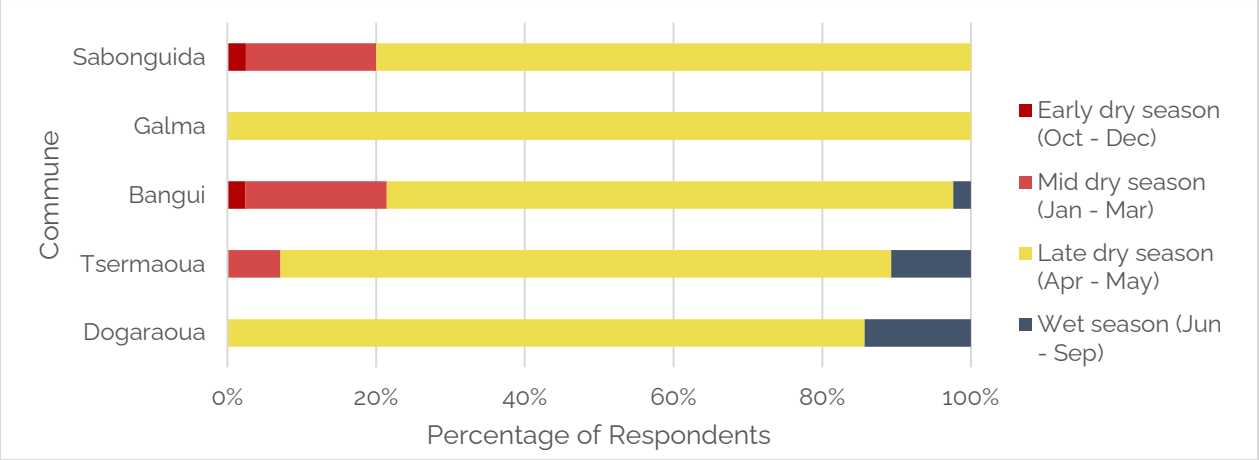

Figure 21: Respondents' perception of period of the year when feed constraint is acute in the study sites

5.2.3 Livestock Mobility

About 116 out of the 195 respondents interviewed in the household survey reported that they normally take their animals on transhumance (Figure 22). Only seven out of the 21 respondents interviewed in Dogaraoua took their animals on transhumance (Figure 22) whereas 45 out of the 64 respondents in Galma reported taking their animals on transhumance. In all the sites, more than 50% of the respondents departed on transhumance in June while the rest departed in July (Figure 23). There was one respondent each in Tsermaoua and Sabonguida who reported departing as late as August. Departure on transhumance by the respondents in June, the start of the rainy season, which corresponds with the establishment of pastures at the destination, is necessary to avoid damage to growing crops in the community by the animals. Most of the respondents reported that they returned from transhumance between October and December (Figure 24). The returning period from transhumance corresponded to the crop harvest, when the crop field is open for grazing of the crop residues. The duration of transhumance per year according to the respondents varied from 4.05±0.15 month (mean ± standard error) in Sabongida to 5.57±0.43 month in Dogaraoua (Table 9). The number of months spent on transhumance varied significantly with the study sites (Table 9). From the results, the distance covered during the transhumance varied from 279 to 450 km on average. From the results of regression analysis, the location of the respondents at departure largely determined the distance covered during the transhumance. Taking the animals on transhumance by the pastoralists is not a cultural norm but responds to the nutritional needs of livestock (Turner and Schlecht, 2019). According to these authors, the magnitude of travel mobility is highest for those transhumance systems moving along latitudinal and elevation gradients, thus moving across variation that is more predictable.

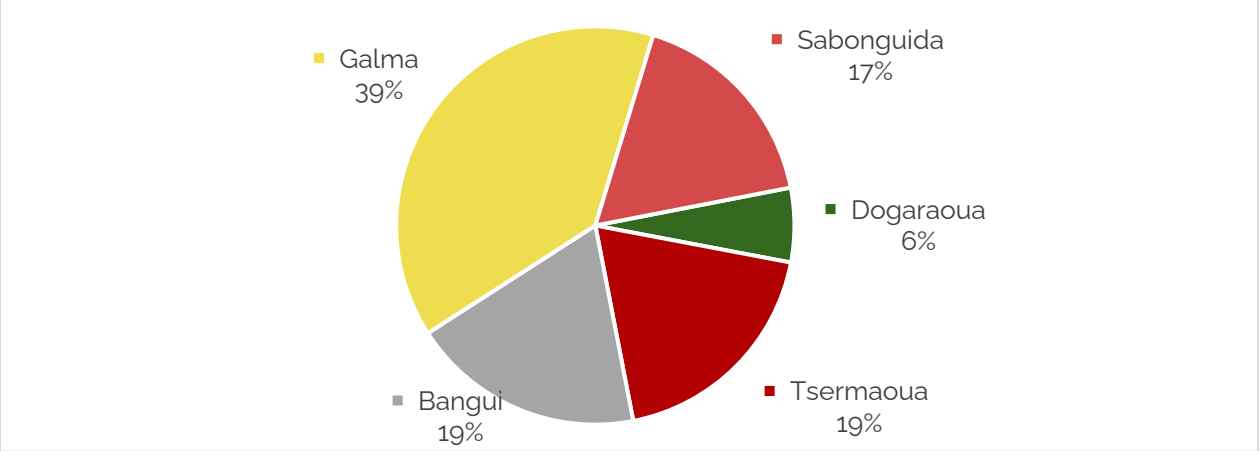

Figure 22: Proportion of respondents in each commune who practiced transhumance (n=116)

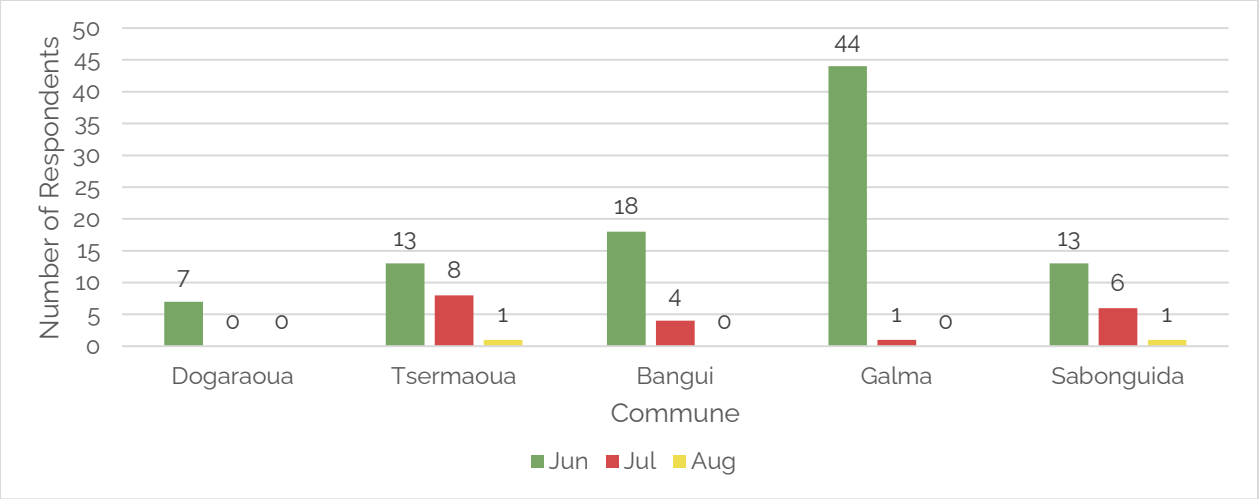

Figure 23: Month of departure for transhumance according to the respondents in the study sites

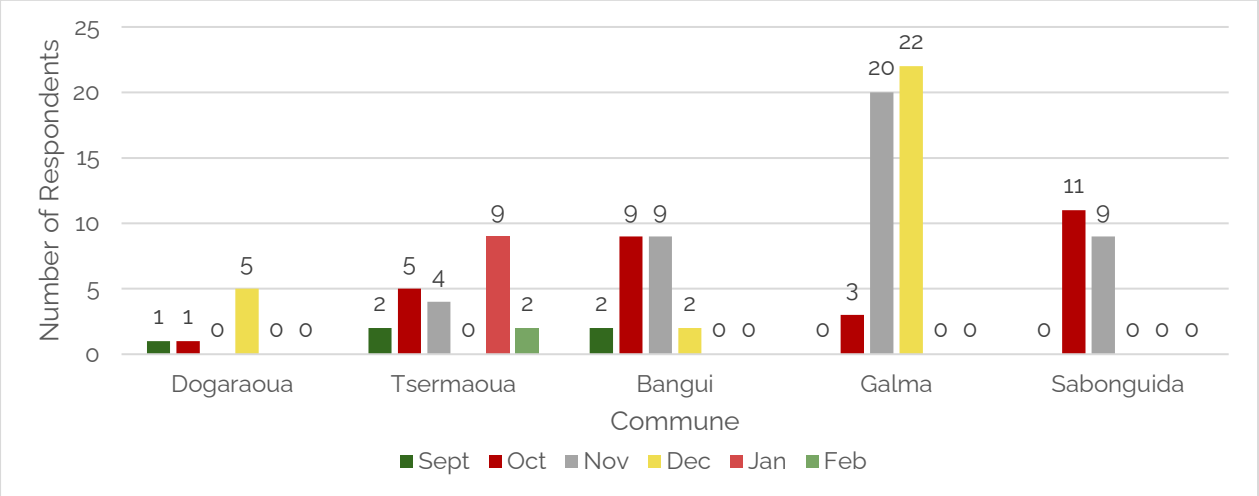

Figure 24: Month of return from transhumance according to the respondents in the study sites

Table 9. Means (±standard error) of duration (month), distance covered (km), heads of animals and experience (year) of herders on transhumance in the study sites (N; Dogaraoua=7; Tsermaoua=22; Bangui=22; Galma=44; Sabonguida=20)

Variable	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Duration	5.57±0.43^{a}	5.09±0.33^{a}	4.23±0.16^{b}	5.41±0.10^{a}	4.05±0.15^{b}
Distance	378.57±39.12^{b}	383.18±23.28^{b}	279.45±12.72^{c}	450.00±7.96^{a}	331.05±15.01^{bc}
Heads of animals	56.29±13.11^{b}	54.00±21.65^{b}	32.45±4.76^{b}	155.27±28.21^{a}	69.00±23.12^{b}
Experience of herder	9.71±1.89^{c}	17.86±3.26^{ab}	15.68±3.20^{b}	20.61±1.67^{a}	17.20±2.54^{ab}

The common destination for the transhumant herders from Dogaraoua, Bangui, Galma and Sabonguida was Abalak, which is a pastoral zone situated in the east of the Tahoua region. The destinations reported by the respondents in Tsermaoua were Talamssess, northwest of the town of Tahoua, and Ader, a plateau southeast of Tahoua. The results suggest that the destination for transhumant herders varies with the communities they depart from. Cattle were reported as the common animal species taken on transhumance according to the respondents (Figure 25), which is normally taken along with sheep and goats. The results indicate that it is rare to take small ruminants (sheep and goats) alone on transhumance. These findings on the animal species typically taken on transhumance are consistent with observations by de Leeuw et al. (2020), who reported that cattle are often the dominant species in transhumant herds. The results show that more than 60% of respondents in Tsermaoua and Galma reported that between 76% and 100% of the household herds were taken on transhumance (Figure 26). Respondents in Dogaraoua and Bangui reported that a much lower proportion of their household herds—between 0% and 25%—were taken on transhumance (Figure 26). The decision on the proportion of the household herd to take on transhumance may be influenced by several factors, including herd size—particularly cattle—availability and access to grazing resources in the communities during the wet season, and the availability of household labour.

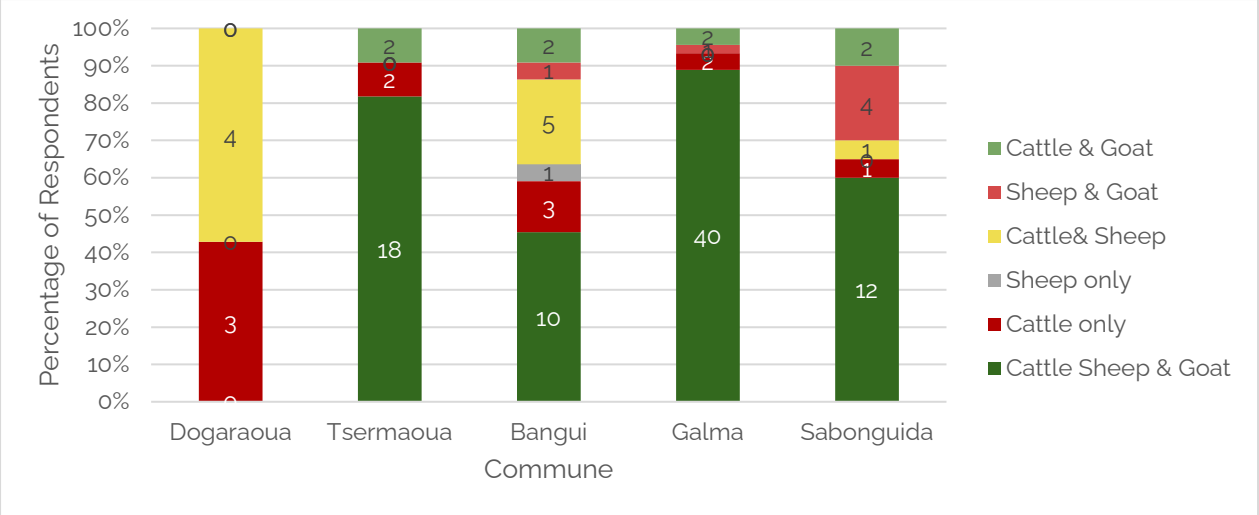

Figure 25: Animal species taken on transhumance according to the respondents in the study sites (N: Dagoraoua = 7; Tsermaoua = 22; Bangui = 22; Galma = 45; Sabonguida = 20)

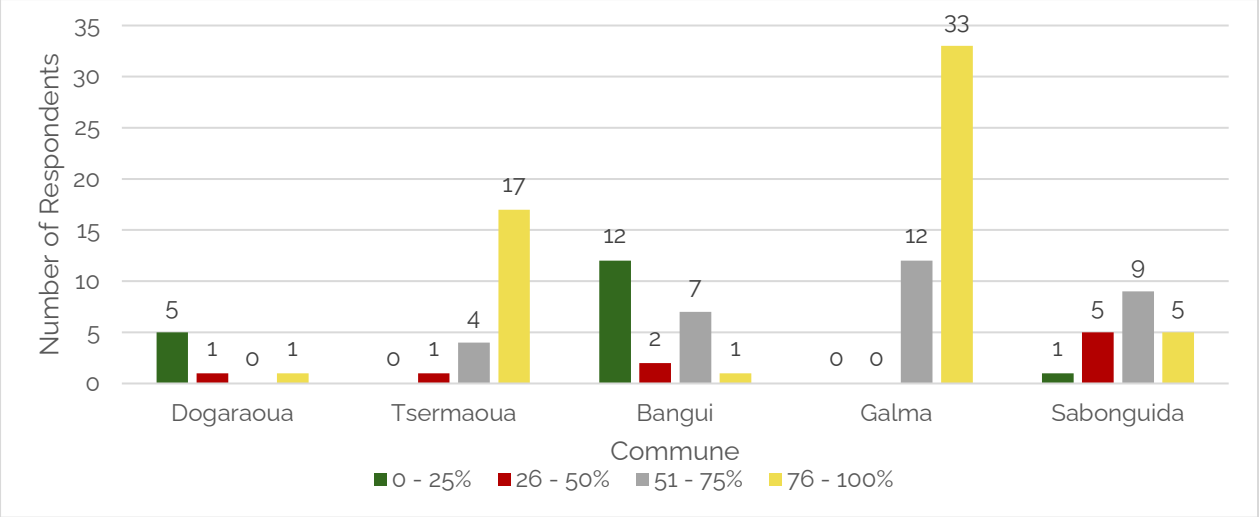

Figure 26: Proportion of household herds taken on transhumance according to the respondents in the study sites (N: Dagoraoua = 7; Tsermaoua = 22; Bangui = 22; Galma = 45; Sabonguida = 20)

In all the study sites, the respondents reported that young members of the household and household heads were responsible for herding the animals on transhumance, except in Dogaraoua and Sabongida, where one respondent each reported the use of an outside herder (Figure 27). These results confirm that herding of household herds on transhumance depends on household labour (de Leeuw et al., 2020). The experience of the herders who took the animals on transhumance varied from 9.71±1.89 years in Dogaraoua to 20.61±1.67 years in Galma (Table 9). These results indicate that herders taking animals on transhumance need to have substantial experience. The regression analysis of the duration of transhumance on independent variables such as commune (location), age, sex, ethnic group, area of land cultivated and cattle herd size showed that commune (location), ethnic group, and cattle herd size had significant positive effect, whereas area of land cultivated had a negative effect. These results show that the number of months spent on transhumance is location-specific and that the Fulani ethnic group tended to stay longer than other ethnic groups. It is expected that high cattle herd size will impact on duration of transhumance due to the nutritional needs of the high herd size.

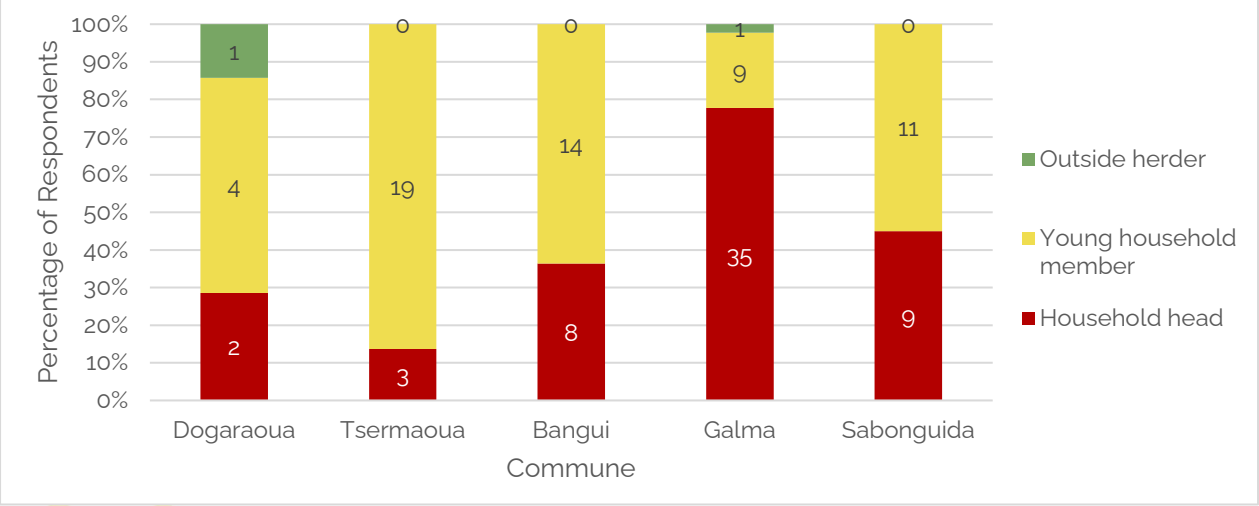

Figure 27: The person responsible for taking the animal on transhumance according to the respondents in the study sites (N: Dagoraoua = 7; Tsermaoua = 22; Bangui = 22; Galma = 45; Sabonguida = 20)

The negative effect of the area of land owned on time spent on transhumance suggests that herders from the household that grow crops may likely spend less time in transhumance so that their herd can graze the crop residues on their field immediately after the harvest. Results of regression analysis of distance covered during the transhumance showed that the departing location of the herders was the key determinant. Results of regression analysis of heads of animals taken on transhumance depended largely on the age of the herders, which essentially implies experience of the herders. These results suggest that herders with more experience are likely to take higher number of household herd to transhumance, which is expected. The results of the perceived influence of the pull-push or stimulus-response factors on transhumance are presented in Table 10.

A key concept of the pull-push, or stimulus–response, framework as applied to pastoralism is that critical positive socioeconomic, environmental and sociopolitical factors 'pull' transhumant herders toward a particular area, while, conversely, critical negative factors such as feed and water scarcity or civil strife 'push' them away (Basset and Turner 2007). The key pull factors to the destination of the transhumant herders reported by the respondents were availability of pasture and water, good social relations with the host community, presence of livestock routes and corridors and presence of livestock markets in or near the community. The main push factor to go on transhumance reported was large herd size as generally, there is low drive for pastoralists with low herd size to be 'pulled.' These results confirm widely reported pull factors for transhumance, namely availability of pasture and water, and good social relations with the host community (Ayantunde et al., 2014).

Table 10. Perceived influence (1=none; 2=weak; 3=average; 4=high; 5=very high) of different pull-push factors for transhumance according to the respondents in the study sites (N; Dogaraoua=7; Tsermaoua=22; Bangui=22; Galma=44; Sabonguida=20)

Factor	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. Availability of pasture and water	3.29±0.29	3.32±0.18	3.50±0.32	4.09±0.17	3.15±0.18
2. Availability of crop residues in fields for transhumant herds	3.29±0.29	3.09±0.16	2.86±0.31	2.84±0.27	3.25±0.14
3. Good social relations with the host community	3.14±0.46	3.09±0.11	3.14±0.30	3.80±0.15	3.45±0.27
4. Presence of sedentary pastoralists (pastoral residents) in the community	2.86±0.34	2.95±0.12	2.68±0.32	3.48±0.16	3.10±0.12
5. Large herd size by transhumant pastoralists	2.71±0.29	3.68±0.10	3.09±0.34	4.11±0.12	3.30±0.15
6. Absence of conflict, protest, or civil strife	2.86±0.26	2.77±0.20	2.41±0.35	3.89±0.16	2.35±0.18
7. Favorable local or central government policies, e.g., regulations ensuring livestock mobility	2.86±0.34	2.82±0.16	2.59±0.33	3.55±0.14	2.30±0.18
8. Low morbidity rates, e.g., low tsetse fly population	2.29±0.29	2.50±0.16	2.68±0.32	3.50±0.17	2.10±0.26
9. Presence of pastoral corridors/routes near the community	2.71±0.29	3.45±0.16	3.14±0.33	3.55±0.14	3.10±0.12
10. Presence of livestock markets in or near the community	2.71±0.29	3.09±0.22	2.95±0.33	2.93±0.17	3.50±0.11
11. Availability of labour in pastoralist households	2.86±0.34	3.45±0.18	2.50±0.31	3.07±0.18	2.95±0.15
12. Presence of veterinary services	2.71±0.29	2.14±0.12	2.64±0.33	2.64±0.21	2.15±0.13
13. Presence of pasture of good quality	1.00±0.38	0.00±0.00	1.68±0.32	2.00±0.34	0.10±0.10

5.2.4 Highlights of results on Pastoral Production Systems

- The main livestock production systems for cattle, sheep and goat in the study sites were extensive, semi-intensive and transhumance. The rarity of intensive production systems in the study sites is a confirmation of the low level of external inputs in the production systems in the study sites.
- The major constraints to livestock production in the study sites were seasonal feed scarcity, decline in grazing areas, water scarcity, and unfavorable climatic conditions. The growing insecurity problem has added to the existing constraints on pastoral production systems.
- The major feed resources in the study sites were pastures in and outside the community, crop residues (millet straw, sorghum straw, cowpea hay, groundnut haulm), shrub leaves/fruits, agro-industrial byproducts (cotton seedcake, millet bran, sorghum bran, wheat bran), and concentrates.
- The availability of feed resources varied markedly with season, except for shrub leaves/fruits, agro-industrial byproducts and concentrates, which are available year-round, though the extent of use varied.
- Departure on transhumance by the respondents in June, the start of the rainy season, which corresponds with the establishment of pastures at the destination, is necessary to avoid damage to growing crops in the community by the animals. The returning period from transhumance was between October and December, which corresponded to the crop harvest when the crop field is open for grazing of the crop residues. The duration of transhumance per year, according to the respondents, varied from 4 to 6 months. The distance covered during the transhumance varied from 279 to 450 km on average.
- The decision on the proportion of the household herd to take on transhumance was influenced by factors such as herd size, particularly cattle, availability and access to grazing resources in the communities during the wet season, and availability of household labour.

5.3 Pastoral Communities

5.3.1 Social relations and Inclusion

Social relations and inclusion in the community are essential to access natural resources, and to boost social cohesion between pastoral and agropastoral and the farming communities. An indicator of social inclusion is membership in community groups/associations. The results of this study showed that membership of the pastoralists and agropastoralists in an association or group was quite low in Dogaraoua, Tsermaoua and Bangui, whereas nearly all the respondents in Galma belonged to an association or group (Figure 28). The results further showed that about half of the respondents in Sabonguida belonged to a group. These results demonstrate that group membership is location-specific, as this may be influenced by social relations in the community, which was reported to be strong in Galma, according to the responses of the respondents to statements on social inclusion (Table 11). The scores by the respondents in Galma were consistently higher than in the other study sites. Strengthening membership in associations or groups in Dogaraoua, Tsermaoua, and Bangui is important for access to services, market participation and capacity building. Pro-ARIDES can intervene through awareness raising of the benefits of membership in an association and capacity building of the leaders of the associations in organisation management.

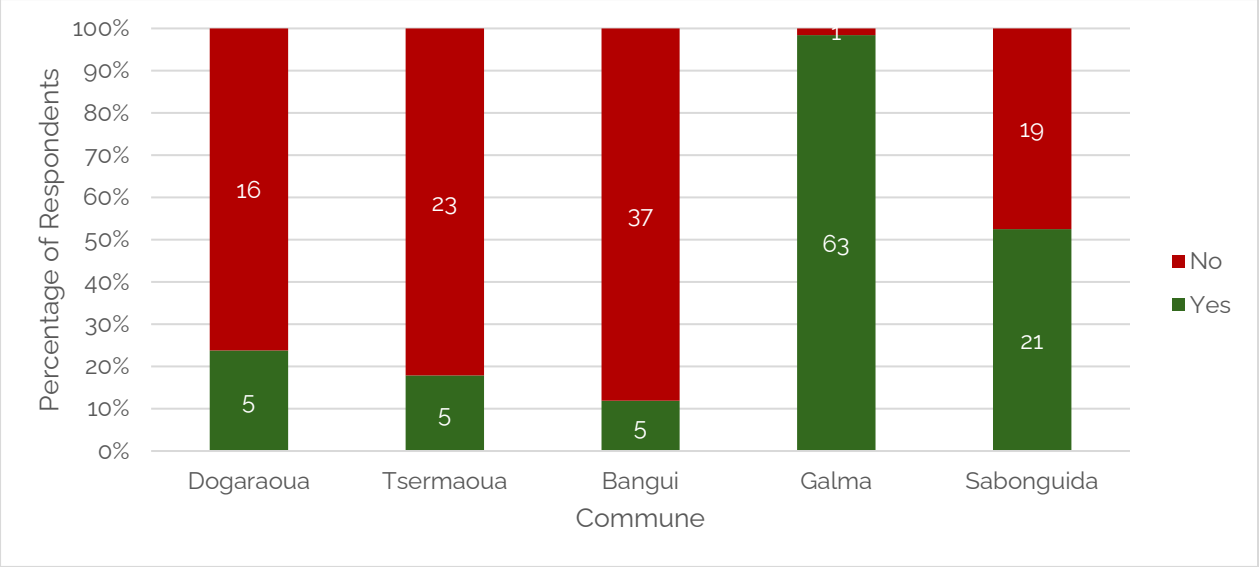

Figure 28: Responses to whether the respondents were members of an association or group in the study sites (N: Dogaraoua=21; Tsermaoua=28; Bangui=42; Galma=64; Sabonguida=40)

Pastoral and agropastoral associations (at village and commune levels) were the common group the respondents belonged to in all the study sites (Figure 29). Other associations or groups the respondents belong to were livestock marketing group and social group for community development. In Sabonguida, the respondents also belonged to a savings and credit group and an agriculture product marketing group. Membership in a pastoral or agropastoral association or group, by most respondents, is expected given their animal husbandry profession. When asked about their degree of participation in different associations or groups, most of the respondents reported that they are active members, while a few respondents mentioned that they were leaders (Figure 30). Three respondents, each in Galma and Sabonguida reported that they were not active in their groups. The most common pastoral association the respondents belonged to is AREN (L'Association pour la Redynamisation de le L'Elevage au Niger), which is an association of livestock keepers which aims to develop the livestock sector in Niger, specifically through capacity building of pastoralists and agropastoralists, and policy dialogue and advocacy on pastoral issues. Though Pro-ARIDES has been collaborating with AREN, this collaboration should be strengthened in identifying, designing and implementing of interventions on pastoral issues in the study sites. Other pastoral associations mentioned, particularly in Sabonguida included Droube, Kora Rougi, and Lamorde.

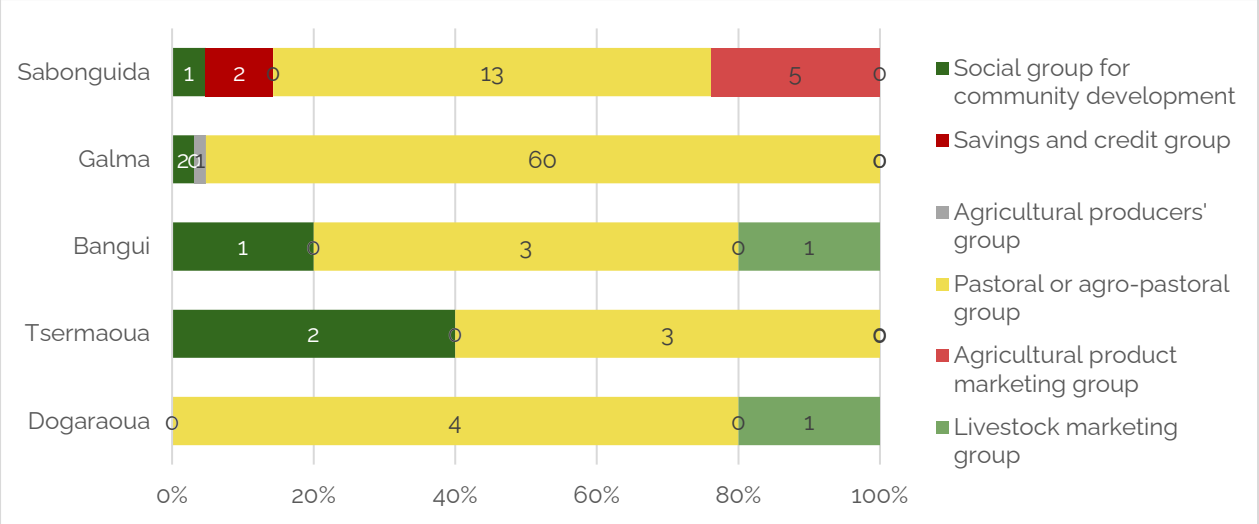

Figure 29: Types of association or group the respondents in the study sites belonged to (N: Dogaraoua=5; Tsermaoua=5; Bangui=5; Galma=63; Sabonguida=21)

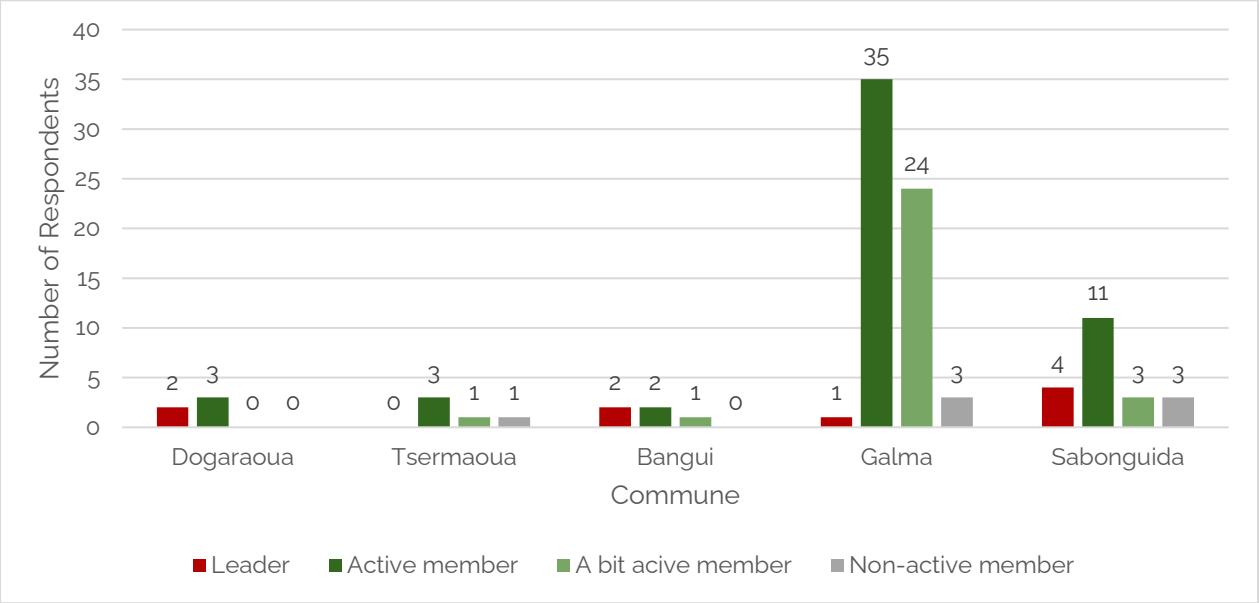

Figure 30: Degree of participation in an association or group by the respondents in the study sites (N: Dogaraoua=5; Tsermaoua=5; Bangui=5; Galma=63; Sabonguida=21)

Table 11. Responses (1=completely disagree; 2=disagree; 3=neither disagree nor agree; 4=agree; 5=completely agree) of the respondents on characterisation of social inclusion in the community in the study sites (N; Dogaraoua=21; Tsermaoua=28; Bangui=42; Galma=64; Sabonguida=40)

Statement	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. There is freedom to join any relevant association.	3.95 ± 0.08^{b}	3.18 ± 0.16^{c}	3.86 ± 0.18^{b}	4.53 ± 0.15^{a}	4.30 ± 0.09^{ab}
2. Participation in community groups provides opportunities for personal development.	3.95 ± 0.08^{b}	3.21 ± 0.16^{c}	3.60 ± 0.18^{bc}	4.59 ± 0.14^{b}	4.05 ± 0.09^{b}
3. My opinion is valued in the community.	3.95 ± 0.08^{b}	3.14 ± 0.17^{c}	3.52 ± 0.17^{bc}	4.48 ± 0.14^{a}	3.63 ± 0.12^{bc}
4. Decision-making on key livelihood issues and natural resource management is participatory.	3.76 ± 0.12^{b}	3.11 ± 0.17^{c}	3.74 ± 0.17^{b}	4.55 ± 0.14^{a}	3.63 ± 0.11^{b}
5. My rights are respected in the community.	3.95 ± 0.05^{b}	3.18 ± 0.16^{c}	3.90 ± 0.18^{b}	4.53 ± 0.14^{a}	3.70 ± 0.11^{b}
6. I have a sense of belonging to the community.	4.00 ± 0.07^{b}	3.46 ± 0.18^{c}	3.86 ± 0.18^{bc}	4.58 ± 0.14^{a}	4.30 ± 0.12^{ab}
7. Diversity is valued and respected.	4.00 ± 0.07^{ab}	3.50 ± 0.20^{b}	3.67 ± 0.21^{b}	4.48 ± 0.15^{a}	3.93 ± 0.12^{b}
8. I feel empowered through my participation in different community groups.	3.90 ± 0.07^{b}	3.07 ± 0.15^{c}	3.76 ± 0.19^{b}	4.52 ± 0.14^{a}	3.73 ± 0.11^{b}
9. The activities of different groups are transparent.	3.86 ± 0.10^{b}	2.79 ± 0.15^{c}	3.67 ± 0.17^{b}	4.52 ± 0.14^{a}	3.48 ± 0.11^{b}
10. There are open channels of communication.	3.81 ± 0.09^{bc}	3.36 ± 0.16^{c}	3.81 ± 0.16^{bc}	4.50 ± 0.14^{a}	3.95 ± 0.09^{b}

Values with different superscripts along the same row are statistically significant (P<0.05)

The respondents generally agreed with statements that there is freedom to join any relevant association, participation in community groups provides opportunities for personal development, they feel empowered through participation in different community groups, and that they have a sense of belonging to the community (Table 11). These results suggest that there is social inclusion in the communities, but responses of the respondents in Dogaraoua, Tsermaoua and Bangui should not be generalised for the communes as they represented only 12 to 23% of the total respondents interviewed in this study. As the respondents in these study sites are active members of community groups or associations, it is most likely that they would present a positive picture of the social relations and inclusion in their communities. Perhaps, responses of the respondents who did not belong to any group or association might have been different. These results affirm the importance of social inclusion of pastoralists in the Sahel region, which may be influenced by factors such as resource competition, social cohesion in the community, and security conditions. To improve social inclusion of the pastoralists in the Sahel, efforts should include strengthening their livelihood options, enhancing access to resources, and promoting peaceful coexistence with other communities. Improving social relations and inclusion of pastoralistsa and agropastoralists in the region is also essential to addressing the security challenge.

5.3.2 Natural Resource Governance

Since the 1990s, decentralisation reforms in the Sahelian countries have allowed for a greater role for local communities in natural resource management through the transfer of some decision-making power and responsibilities to sub-national institutions at the provincial, district, city, town and village levels to promote public participation in local governance (Umutoni et al., 2016). Basically, the key thrust of decentralisation is rooted in democratic principles of representation and accountability that allow constituencies to effectively express their needs and preferences to local government officials and to hold these officials accountable.

One of the instruments of natural resource governance at the local (rural) level is local conventions. Local conventions refer to an agreement, written or not, between local actors, defining the rules for access and use of these resources, with a view to their conservation or rational and sustainable use. This agreement may result from the desire either to rationalise the misuse of these resources and to put an end to their degradation, or to resolve or prevent conflicts related to their use by multiple users. Local conventions provide a mechanism for managing local specificities through negotiated rules and management principles, and reconciling legal ambiguities not adequately addressed in national legislation.

Results of the survey on the perception of the respondents to a series of statements on local conventions are presented in Table 12. The respondents agreed or completely agreed with the statement that there are well-developed local natural resource management conventions in the community. This suggests that there exist local conventions in the study sites, either in oral (informal) or written form (formal), which was also confirmed at the focus group discussion. The respondents also agreed or completely agreed that they are aware of their rights, obligations, and benefits under the local conventions and that the local conventions generally improve natural resource management, which is one of the objectives. The respondents also agreed that there are incentives to respect and comply with local conventions. However, they responded that compliance with local conventions is primarily to avoid the imposition of fines and penalties.

The results confirm the beneficial effects of local conventions on natural resources management, which are similar to findings by Umutoni et al. (2016) in the Sikasso region of Mali. According to these authors, local conventions reduced conflicts, empowered local people to manage their resources, strengthened communities' capacities to make decisions on the use of their resources, and facilitated better planning

of land use. The main challenge of local conventions is their enforcement, which was reported to be weak or at best modest from the focus group discussions in all the study sites except Galma where it was reported to be strong. From the results of the focus group discussion, local conventions or rules that govern grazing of communal rangelands and grazing of crop residues after the harvest are generally oral, and the enforcement can be challenging. The local conventions that govern livestock routes used by the transhumant herders and their presence in the community are often inter-communal in nature, whereas national law often applies regarding land tenure according to the results of the focus group discussion. Sometimes, there may be conflict between the customary law and national law regarding land tenure security, in which case the national law applies. This supremacy of national law over the local conventions helps to check the excess and bias of local conventions, for example, they tend to be biased against women when it comes to land tenure security. Nevertheless, local conventions are generally beneficial to governance of natural resources at local level. Therefore, necessary support from NGOs and projects such as Pro-ARIDES can facilitate strengthening of the local conventions to enhance natural resource governance in the study sites.

Table 12. Response (1=completely disagree; 2=disagree; 3=neither disagree nor agree; 4=agree; 5=completely agree) of the respondents on characterisation of local conventions governing community-based natural resources in the study sites (N; Dogaraoua=21; Tsermaoua=28; Bangui=42; Galma=64; Sabonguida=40)

Statement	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. There are well-developed local NRM conventions in the community.	3.90±0.10	3.57±0.15	4.24±0.16	4.97±0.02	4.20±0.08
2. I am aware of my rights, obligations, and benefits under the local conventions.	3.90±0.10	3.64±0.12	4.36±0.14	4.92±0.04	3.55±0.11
3. Local conventions improve NRM in the community.	3.86±0.10	3.640.11	4.14±0.16	4.92±0.3	3.78±0.10
4. With local conventions, the rights and responsibilities of different community stakeholders are clearly defined regarding the use and management of natural resources.	3.67±0.11	3.25±0.12	3.95±0.15	4.89±0.04	3.43±0.11
5. Conflict over natural resource use has decreased in the community following the implementation of local conventions.	3.76±0.10	3.25±0.16	3.71±0.18	4.91±0.04	4.03±0.08
6. All community stakeholders accept the rules contained in local conventions.	3.48±0.18	2.82±0.15	3.95±0.17	4.91±0.04	3.53±0.13
7. There are monitoring and evaluation mechanisms for the implementation of local conventions.	3.62±0.11	3.11±0.12	3.71±0.16	4.91±0.04	3.55±0.11
8. Certain social groups, such as immigrants and transhumant pastoralists, are excluded from the development processes and implementation committees of local conventions.	3.48±0.13	3.25±0.17	4.00±0.17	3.72±0.23	3.48±0.13
9. There are incentives to respect and comply with local conventions.	3.67±0.13	3.25±0.11	3.45±0.20	4.89±0.04	3.80±0.10
10. Compliance with local conventions is primarily to avoid the imposition of fines and penalties.	3.48±0.13	3.36±0.09	3.79±0.17	4.67±0.12	4.00±0.09

The perception of the pastoralists and agropastoralists of relations with the local government authorities was generally between fair and good (Table 13). The perception of the respondents in Tsermaoua was consistently fair on relations with the local government authorities in terms of representation in the local council, participation in platforms organised by the local council and the extent to which their interests were considered in the decision-making by the local council. In contrast to respondents in Tsermaoua, the respondents in Galma rated their relations with the local government authorities as good (Table 13). These results suggest that the relations between the pastoralists and the local government authorities are location-specific, and not very good in all study sites, though were perceived to be good in the Galma commune. Of the three parameters used to assess relations between pastoralists and agropastoralists and local authorities, the extent to which their interests were considered in decision-making by the local government was consistently scored lowest compared to other parameters. These results suggest that respondents generally perceive that the local government authorities rarely consider their interests in their decision making. These results agree with findings by Benjaminsen and Ba (2024) that the pastoralists in the Sahelian region are generally marginalised by the authorities at various levels (national, state/region or local) in their decision-making, and there is apprehension over the appropriateness of policy responses to utilisation of dryland resources for livestock production (Benjaminsen and Ba, 2024). According to these authors, there is widespread negative perception of pastoralism by decision-makers in West Africa, and state policies tend to favour settled crop farming at the expense of mobile livestock production. Empowering the pastoralists and agropastoralists in decision-making over natural resources is essential to change in relations with the local government authorities.

Table 13. *Perception of pastoralists and agropastoralists of relations with local government authorities (commune rurale) in the study sites on a Likert scale of 1 to 4 (1=bad; 2=fair; 3=good; 4=very good (N; Dogaraoua=21; Tsermaoua=28; Bangui=42; Galma=64; Sabonguida=40)*

Variable	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Representation in the local council	2.71 ± 0.16^{a}	1.89 ± 0.14^{c}	2.17 ± 0.11^{bc}	2.95 ± 0.09^{a}	2.30 ± 0.07^{b}
Participation in platforms organised by the local authority	2.81 ± 0.11^{a}	1.86 ± 0.12^{c}	2.29 ± 0.11^{b}	2.95 ± 0.10^{a}	2.28 ± 0.07^{b}
Degree to which interest is addressed in decision by the local council	2.57 ± 0.13^{b}	1.83 ± 0.09^{c}	2.14 ± 0.13^{c}	2.85 ± 0.1^{a}	2.10 ± 0.09^{c}

5.3.3 Conflict over natural resources and Resolution

Conflict over natural resource use, particularly between farmers and herders, has been widely reported in the Sahel (Turner et al., 2011; Turner et al., 2012; Benjaminsen and Ba, 2019). Some report underlying conditions for increased potential of farmer-herder conflicts included the expansion of crop fields to grazing areas, and reductions in livestock mobility (Turner et al., 2011). From the results of the household survey, 53 (27.1%) out of the 195 respondents interviewed reported incidents of conflict over natural resource use in the past 5 years, which may suggest a low incidence of conflict. Nearly half of the respondents who reported cases of conflict in the study sites in the past 5 years were from Sabonguida commune (Figure 31), whereas only one respondent reported a case of conflict in Galma over the same period.

According to the respondents, most cases of conflict were non-violent and often resolved at the community level. The high number of respondents who reported cases of conflict in Sabonguida can be attributed to high cropping pressure in the commune and high degree of day-to-day interactions around production between herding and farming groups, which may imply high competition over natural resources as reported by Turner et al. (2011). A very low number of respondents reported that incidence of conflict can be attributed to social relation problems including power relations in the community, which confirms that good social cohesion in a community will likely reduce conflict over natural resource use. The common types of conflict reported were damage to crops by the animals, expansion of crop field into grazing areas and into livestock routes which obstruct animal passage, access to grazing areas and unauthorised grazing of crop residues (Figure 32). From the focus group discussion in the study sites, damage to crops was mentioned as the most important cause of conflict, followed by the expansion of crop fields into grazing areas. These results are similar to findings by Turner et al. (2011) in their study in Niger, where damage to crops was reported as the main cause of farmer-herder conflict. Other causes mentioned by the authors were encroachment of cropping activities into grazing areas and access to water from wells. The results of the responses of the respondents on the importance of different causes of conflict are presented in Table 14. The results indicate that the respondents rated damage to crops, the expansion of crop fields into grazing areas and livestock corridors, and animal theft as important causes.

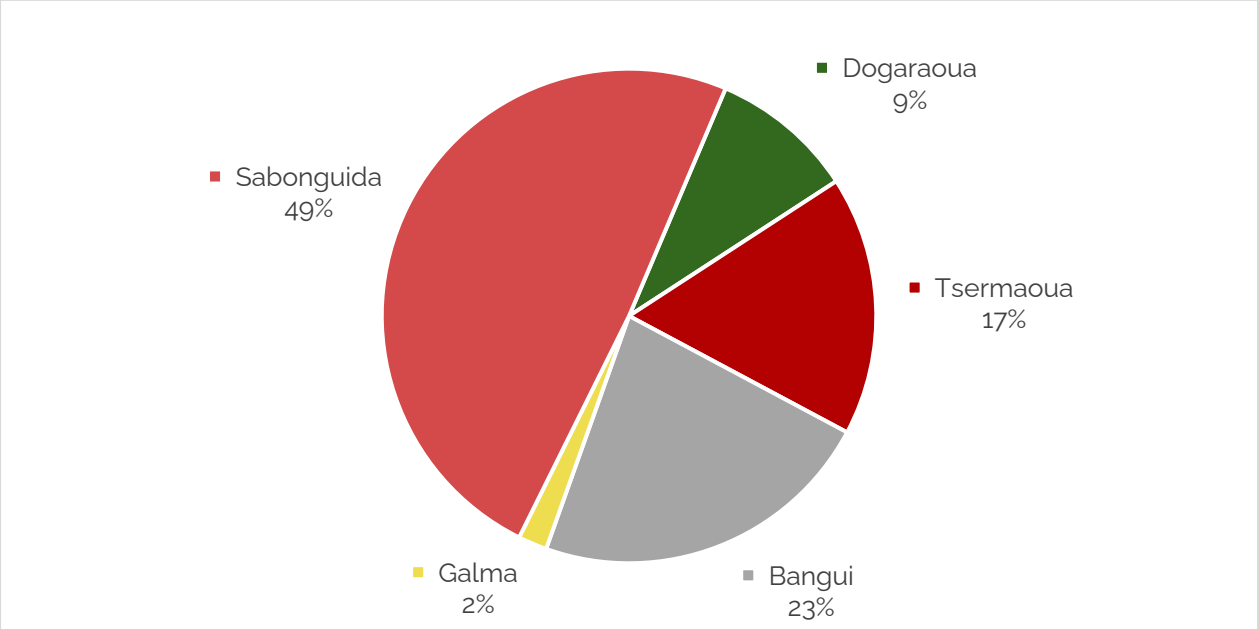

Figure 31: Percentage of respondents in each study site who reported cases of conflict over natural resource use in the past 5 years (N: Dogaraoua=5; Tsermaoua=9; Bangui=12; Galma=1; Sabonguida=26)

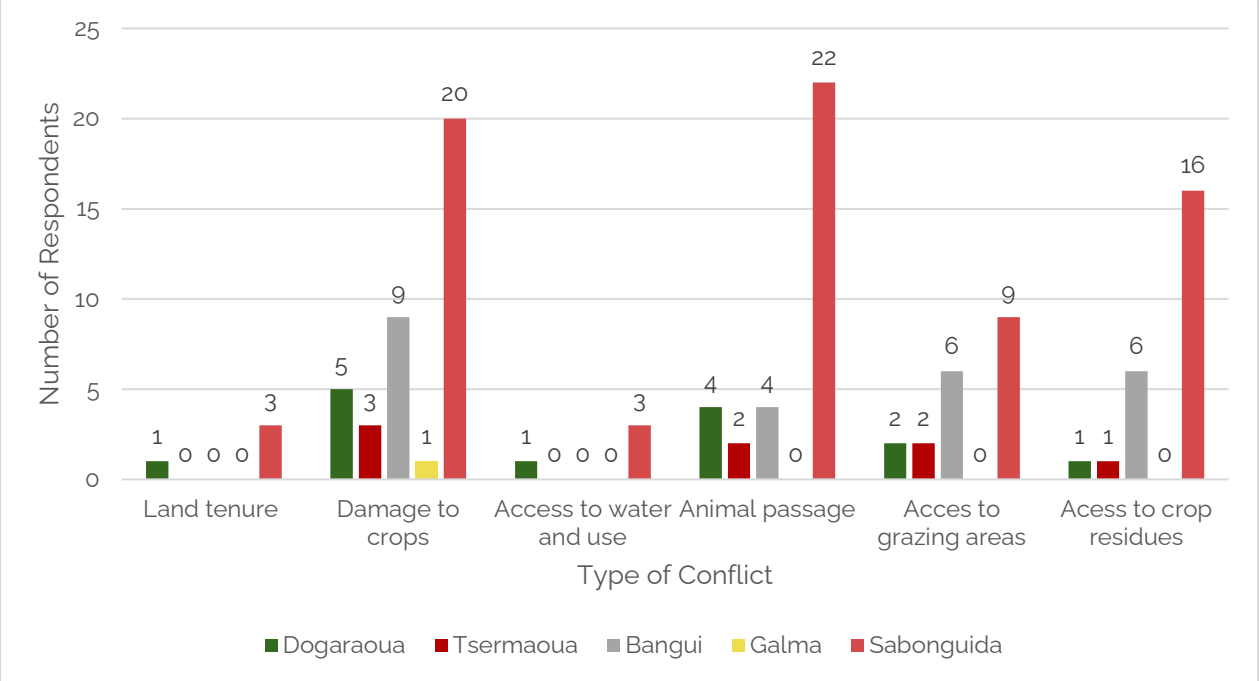

Figure 32: *Types of conflict reported by the respondents in the study sites (N: Dogaraoua=5; Tsermaoua=9; Bangui=12; Galma=1; Sabonguida=26)*

Table 14. Responses (1= Not important; 2 = Probably important; 3= Important; 4 = Very important) of the respondents on the importance of different causes of conflict over natural resources in the study sites (N; Dogaraoua=5; Tsermaoua= 9; Bangui=12; Galma=1; Sabonguida=26)

Cause	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. Damage to fields (crops) caused by livestock	2.80±0.20	2.33±0.33	2.00±0.12	1.00	2.58±0.18
2. Unauthorised grazing of crop residues by foreign herds	1.60±0.24	2.33±0.33	2.17±0.11	1.00	2.77±0.19
3. Competition over pasture use	1.60±0.24	1.67±0.24	1.75±0.13	1.00	1.92±0.16
4. Competition over water resources	1.80±0.37	1.78±0.22	1.67±0.22	1.00	1.88±0.18
5. Lack of clarity in local agreements and norms regulating the use of natural resources	1.40±0.24	1.56±0.18	1.42±0.15	1.00	2.88±0.15
6. Expansion of crop fields into grazing areas	2.60±0.24	2.67±0.37	1.92±0.15	1.00	3.23±0.16
7. Expansion of crop fields into livestock corridors	3.00±0.10	3.00±0.24	2.00±0.17	1.00	3.19±0.15
8. Multiple and illegal taxes by traditional and local authorities on the use of natural resources	1.00±0.10	1.67±0.33	1.58±0.15	1.00	1.85±0.26
9. Unresolved conflicts between different social groups in the community	1.00±0.05	1.22±0.15	1.92±0.23	1.00	2.58±0.16
10. External influence, e.g., local and national politics	1.00±0.10	1.11±0.26	1.67±0.22	1.00	2.42±0.19
11. Animal theft	3.00±0.10	1.78±0.32	2.83±0.30	3.00	2.73±0.10
12. Unauthorised cultivation of community land	1.00±0.10	1.33±0.17	1.67±0.14	1.00	1.65±0.17
13. Presence of transhumant herds in the community before crop harvest	1.00±0.10	2.22±0.22	2.00±0.17	1.00	1.92±0.17
14. Exclusion from decision making on natural resource management	1.00±0.08	1.00±0.17	1.42±0.15	1.00	1.77±0.15

These results were also confirmed at the focus group discussion in the study sites, where damage to crops and expansion of crop fields into grazing areas and into livestock routes as very important causes of conflict. Overall, participants in the focus group discussion assigned higher importance scores to the various causes than the respondents did in the individual household interviews. The group effect and perhaps the domination of the focus group discussion by a few participants might have contributed to the higher scores. Despite the differences in scoring of the importance of different causes of conflict over natural resource use in the study sites, the trends of the results from the household survey and the focus group discussion are similar with damage to crops by the animals and expansion of crop fields into the grazing areas and into livestock routes as the most important. The underlying condition for the expansion of crop fields into the grazing areas and into livestock routes is demographic, as rapid population growth in Niger over the last two decades, as in many other countries in the Sahel, necessitates cultivation of more land to feed the people (Turner et al., 2012).

With farming systems characterised by low external inputs, the common option for smallholders to increase crop yield is always extensification instead of intensification (Ayantunde et al., 2018). The increasing proximity of crop fields to grazing areas and livestock routes also increases the potential for conflict through damage to crops by the animals. The suggested measures by the focus groups to address the incidence of conflict over natural resources included enforcement of existing local conventions and rules, protection of the livestock routes, including clear demarcation of the animal passage, building capacities of the community leaders in participatory conflict management, and incentivising good management practices of the natural resources. These suggested measures show that strengthening the local conventions or rules governing access, control and use of natural resources in the communities is essential to controlling encroachment into the grazing areas. However, this may not be sufficient if the cropping pressure persists as the rapid population growth continues.

5.3.4 Highlights from results on Pastoral Communities

- Membership of the pastoralists and agropastoralists in an association or group was quite low in Dogaraoua, Tsermaoua and Bangui, whereas nearly all the respondents in Galma belonged to an association or group, which suggests group membership is location-specific as this may be influenced by social relations in the community.
- The respondents reported that there are well-developed local natural resource management conventions in the community, in oral (informal) or written form (formal). However, the challenge is the enforcement of the local conventions.
- The perception of the pastoralists and agropastoralists of relations with the local government authorities was generally between fair and good.
- The common types of conflict in the study sites were damage to crops by the animals, expansion of crop fields into grazing areas and into livestock routes, which obstruct animal passage, access to grazing areas and unauthorised grazing of crop residues. Damage to crops was mentioned as the most important cause of conflict.
- Most cases of conflict reported by the respondents were non-violent and were resolved at the community level.

5.4 Perceptions by the Pastoralists

5.4.1 Climate change

Climate change and variability are a menace to pastoral and agropastoral systems in the Sahel as it can impact negatively on herd mobility (Zougmore et al., 2016). The decimation of livestock herds by the severe droughts in the 1970s and 1980s in the Sahel is an example of the impact of climate change on pastoral systems, as this led to sedentarisation of many pastoralists to grow crops after they lost their

herds (Zougmore et al., 2016). To understand the trends and magnitudes of the impact of climate change on pastoral systems in the study sites, we interviewed the respondents on their perceptions. In response to the question whether they had observed climate change in the past 20 years in the communities, 81.5% of the 195 respondents interviewed responded yes (Figure 33). This suggests that most of the respondents had observed a change in the climatic conditions in their communities. The results are consistent with observations by Zougmore et al. (2016) that the smallholder crop and livestock farmers are faced with episodic climatic shocks in the Sahel. The specific attributes of climate change observed by the respondents in the past 20 years in the community included late onset of rainfall, shorter duration of rainy season, sudden cessation of rainy season and increase in average temperature across the study sites (Figure 34). Increased frequency of violent winds and flooding was also mentioned as the attributes of the climate change observed in some of the sites.

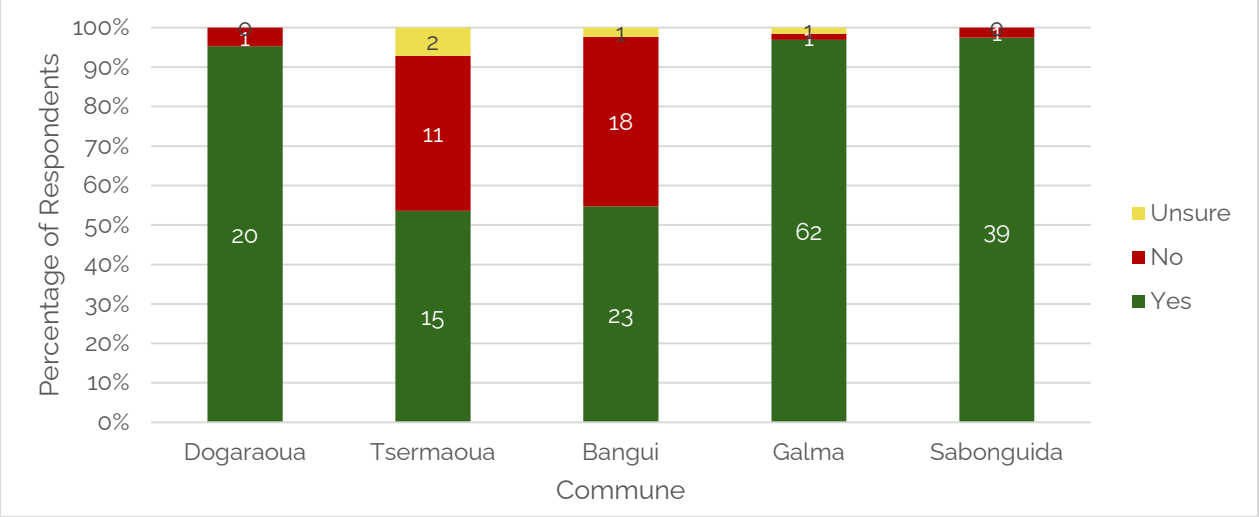

Figure 33 Response to observation of climate change by the respondents in the past 20 years in the community (N: Dogaraoua=21; Tsermaoua=28; Bangui=42; Galma=64; Sabonguida=40)

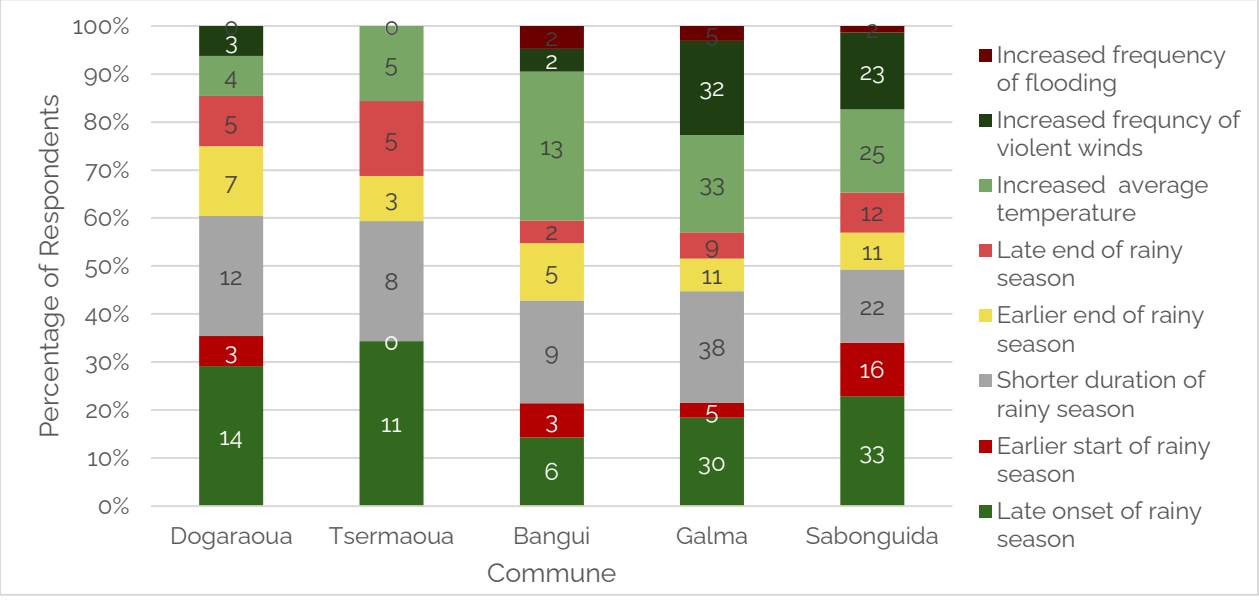

Figure 34: Specific attributes of climate change observed by the respondents in the past 20 years in the community (N: Dogaraoua=48; Tsermaoua=32; Bangui=42; Galma=163; Sabonguida=144)

The respondents further reported change in the climatic pattern was more noticeable at the onset of the rainy season and towards the end of the rainy season (Figure 35), though some respondents responded that the changes were noticed throughout the rainy season. These results suggest that interventions to enhance resilience of the pastoral households to climate change have to be targeted, focusing on the common types of changes that are experienced in the study sites, given that climatic conditions often vary from location to location. In terms of the trend of climate change in the study sites, the respondents reported an increase in the emergence of new crop pests and diseases, emergence of new livestock diseases, presence of non-palatable herbaceous species, livestock mortality, and household food shortage (Table 15). The results further showed that there was a decrease in the availability of pastures for the animals, crop yield, and household herd size. Responses regarding the trend in impact of climate change on the availability of water for livestock and humans were mixed and appeared to be location-specific: some respondents reported an increase, while others reported a decrease. Given that these results were based on respondents' perceptions, they should be triangulated with biophysical data to establish the actual trends. In Table 16, the results of the perception of the magnitude of the impact of climate change on pastoral and agropastoral production and livelihood showed that the perceived impact ranged from 1.80±0.14 in Tsermaoua for emergence of new crop pests and diseases to 3.92±0.21 in Sabonguida for the presence of poor-quality fodder species. For nearly all the parameters, the results were generally between 2.5 and 3, which means that the impact of climate change was perceived as average. The perceived high impact of climate change on species composition of the herbaceous vegetation has also been reported by Zougmore et al. (2016) for vegetation in dryland West Africa. The authors reported that the specific impacts of climate change on livestock may include changes in the availability and quality of forage resources, access to water, livestock mobility and animal diseases (emerging and re-emerging diseases).

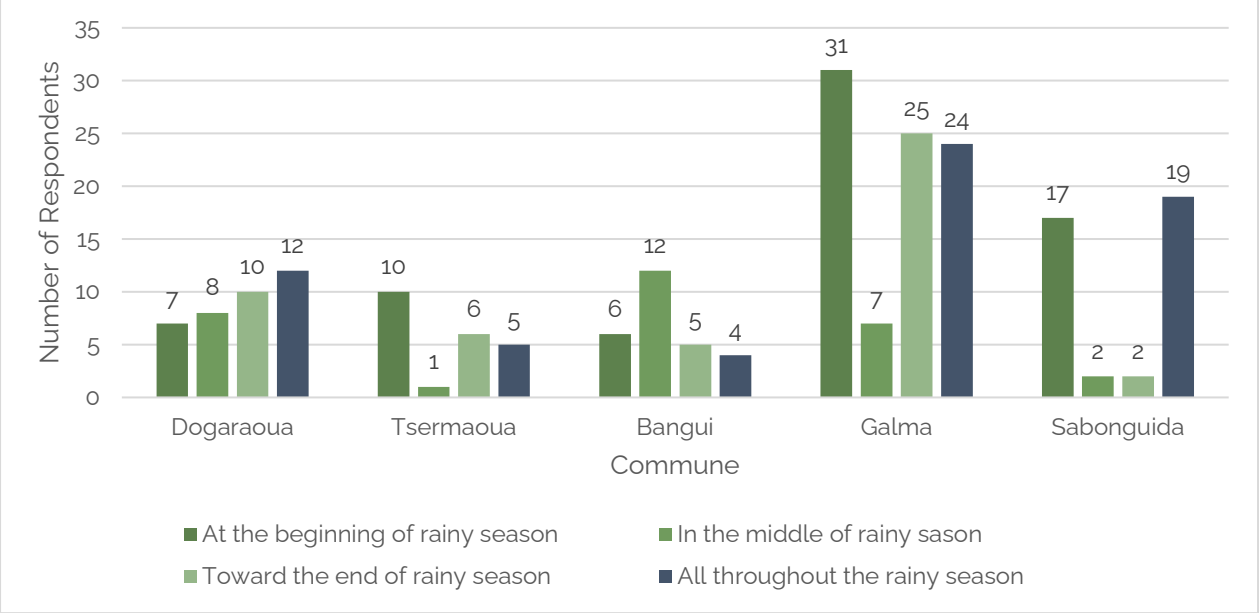

Figure 35: Season when the impact of climate change was observed by the respondents in the past 20 years in the community.

Table 15. The modal score for trend (1=Increase; 2=Decrease; 3=No change; 4=Not sure) in climate change observed for different impacts on agropastoral production and livelihood in the study sites (N: Dogaraoua=20; Tsermaoua=15; Bangui=23; Galma=62; Sabonguida=39)

Impact	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. Emergence of new crop pests & diseases	1	3	1	1	1
2. Incidence of crop failure	2	1	2	1	2
3. Crop yield	2	2	2	2	2
4. Availability of fodder/pasture for animals	2	2	1	2	2
5. Presence of poor-quality fodder species	1	1	2	1	1
6. Emergence of new livestock diseases	1	3	1	1	1
7. Livestock mortality	1	3	1	1	1
8. Household herd size	2	2	2	2	2
9. Incidence of human epidemics (meningitis, malaria)	3	3	1	1	1
10. Availability of water for animals	2	1	1	1	2
11. Availability of water for humans	3	3	1	1	2
12. Food shortage for household	1	1	1	1	1
13. Distance covered on transhumance	2	1	1	1	1
14. Changes in transhumance routes	1	1	1	1	1

Table 16. The means (±standard error) for magnitude (1=None; 2=Weak; 3=Average; 4=High; 5=Very high) of impact of climate change on agropastoral production and livelihood in the study sites (N: Dogaraoua=20; Tsermaoua=15; Bangui=23; Galma=62; Sabonguida=39)

Impact	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. Emergence of new crop pests & diseases	2.40±0.15	1.80±0.14	2.17±0.254	2.60±0.24	2.38±0.18
2. Incidence of crop failure	2.60±0.18	2.33±0.19	2.00±0.24	2.56±0.24	2.59±0.18
3. Crop yield	2.45±0.17	2.67±0.13	2.17±0.26	1.81±0.14	3.08±0.19
4. Availability of fodder/pasture for animals	2.35±0.13	2.60±0.13	1.87±0.27	2.92±0.15	3.13±0.17
5. Presence of poor-quality fodder species	2.75±0.16	2.67±0.23	2.09±0.32	2.84±0.19	3.92±0.21
6. Emergence of new livestock diseases	2.60±0.17	2.20±0.14	2.48±0.29	3.18±0.19	2.79±0.13
7. Livestock mortality	2.60±0.13	2.27±0.12	2.87±0.30	2.97±0.16	2.69±0.13
8. Household herd size	2.45±0.11	2.67±0.23	2.48±0.34	2.77±0.14	2.38±0.11
9. Incidence of human epidemics (meningitis, malaria)	2.30±0.11	2.33±0.16	1.87±0.25	2.98±0.17	3.15±0.17
10. Availability of water for animals	2.65±0.18	2.53±0.17	2.13±0.31	3.53±0.19	3.00±0.17
11. Availability of water for humans	2.55±0.17	2.60±0.19	2.22±0.31	3.53±0.19	2.92±0.16
12. Food shortage for household	2.65±0.13	2.67±0.13	2.96±0.34	3.48±0.19	3.51±0.17
13. Distance covered on transhumance	2.65±0,17	2.73±0.18	2.39±0.34	2.50±0.25	3.26±0.20
14. Changes in transhumance routes	2.70±0.19	2.40±0.16	2.48±0.29	2.13±0.23	3.03±0.17

5.4.2 Insecurity

The deteriorating security situation in the Sahel has been regularly in the news and the impact of the insecurity on pastoral systems has been reported by Benjaminsen and Ba (2019, 2024), particularly in Mali. These authors argue that local contexts are a key element in understanding the evolution of the security challenge and the impact on pastoralists in the Sahel.

When asked whether they had observed any change in the security situation in their communities over the past 10 years, 37.4% of respondents said yes, while the majority reported no change (Figure 36). However, the results were skewed to a negative response by the sample size of the respondents in Galma, who overwhelmingly responded that they had not noticed any change in the security situation in their community. In the remaining four study sites, more than 50% of the respondents reported that they had noticed a change in the security in their locations. These results suggest that the security situation may be location-specific, as in the study sites. These results are consistent with observations of Benjaminsen and Ba (2019) that the security situation is significantly influenced by local contexts.

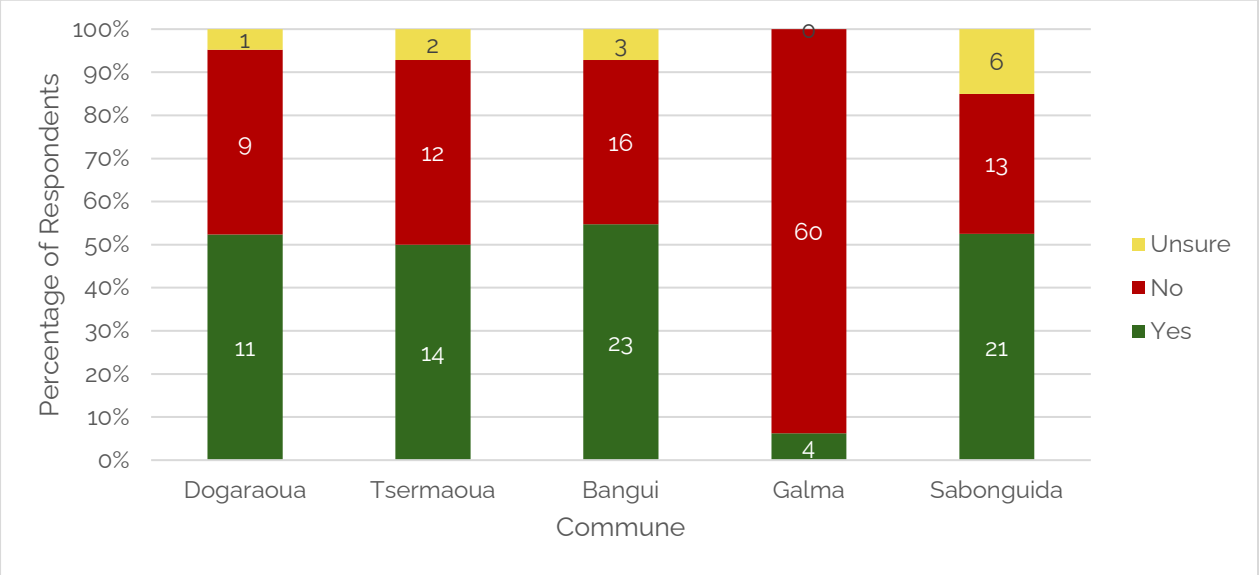

Figure 36: Responses to whether the respondents had observed any change in the security situation in the community in the past 10 years (N: Dogaraoua=21; Tsermaoua=28; Bangui=42; Galma=64; Sabonguida=40)

Most respondents who reported having observed a change in security situation in their communities responded that it has been getting worse or becoming alarming in the past 10 years (Figure 37). Their concern about worsening security conditions has been observed in a publication on security in Niger by FAO (2021), which has been partly attributed to the expansion of Boko Haram activities in the country.

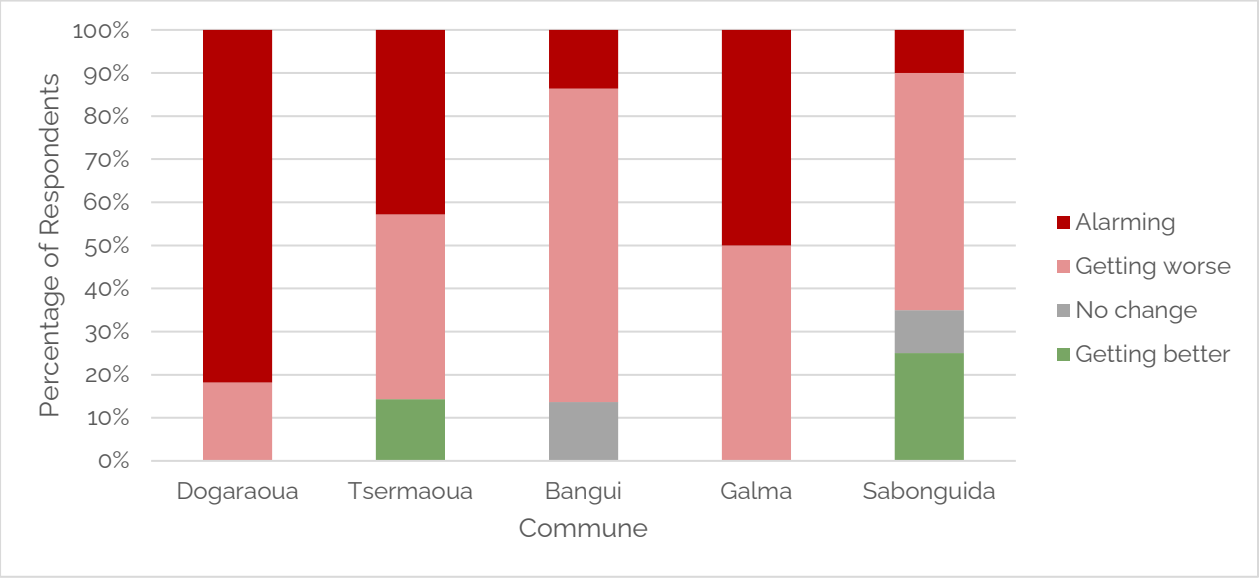

Figure 37: Perceived trend in the security situation in the community in the past 10 years according to the respondents (N: Dogaraoua=11; Tsermaoua=14; Bangui=23; Galma=4; Sabonguida=21)

According to the respondents, the major causes of the deteriorating security conditions, in descending order, were the presence of external jihadists in the region or country, the proliferation of jihadist groups in the region or country, accessibility of firearms to bandits, the easy spread of jihadist ideologies through social media, and perceived injustices and marginalisation of certain ethnic groups (Table 17). These results were similar across the study sites, indicating that the causes are widely shared as factors that worsen security in pastoral areas of Niger. These views by the respondents were also reported by Benjaminsen and Ba (2019) in Mali. Radicalisation of youth through erroneous religious teachings and widespread poverty were mentioned as other causes. The porous borders between Niger and Nigeria make it easy for Boko Haram jihadists to move without much resistance into Niger, and the porous borders also facilitate easy access to firearms by the bandits. The results of the effects of deteriorating security conditions on pastoral and agropastoral production systems are presented in Table 18. The most important effect of insecurity on pastoral and agropastoral systems was animal theft, which had the highest score in all the study sites. Other important effects mentioned by the respondents were reduced livestock mobility, change in transhumance routes, change in grazing itineraries to avoid bandits, and restricted movement due to fear of harassment, kidnapping, or being killed by bandits. Interestingly, the respondents did not report any strong effect of insecurity on the incidence of herder-farmer conflict in the study sites. Perhaps it could be attributed to a general low incidence of conflict in the study sites. The results of the perception on causes and effects of deteriorating security conditions on pastoral and agropastoral production systems suggest that multifaceted strategies or measures are required to address the challenge, and this requires active participation of the key stakeholders in the community.

Table 17. The means (±standard error) of causes of deteriorating security situation (1= Not important; 2 = Probably important; 3= Important; 4 = Very important) in the past 10 years in the study sites (N; Dogaraoua=11; Tsermaoua=14; Bangui=23; Galma=4,; Sabonguida=21)

Cause	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. Perceived injustices and marginalisation of certain ethnic groups	1.82±0.30	2.14±0.21	2.04±0.19	2.25±0.75	3.67±0.17
2. Presence of external jihadists in the region or country	3.82±9,35	2.07±0.29	3.17±0.32	3.00±0.91	3.05±0.29
3. Proliferation of Jihadist groups in the region or country	3.73±0.30	2.07±0.34	2.91±0.27	2.75±0.85	2.95±0.16
4. Widespread poverty and unemployment driving young people to join jihadists	2.82±0.12	2.00±0.26	3.13±0.28	2.50±0.50	3.86±0.16
5. Weak surveillance of the country's borders	1.73±0,35	2.43±0.36	2.91±0.24	2.25±0.48	3.48±0.20
6. Authoritarianism of security forces	1.27±0.14	1.79±0.21	2.52±0.20	2.50±0.65	1.76±0.22
7. Accessibility of firearms to bandits	2.82±0.18	1.93±0.22	2.52±0.23	3.00±0.41	2.52±0.33
8. Radicalisation of youth through erroneous religious teachings	2.82±0.18	1.79±0.19	2.61±0.22	2.75±0.48	1.95±0.15
9. Easy spread of jihadist ideologies through social media	2.82±0.16	1.71±0.22	2.35±0.19	2.75±0.48	2.10±0.21
10. Unregulated activities of community-based militant/vigilante groups	1.45±0.16	2.07±0.25	2.35±0.23	2.75±0.75	2.24±0.17

Table 18. The means (±standard error) of effects of deteriorating security situation (1= None; 2 = Weak; 3= Average; 4 = High; 5=Very high) in the past 10 years on pastoral production in the study sites (N: Dogaraoua=11; Tsermaoua=14; Bangui=23; Galma=4; Sabonguida=21)

Effect	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
1. Reduced livestock mobility	2.91±0.28	2.43±0.29	2.87±0.23	3.50±0.65	3.00±0.15
2. Changes in grazing routes to avoid bandits	2.55±0.34	2.79±0.19	2.83±0.26	3.50±0.65	3.33±0.16
3. Changes in transhumance routes	2.45±0.34	3.00±0.23	2.78±0.18	3.50±0.65	3.38±0.16
4. Changes in the destination of transhumant herders	2.36±0.36	3.21±0.21	2.61±0.22	2.75±0.25	3.19±0.20
5. Animal theft	3.91±0.21	3.00±0.23	3.52±0.23	4.25±0.25	3.62±0.15
6. Restricted mobility to reach markets	1.55±0.21	2.21±0.28	2.48±0.21	2.50±0.65	2.95±0.15
7. Bandit attacks in the village to steal money, motorcycles, and other items	2.00±0.23	2.86±0.29	2.74±0.27	2.00±0.41	2.19±0.22
8. Murder of community members	1.82±0.12	2.71±0.24	2.17±0.21	1.75±0.48	1.05±0.05
9. Rape of women and girls	1.09±0.09	1.36±0.17	1.52±0.16	1.00±0.00	1.05±0.05
10. Increased incidence of violent conflict in the region	1.82±0.30	2.36±0.23	1.83±0.16	2.00±0.41	2.00±0.10
11. Decreased labour available to herd animals, as young people have joined the jihadists.	1.36±0.20	1.57±0.23	2.22±0.20	1.75±0.48	1.90±0.15
12. Negative impact on livelihoods	2.55±0.21	2.50±0.17	1.91±0.16	2.25±0.25	2.33±0.16
13. Erosion of trust between different social groups in the community	1.82±0.18	2.64±0.23	1.91±0.17	2.25±0.25	2.33±0.13
14. Restricted movement due to fear of harassment, kidnapping, or death by bandits	1.82±0.18	2.64±0.20	2.61±0.22	2.50±0.50	2.24±0.14
15. Carrying firearms by herdsmen	1.27±0.14	1.86±0.18	1.74±0.18	1.75±0.25	1.10±0.07
16. Agricultural and livestock services are increasingly difficult to access	1.91±0.16	2.21±0.28	2.39±0.20	2.50±0.65	2.81±0.19
17. Payment of taxes imposed by jihadist groups during transhumance	2.36±0.41	2.86±0.31	1.35±10.16	1.50±0.29	1.05±0.05

Table 19. Proposed measures to address the deteriorating security conditions in the study sites from the participants at the focus group discussion. (Potential impact: +=Modest; ++ = High; +++ = Very high)

Proposed measure	Potential impact on security
1.Reinforcement of the presence of the national security forces in the communities	+++
2. Setting up community surveillance committee	++
3. Awareness raising of dangers of hosting strangers	++
4. Proper identification of strangers in the community	+
5. Strengthen security and control at the national borders	++
6. Informing security forces of suspicious movements of strange groups of people	++
7. Proper education of children about dangers of joining the Jihadists	++
8. Strengthen social cohesion in the community	++
9. Provide material and psychological support to victims of bandits	+
10. Mediation by the traditional leaders in resolving farmers and herders	+

From the participants at the focus group discussion in the study sites, reinforcement of the presence of the national security forces in the communities was seen as a measure that can arrest the deteriorating security conditions in the study sites (Table 19). The challenge with this measure is the overstretched national security forces due to the anti-terrorist fights in many parts of the country. The presence of the national security forces in rural communities to fight the Jihadists has been reported to be marked by abuses, for example in Mali. According to Benjaminsen and Ba (2019), the national security forces had been accused of stigmatisation of the Fulanis and extra-judicial killings of the pastoralists. Other proposed measures, such as proper education of children about the dangers of association with Jihadist groups and strengthening social cohesion in the community (Table 19), are long-term measures that can improve security situations in the study sites and in the Sahelian region. Proper education of the children is also important to counter the propaganda of the Jihadists on social media to recruit youths. These proposed measures by the participants at the focus group discussion also show that multifaceted strategies are required.

5.4.3 Access to services

Results from the interviews of the pastoral and agropastoral households on access to technical and financial services showed that, except for access to technical advisory services and animal health services, they generally had limited or no access (Table 20). The results showed that 96, 109, 15, 6 and 1 respondents reported access to technical advisory services, animal health, training, information on market and weather, and financial services, respectively. There was limited access to training, market and climate condition information, while there was virtually no access to financial services. Out of the 195 respondents, only one reported access to livestock insurance through a private service provider. Of all the communes, access to services in Tsermaoua was very limited except for animal health services (Table 20). When asked if they had accessed the services in the past 12 months, nearly all the respondents who reported access responded positively.

The logistic regression of the likelihood of access to the above-mentioned services, using socio-economic factors (commune, age, sex, ethnic group, education level, duration of residence in the community, household size) and household type (pastoral or agropastoral) as independent variables, showed that access to technical advisory services was significantly (P<0.10) influenced by commune (location) and by the sex of the household head. These results suggest that access to technical advisory services is location-specific, and females tend to have lower access than males. The finding that access to technical advisory services is location-specific is expected, as visits by technical agents may be influenced by factors such as community accessibility, infrastructure, and security conditions. The results that women have less access to technical advisory services than men may partly be attributed to cultural and religious factors as most technical service agents are men and may not be able to interact freely with women.

The results of the logistic regression further showed that the likelihood of access to animal health services is significantly (P <0.10) influenced by ethnic group and education level. The results showed that Fulani respondents are likely to have less access to animal health services compared to other ethnic groups interviewed (Tuareg and Hausa), while those who cannot read or write are also likely to have less access to animal health services. The regular movement of the Fulani pastoralists may likely explain why they have less access to animal health services. The results of less access by those who cannot read or write suggest that education affects access to services. The likelihood of access to training is significantly (P<0.05) influenced by ethnic group and household type. Again, the regular movement of the Fulani pastoralists with their herds may explain their less access to training compared to other ethnic groups who are more sedentary. The results on the significant effect of household type showed that the pastoral households tended to have less access to training than the agropastoral households. These results raise the fundamental issue of constant movements of pastoralists with their herds as a major hindrance to access to services. Dyer and Echessa (2019) raised this problem as a hindrance to the schooling of the children of the pastoralists in the Sahel. Providing mobile technical advisory services and animal health services may help to address the challenge of access to services by pastoralists. Also, the results raise the question of adapting services (type, format) to these specific targets and the modes of transmission of the services suitable to the mobile pastoralists etc. That is, services and technologies should be tailored to pastoral contexts – specific needs, mobility patterns and production systems of the pastoral households.

Table 20. *Access to services by the pastoral and agropastoral households in the study sites (N: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)*

Service	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Technical services					
Livestock	11	1	14	36	15
Agriculture	0	0	2	5	4
Environment	1	0	3	2	2
Total	**12**	**1**	**19**	**43**	**21**
Services Accessed in past 12 months	*11*	*0*	*11*	*42*	*18*
Animal health services					
Veterinary	7	9	14	10	31
Para-veterinary	5	6	6	15	6
Total	**12**	**15**	**20**	**25**	**37**
Services accessed in past 12 months	*9*	*2*	*14*	*19*	*30*

Service	Dogaraoua	Tsermaoua	Bangui	Galma	Sabonguida
Training					
Livestock	0	1	2	1	1
Agriculture	0	0	0	0	1
Water	0	0	0	1	1
Soil management	0	0	0	1	6
Total	**0**	**1**	**2**	**3**	**9**
Services accessed in past 12 months	*0*	*0*	*1*	*2*	*7*
Information services					
Market	0	1	1	1	0
Weather	0	1	1	1	0
Total	**0**	**2**	**2**	**2**	**0**
Services accessed in past 12 months	*0*	*1*	*2*	*1*	*0*
Financial services					
Saving schemes	0	0	0	0	0
Access to credit	0	0	0	0	0
Health insurance	0	0	0	0	0
House insurance	0	0	0	0	0
Crop insurance	0	0	0	0	0
Livestock insurance	0	0	1	0	0
Total	**0**	**0**	**1**	**0**	**0**
Services accessed in past 12 months	*0*	*0*	*1*	*0*	*0*

The respondents who had access to technical advisory services, animal health, training, and information services generally rated the quality as good (Figure 38) and the perceived effect on (agro)pastoral production as also good (Figure 39). These results suggest that where the services are available and accessible to the pastoralists and agropastoralists, the benefits are perceived as noticeable in their livestock production. It is therefore pertinent that the provision of technical services should be improved to enhance (agro)pastoral production systems. The perceived positive effect of technical advisory and animal health services by the respondents makes sense as these services improve their animal husbandry skills and the health of their animals, thereby leading to increased milk yield of their cows and body weight development. The sources of technical advisory services, animal health, training, and information on market and weather were the government, Non-Governmental Organisation, community association, private sector and Pro-ARIDES programme through local partners (Table 21). The governmental institutions were largely responsible for technical advisory and animal health services. The Pro-ARIDES programme was also reported as a provider of technical advisory services in Bangui and Sabonguida commune through its local partners. The private sector was mentioned as also providing animal health services in Bangui, Galma and Sabonguida besides the government and NGOs. Training was conducted by Pro-ARIDES, the government agencies and community associations. Reliance on the government for services is a challenge, given the budgetary constraints and bureaucratic bottlenecks in providing these services. Limited access to financial services is a challenge to improving (agro)pastoral production.

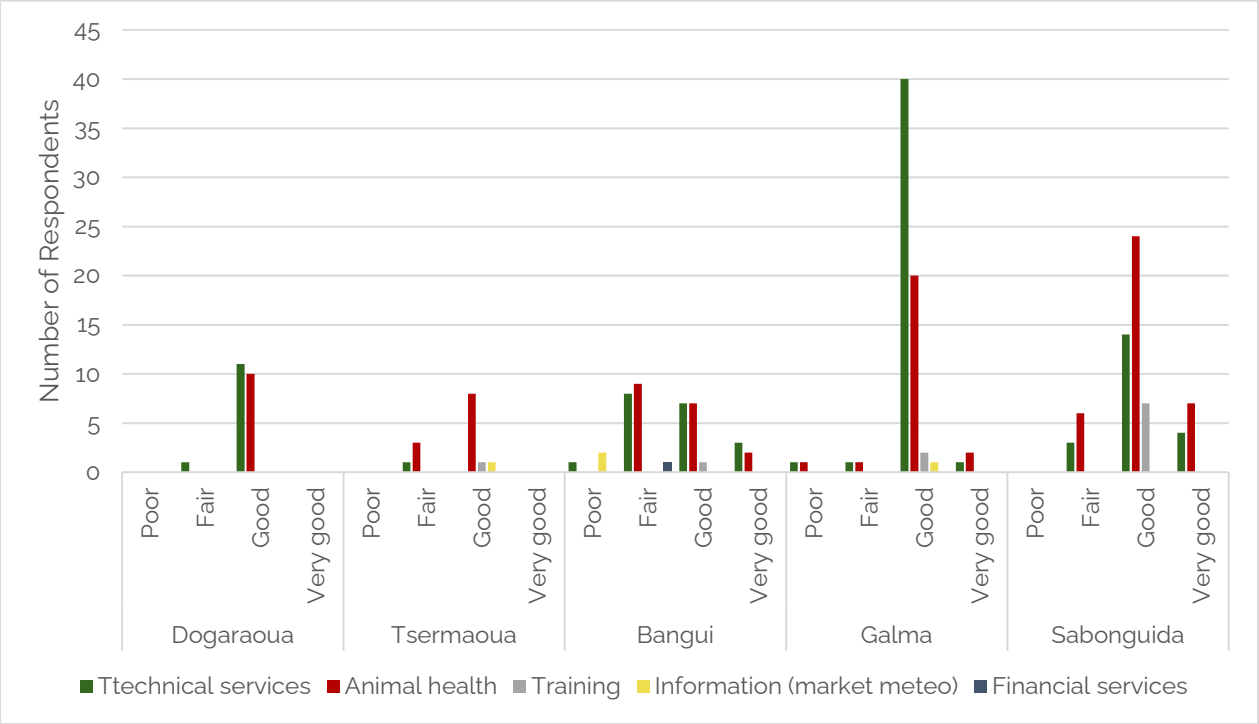

Figure 38. The perceived quality of services by the respondents in the study sites

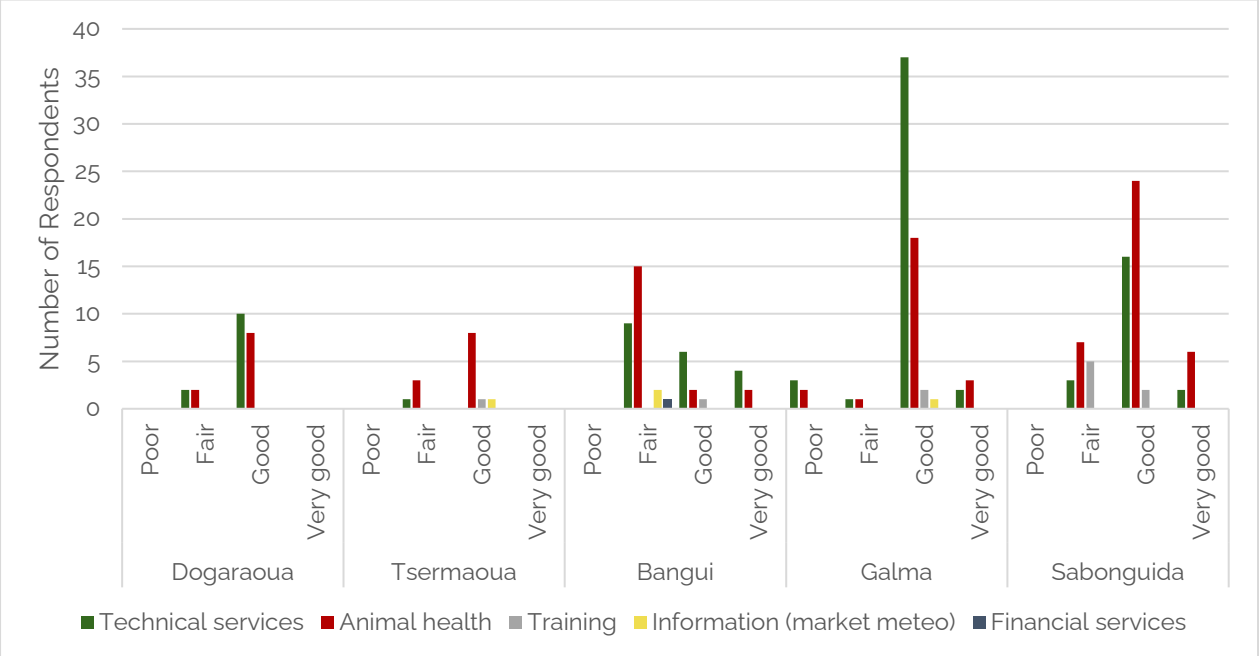

Figure 39. The perceived effect of services on the (agro)pastoral production by the respondents in the study sites

5.4.4 Interventions through Pro-ARIDES

Pro-ARIDES was reported as a source of technical advisory services and training in the study sites (Table 21). The technical advisory services by the Pro-ARIDES programme through its local partners were largely on agriculture (good agronomic practices), diversification of livelihood strategies, and natural resource governance in Bangui and Sabonguida, while two respondents reported training by the project

on soil fertility improvement in Tsermaoua and Galma communes. The quality of the technical advisory services and training by the programme was perceived as good. In the focus group discussion, the interventions by the programme through its local partners were perceived as generally small in Dogaraoua, Bangui and Sabonguida, but the perception of the respondents on the project interventions in Galma commune was good. In the Tsermaoua commune, the respondents reported that Pro-ARIDES is largely absent. These results suggest that the interventions by the programme targeting pastoral and agropastoral households are quite limited. From the focus group discussion, there was a clear demand for more visibility of the Pro-ARIDES in addressing the challenges faced by pastoral and agropastoral households. Pro-ARIDES can provide quality intervention in terms of technical advisory services on livestock and training to improve animal husbandry practices of the pastoralists and agropastoralists. The programme can also intervene in financial services, where there is hardly any actor targeting the pastoral and agropastoral households. The Pro-ARIDES programme can also intervene through local partners to strengthen communication and outreach to pastoral communities by supporting the communes and local service providers to increase the uptake of social services relating to education, hygiene, and nutrition.

Table 21. Institutions that provided technical advisory, animal health, training, information and financial services in the study sites (N: Dogaraoua = 21; Tsermaoua = 28; Bangui = 42; Galma = 64; Sabonguida =40)

Commune	Source of services	Technical advisory	Animal health	Training	Information (market & meteo)	Financial services
Dogaraoua	Government	10	0	0	0	0
	NGO	0	0	0	0	0
	Community association	0	1	0	0	0
	Private sector	1	0	0	0	0
	Pro-ARIDES	0	0	0	0	0
Tsermaoua	Government	1	9	0	1	0
	NGO	0	3	0	0	0
	Community association	0	0	0	0	0
	Private sector	0	0	0	0	0
	Pro-ARIDES	0	0	1	0	0
Bangui	Government	4	7	0	1	0
	NGO	6	10	1	0	0
	Community association	1	1	0	1	0
	Private sector	1	1	0	0	1
	Pro-ARIDES	7	0	0	0	0

Commune	Source of services	Technical advisory	Animal health	Training	Information (market & meteo)	Financial services
Galma	Government	38	17	1	1	0
	NGO	2	0	0	0	0
	Community association	1	0	0	0	0
	Private sector	1	6	0	0	0
	Pro-ARIDES	0	0	1	0	0
Saboguida	Government	14	31	0	0	0
	NGO	2	1	0	0	0
	Community association	0	0	1	0	0
	Private sector	0	3	0	0	0
	Pro-ARIDES	4	0	0	0	0

5.4.5 Highlights of Results on Perceptions by Pastoralists

- Most of the respondents had observed changes in the climatic conditions in their communities in the past 20 years in the communities (81.5% of the 195 respondents interviewed).
- The specific attributes of climate change observed by the respondents in the past 20 years in the community included late onset of rainfall, shorter duration of rainy season, sudden cessation of rainy season and increase in average temperature across the study sites.
- The respondents reported that the change in the climatic pattern was more noticeable at the onset of the rainy season and towards the end of the rainy season.
- The major causes of the deteriorating security conditions, according to the respondents in descending order, were the presence of external jihadists in the region or country, proliferation of jihadist groups in the region or country, accessibility of firearms to bandits, easy spread of jihadist ideologies through social media, and perceived injustices and marginalisation of certain ethnic groups.
- The most important effect of insecurity on pastoral and agropastoral systems was animal theft, which had the highest score in all the study sites.
- From the results of the perception on causes and effects of deteriorating security conditions on pastoral and agropastoral production systems, multifaceted strategies are required to address the challenge, and this requires the active participation of the key stakeholders in the community.
- Access to technical advisory services is location-specific and females tend to have lower access than males.
- The constant movements of pastoralists with their herds are a major hindrance to access to services. Providing mobile technical advisory services and animal health services may help to address this challenge.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Conclusions

This study was conducted to get a better understanding of the evolution of pastoral production systems in the Sahel in view of the changing security landscape, and of the relevance of Pro-ARIDES interventions for the pastoralists, with a focus on Niger as a case study. Results from the study showed that land and livestock assets of pastoral households varied significantly across study sites. The herd size of cattle owned by the respondents was on average between 6 to 8 TLU per household. Cattle herd size increased significantly with age and household size. Extensive livestock production was dominant in the study sites, although a significant proportion of the respondents practiced a transhumance system. The likelihood of practicing transhumance production system for cattle and sheep by the respondents is determined solely by the herd size, which means the higher the household cattle and sheep herd/flock size, the higher the probability of practicing transhumance, but there was no such trend for goats.

The reported major constraints to livestock production in the study sites were seasonal feed scarcity, decline in grazing areas, water scarcity and unfavorable climatic conditions, which are perennial problems in the Sahel. The availability of major feed resources in the study sites is seasonal, except for shrub leaves/fruits, agro-industrial byproducts, and concentrate feeds, which are available year-round. The pastoral and agropastoral households in the study sites experienced between 3 to 5 months of food insufficiency in a year. At least 60% of the respondents reported insufficient or just sufficient food as their food security status in the study sites in both wet and late dry seasons.

The reported food security status of the households was best during the early dry season, which corresponds to the harvest period. Sex had a negative impact on food security status in the late dry season, indicating that female-headed households are likely to experience worse food security compared to male-headed households. The period from May to August was reported as the most difficult for household food security. The positive effect of household type as one of the determinants of the household food security status in the wet season confirms that diversification of pastoralists by growing crops impacts positively on household food security status. The results show that access to technical advisory services is location-specific, as visits by technical agents may be influenced by accessibility of the community, infrastructures, and insecurity. The results also showed that women have less access to technical advisory services than men due to cultural and religious factors, as most technical service agents are men and may not be able to interact freely with women. The Fulani pastoralists had less access to animal health services, which could be attributed to their regular movements.

Results further showed that 60% of the respondents normally take their animals on transhumance. The results showed that number of months spent on transhumance is location-specific and that Fulani ethnic group tended to stay longer than other ethnic groups. The negative effect of area of land owned on time spent in transhumance suggests that herders from the household that grow crops may likely spend less time in transhumance so that their herd can graze the crop residues on their field immediately after the harvest. Departure on transhumance by the respondents was in June, the start of the rainy season, which corresponds with establishment of pastures at the destination, and they returned from transhumance between October and December. Young members of the household and the household head were responsible for herding the animals on transhumance. The key pull factors to destination of the transhumant herders reported by the respondents were availability of pasture and water, good social relations with the host community, presence of livestock routes/corridors, and presence of livestock markets in or near the community. The main push factor to go on transhumance

reported was a large herd size, as generally, there is low drive for pastoralists with small herd sizes to be 'pulled.'

Results suggest that the incidence of conflict over natural resources is low in the study sites. Damage to crops and expansion of crop fields into grazing areas and livestock routes were the most important causes of conflict in the study sites. Local conventions exist in the study sites, either in oral or written form, but the common challenge is enforcement. Necessary support by NGOs and projects such as Pro-ARIDES can facilitate natural resource governance in the study sites. The perception of the pastoralists and agropastoralists of relations with the local government authorities was generally between fair and good. To improve social inclusion of the pastoralists in the Sahel, efforts should include strengthening their livelihood options, enhancing access to resources, and promoting peaceful coexistence with other communities. Improving social relations and inclusion of pastoralists and agropastoralists in the region is also essential to addressing security challenges.

The respondents reported change in the climatic conditions was more noticeable at the onset of the rainy season and towards the end of rainy season. The specific attributes of climate change observed across the study sites by the respondents in the past 20 years in their communities included late onset of rainfall, shorter duration of the rainy season, sudden cessation of the rainy season and increase in average temperature. In terms of trends of climate change in the study sites, the respondents reported increase in emergence of new crop pests and diseases, emergence of new livestock diseases, presence of non-palatable herbaceous species, livestock mortality, and household food shortages, while there was a decrease in availability of pastures for the animals, crop yield, and household herd size.

These results suggest that security situations are location-specific, which is consistent with observations by other authors that the security situation is significantly influenced by local contexts. The most important effect of insecurity on pastoral and agropastoral systems was animal theft, which had the highest score in all the study sites. Other important effects mentioned by the respondents were reduced livestock mobility, change in transhumance routes, and change in grazing itineraries to avoid bandits. The respondents did not report any strong effect of insecurity on incidence of herder-farmer conflict in the study sites. Perhaps, it could be attributed to general low incidence of conflict in the study sites. Strategies to address insecurity in the region should be multi-faceted. Proper education of children of the dangers of association with Jihadist groups and strengthening social cohesion in the community are long-term measures that can improve security situations in the study sites and in the Sahelian region. Proper education of the children is also important to counter the propaganda of the Jihadists on the social media to recruit youths. These proposed measures by the participants at the focus group discussion also show that multifaceted strategies are required. The results of this study further showed that membership of the pastoralists and agropastoralists in associations or groups was quite low in Dogaraoua, Tsermaoua and Bangui whereas nearly all the respondents in Galma belonged to an association or group.

Given the context specificity of many pastoralism-related issues from the results of this study, the discourse on pastoralism should avoid over-generalisation. In addition, efforts should be made by Pro-ARIDES to tailor interventions to local contexts.

6.2 Recommendations for Pro-ARIDES

Based on the results of this study, the following recommendations are suggested for Pro-ARIDES to improve pastoral production systems. These should be seriously considered in the second phase. Implementation of these recommendations will require participation of key stakeholders in the community to ensure the effectiveness of the project interventions.

R1. Securing the grazing areas and livestock routes is essential to resilience of pastoral systems but participation of the pastoralists in natural resource governance is critical. Our results suggest that the interests of the pastoralists are not often considered in decision making by the local government authorities due partly to weak power relations. So, the project should facilitate increased participation of the pastoralists in platforms on natural resource governance and in decision making.

R2. Pro-ARIDES should support policy dialogue on livestock mobility by facilitating linkages between local pastoral associations and pastoral networks (e.g. AREN) to strengthen their lobbying and advocacy capacity. Besides, Pro-ARIDES should also focus on addressing livestock mobility and transhumance-related issues that extend beyond the programme intervention communes, requiring inter-communal and cross-border coordination.

R3. To enhance ownership and sustainability, capacity building activities of the project should be jointly identified with the pastoralists and agropastoralists. The most common pastoral association the respondents in the study sites belonged to is AREN, which Pro-ARIDES has been collaborating with, and this should be strengthened in identifying, designing and implementation of interventions on pastoral issues in the intervention areas.

R4. Strengthening the local rules or local conventions governing natural resource use and management should be given priority in the second phase. Natural resources such as communal grazing areas, grazing crop residues, land tenure, and access to wells, are still governed by traditional rules (oral or written) and the challenge with this is enforcement. So, strengthening the local conventions in terms of elaboration, documentation, validation, and formalisation is important, where required in the national texts.

R5. To strengthen the relations of pastoralists with the local government authorities, Pro-ARIDES should prioritise activities that empower the pastoralists in decision making over natural resources. This is also necessary to improve power relations of the pastoralists with the local government authorities.

R6. Pro-ARIDES should give attention to strengthening communication and outreach to pastoral communities by supporting communes and local service providers in designing and implementing targeted communication and outreach strategies with the aim of increasing the update of social services relating to education, hygiene and nutrition.

R7. Given that access to services by pastoralists and agropastoralists is still a big challenge in the study sites, Pro-ARIDES could provide quality interventions in terms of technical advisory services on livestock and training to improve animal husbandry practices of the pastoralists and agropastoralists. Providing mobile technical advisory services and animal health services may help to address this challenge of access to services by pastoralists. The project can also intervene where financial service providers targeting pastoral and agropastoral households are lacking.

R8. To improve social inclusion of the pastoralists in the Sahel, efforts should include strengthening their livelihood options, enhancing access to resources, and promoting peaceful coexistence with other communities. Improving social and power relations, and inclusion of the pastoralists and agropastoralists in relevant initiatives and platforms and networks in the region are also essential in addressing security challenges.

R9. Strengthening membership of pastoralists and agropastoralists in the study sites in association or group is important for access to services, market participation and capacity building. Pro-ARIDES can intervene through awareness raising of the benefits of membership in an association, and capacity building of the leaders of the associations in organisation management and record keeping.

R10. The results of the perception on causes and effects of deteriorating security conditions on pastoral and agropastoral production systems affirm that multifaceted strategies or measures are required to address the challenge, and this requires active participation of the key stakeholders in the community.

R11. For the respondents in the study sites, climate change is real and the impacts on pastoral and agropastoral production and livelihoods vary. To enhance the resilience of pastoral households to climate change and boost their adaptive capacity, climate-smart agricultural practices are required. Interventions to build adaptive capacity of the pastoral and agropastoral households should target crop farming and animal husbandry activities, particularly at the onset and towards the end of the rainy season as changes in the climatic conditions are more noticeable during these periods.

R12. Intervention to enhance resilience of pastoral households to climate change have to be targeted focusing on the common types of changes that are experienced in the study sites given that climatic conditions often vary from location to location

R13. The increasing proximity of crop fields to grazing areas and livestock routes increases the potential for conflict through damage to crops by the animals. Most causes of conflict over natural resources are partly due to power relations between actors according to the respondents. The programme should give attention to strengthening the existing local conventions and rules to protect livestock routes through clear demarcation of the animal corridors and building capacity of the community leaders in participatory conflict management.

R14. Pro-ARIDES should develop collaboration with other projects or programmes on pastoral development with specific focus on enhancing resilience of pastoral households and herd mobility. This would allow for synergies, shared learning, and complementarity targeting the structural challenges faced by pastoral communities.

R15. The programme interventions in the second phase should be adapted to the local contexts as the results of our study consistently showed differences across the study sites on many pastoralism-related issues. So, efforts should be made to tailor interventions to local contexts.

R16. This study should also be conducted in Burkina Faso and Mali as the local contexts may be different on various pastoral issues when compared to the study sites in Niger.

7 REFERENCES

Amole, T., Ayantunde, A., Balehegn, M. and Adesogan, A.T. 2022. Livestock feed resources in the West African Sahel. Agronomy Journal 114:26-45. https://doi.org/10.1002/agj2.20955

Amole, T.A and Ayantunde, A.A. 2016. Assessment of existing and potential feed resources for improving livestock productivity in Niger. *International Journal of Agricultural Research* 11:40-55. https://doi.org/10.3923/ijar.2016.40.55

Ayantunde, A.A., Duncan, A.J., van Wijk, M.T. and Thorne, P. 2018. Review: Role of herbivores in sustainable agriculture in Sub-Saharan Africa. *Animal* 12:S2, s199–s209. https://doi:org/10.1017/S175173111800174X.

Ayantunde, A.A., Asse, R., Said, M.Y. and Fall, A. 2014. Transhumance pastoralism, sustainable management of natural resources and endemic ruminant livestock in the sub-humid zone of West Africa. *Environment, Development and Sustainability* 16 (5):1097-1117. https://doi.org/10.1007/s10668-014-9515-z

Ayantunde, A.A., de Leeuw, J., Turner, M.D and Said, M. 2011. Challenges of assessing the sustainability of (agro)pastoral systems. *Livestock Science* 139:30-43. https://doi.org/10.1016/j.livsci.2011.03.019

Ayantunde, A.A., Williams, T.O., Udo, H.M.J., Fernández-Rivera, S., Hiernaux, P. and van Keulen, H. 2000. Herders' perceptions, practice, and problems of night grazing in the Sahel: Case studies from Niger. *Human Ecology* 28: 109-129. https://doi.org/10.1023/A:1007031805986

Benjaminsen, T.A. and Ba, B. 2024. A moral economy of pastoralists? Understanding the 'jihadist' insurgency in Mali. *Political Geography* 113: 103149

Benjaminsen, T.A. and Ba, B. 2021. Fulani-Dogon Killings in Mali: Farmer-Herder Conflicts as Insurgency and Counterinsurgency. *African Security*, 14: 1, 4–26

Benjaminsen T.A. and Ba, B. 2019. Why do pastoralists in Mali join jihadist groups? A political ecological explanation. *The Journal of Peasant Studies*, 46:1–20. https://doi.org/10.1080/03066150.2018.1474457

Berger, F. 2023. Locked Horns: Cattle rustling and Mali's war economy. Research report. The Global Initiative Against Transnational Organized Crime, Geneva, Switzerland. https://globalinitiative.net/analysis/cattle-rustling-mali-war-economy/

Bonfoh B., Fokou G., Crump L., Zinsstag, J. and Schelling, E. 2016. Institutional development and policy frameworks for pastoralism: from local to regional perspectives. Rev. Sci. Tech. Off. Int. Epiz. 35 (2): 499–509. https://doi.org/10.20506/rst.35.2.2537

Dyer, C. and Echessa. E. 2019. 'Sustaining learner participation and progression through networked schooling. A systemic approach for mobile out of School Children'. *International Journal of Development* 64: 8–16. https://doi.org/10.1016/j.ijedudev.2018.11.002

FAO. 2021. *The Niger – Analysis of conflicts over transhumance in Diffa region*: Summary. Rome, Italy. https://doi.org/10.4060/cb6957en

FAO. 2001. *Pastoralism in the new millennium*. FAO Animal Production and Health Paper 150. Rome, Italy.

Higazi, A., and Abubakar Ali, S. 2018. Pastoralism and Security in West Africa and the Sahel: Towards Peaceful Coexistence. UNOWAS. https://unowas.unmissions.org/pastoralism-andsecurity-west-africa-and-sahel

IFAD, 202. Country Technical Notes on Indigenous Peoples' Issues. The Niger Republic. Rome, Italy.

de Leeuw, J., Osano, P., Said, M., Ayantunde, A., Dube, S., Neely, C., Vrieling, A., Thornton, P. and Ericksen. P. 2020. *The pastoral farming system: Balancing between tradition and transition*. In: Dixon, J., Garrity, D.P., Boffa, J.M., Williams, T.O. and Amede, T. (Eds.) Farming systems and food security in Africa: Priorities for science and policy under global change. Earthscan, Routledge, London, UK. pp 318-352. https://hdl.handle.net/10568/106715; https://doi.org/10.4324/9781315658841

Lunaček, S. 2023. Schooled Tuaregs' engagement with mobile pastoralism in the Agadez region (Niger): avoidable sedentism and alternative forms of cooperation. *Nomadic Peoples*, 27:242–264. https://doi.org/10.3197/np.2023.270205

Moussa Dit Kalakou M., Andres L., Yamba B. and Lebailly, P. 2023. Typology of Peri-Urban Farming Households in the Tahoua Region, Niger Republic. *European Scientific Journal*, 19 (39), 86. https://doi.org/10.19044/esj.2023.v19n39p86

Ousseini, M., Baba, M., Idrissa, M., Inusa, S.K., Dar, K., and Seydou, H. 2023. Forage production, pastoral value and carrying capacity of the rangeland of Tahoua State in Niger Republic. *International Journal of Novel Research and Development*, 8:10.

Oxby, C. 2011. Will the 2010 'Code Pastoral' help herders in Central Niger? Land rights and land use strategies in the grasslands of Abalak and Dakoro Department. *Nomadic Peoples*, 15 (2): 53-81

Statistical Analysis System (SAS) institute (2016). SAS for personal computers (Cary, NC, USA: SAS Institute).

Turner, M.D., Teague, M. and Ayantunde, A. 2021. Livelihood, culture and patterns of food consumption in rural Burkina Faso. *Food Security*. http://link.springer.com/article/10.1007/s12571-021-01150-2

Turner, M.D. and Schlecht, E. 2019. Livestock mobility in sub-Saharan Africa: A critical review. *Pastoralism: Research, Policy and Practice,* 9:13. https://doi.org/10.1186/s13570-019-0150-z

Turner, M.D., Ayantunde, A.A., Patterson, K.P. and Patterson, E.D.2012. Conflict management, decentralization and agropastoralism in Niger. *World Development* 40 (4) 745-757. https://doi.org/10.1016/j.worlddev.2011.09.017

Turner, M.D., Ayantunde, A.A., Patterson, K.P. and Patterson, E.D. 2011. Livelihood Transitions and the Changing Nature of Farmer–Herder Conflict in Sahelian West Africa. *Journal of Developments Studies* 47 (2):183-206. https://doi.org/10.1080/00220381003599352

Umutoni, C and Ayantunde, A. 2024. Awareness and use of improved livestock feed technologies among agro-pastoral households in the West African Sahel. *Tropical Animal Health and Production* 56:194. https://doi.org/10.1007/s11250-024-04052-5

Umutoni, C., Ayantunde, A., Turner, M. and Sawadogo, G.J. 2016. Community Participation in Decentralized Management of Natural Resources in the Southern Region of Mali. *Environment and Natural Resources Research*, 6 (2). https://doi.org/10.5539/enrr.v6n2p1

Unusa, H. 2012. *The new pastoralism: Absentee owners, new technologies, economic change and natural resource management in the Sahelian region of far north Cameroon*. PhD dissertation, Leiden University, Leiden, The Netherlands. 306 pages. http://hdl.handle.net/1887/19840

Williams, T.O., Spycher, B., and Okike, I. 2006. *Improving livestock marketing and intra-regional trade in West Africa:* Determining appropriate economic incentives and policy framework. Report, International Livestock Research Institute, Nairobi, Kenya.

Zougmoré, R., Partey, S., Ouédraogo, M., Omitoyin, B., Thomas, T., Ayantunde, A., Ericksen, P., Said, M. and Jalloh, A. 2016. Toward climate-smart agriculture in West Africa: a review of climate change impacts, adaptation strategies and policy developments for the livestock, fishery and crop production sectors. *Agriculture & Food Security* 5:26. https://doi.org/10.1186/s40066-016-0075-3.

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