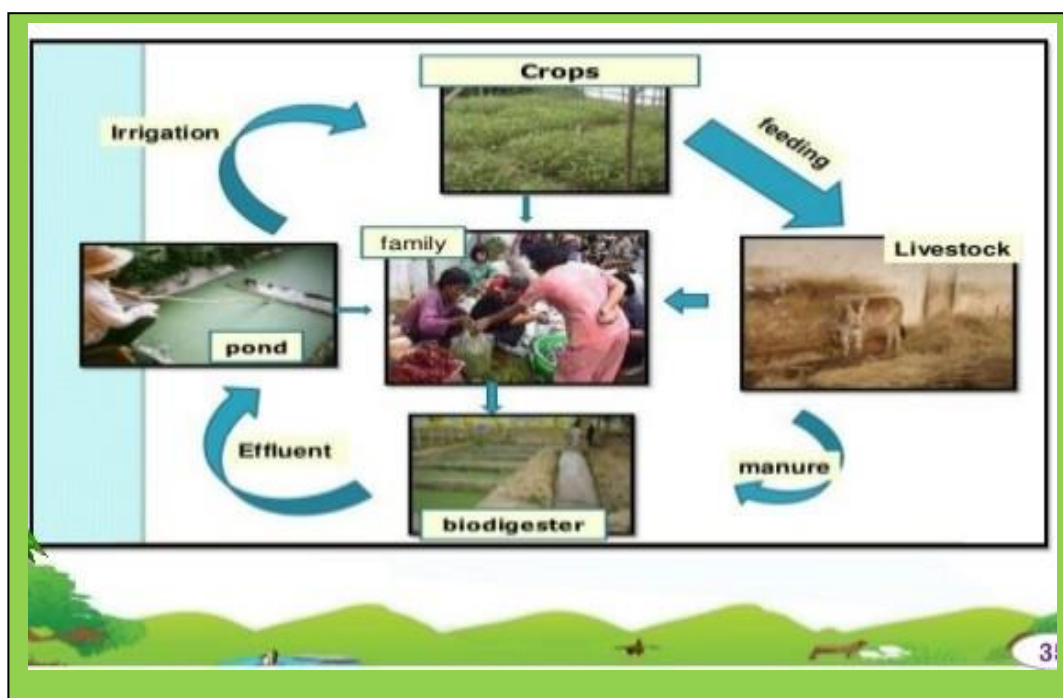


Project:

**Enabling Value Chains to Create Sustainable Income for Vulnerable People
in Crop-Livestock Systems of Burkina Faso and Niger**



**Baseline Report: Understanding farming system and crop-livestock value chains
dynamics to identify potential interventions to improve farmers' livelihoods in Niger and
Burkina Faso**

Produced by ICRISAT

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Abbreviation

APESS	: Association pour le Promotion de l’Elevage au Sahel et en Savane
ASF	: Animal-source food
BAD	: Banque Africaine de Développement
CFA	: Communauté Financière en Afrique
CN	: Centre Nord
FAO	: Food and Agriculture Organization
GDP	: Gross domestic product
Ha	: Hectare
HH	: Household
ICRAF	: The World Agroforestry Centre
ICRISAT	: The International Crops Research Institute for the Semi-Arid Tropics
IEPC	: Initiative Elevage Pauvreté et Croissance
ILRI	: International Livestock Research Institute
INERA	: Institut de l'Environnement et Recherches Agricoles
INSD	: Institut national de la statistique et de la démographie
IP	: Innovation Platform
NRM	: Natural Resource Management
OECD	: Organization for Economic Co-operation and Development
PCA	: Principal Component Analysis (PCA)
PCR	: Regression
R&D	: Research and Development
RBM	: Réseau Bilitaal Maroobé
RECA	: Réseau National des Chambres d’Agriculture
REGIS- ER	: Resilience and Economic Growth in the Sahel – Enhanced Resilience
SAREL	: Sahel Resilience Learning Project
TLU	: Tropical Livestock Unit

USAID : The United States Agency for International Development

USD : U.S. dollar

VC : Value Chain

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Summary

Niger and Burkina Faso are among the poorest countries in the world, with more than 80 % of households in these countries relying on agriculture for their livelihood. Mixed farming combining grain and livestock production dominates the farming systems of the two countries. Despite their importance, the farming systems in the two countries have failed to reach their potentials. Though many studies have been undertaken with the aim of finding ways to boost the agriculture sector, little attention has been paid to the integration and mainstreaming of inclusive and equitable agricultural policy processes, and research programs. This project was funded to conduct more research on integrated technologies; practices or management options to improve the inclusive crop-livestock systems value chains, increase incomes, reduce poverty and improve nutrition and health. The project baseline study aimed at understanding crop-livestock value chains in Burkina Faso and Niger.

The baseline data was collected in Niger and Burkina Faso, two neighboring Sahelian countries with similar constraints in their agro-pastoral systems. The study is based on analysis of quantitative and qualitative data. Quantitative data was gathered from 391 households from four regions (two regions in each country) while qualitative information was purposely gathered using group discussions with farmers in each community.

The findings of this study revealed among others: low involvement of youth in agriculture activities, low level of organization among farmers, and low support received by farmers from extension officers. Agriculture was the primary activity of more than 90% of respondents. Besides, the study revealed that the average land size was 3.61 ha and 3.65 ha in Burkina Faso and Niger, respectively. Furthermore, women-headed households had low land area compared to the households headed by men. The average production of one of the main crops grown, that is millet per hectare, was about 550 kg in both regions of Niger, and 439.6 kg and 1049 kg in the Centre Nord and Sahel regions, respectively. More than 90 % of the production was kept for home consumption. Usage of new agricultural technology is still very low in the project sites. Farmers in the study sites had adopted conservative agriculture farming practices, where trees were used as a technological element within the farming practice. These trees constituted also a big source of income for the farmers.

Livestock is a part of the system, with the average number of livestock owned by households being 2.5 TLU and 2.09 TLU, in Burkina Faso and Niger respectively. Data on milk production showed that production of milk was still very low, with an average of two liters/day per cow in Burkina Faso, and 1.5 liters/day in Niger. Sheep and goats produced between 0.5 and 1 liter per day. The main sources of animal feed were crop residues, purchased feed, and available grass. With regard to the market conditions, majority of the respondents sold their produce either at the village market or market of the neighboring village, and got information of the market through among others news from local radio, friends and family, and from extension officers in limited cases. Majority of rural households, especially women (85%) had access to credit in the Sahel region of Burkina Faso, regardless the source of credit.

There were four and three crop-livestock farm types identified in Niger and Burkina Faso respectively: based on land size, family size, livestock ownership, small ruminant ownership, technology use, and animal traction use. These farm typologies were related to specific characters and agriculture practices. These farm typologies explain 80% of variability in the agricultural system of Niger. Majority of farmers in Niger were represented in type 4, which had 64% of farmers surveyed, while in Burkina Faso the majority of farmers were represented in group 2. Respondents felt that improving access to market and facilitating access to inputs (fertilizer, dual-purpose crops, etc.) will improve crop livestock agricultural activities, and enhance climate resilience of their farming systems.

1. Introduction

Has the extent of poverty within the Sahelian countries increased or decreased over the last 20 years? How can we improve the lives of the rural population? The extent of extreme poverty is shrinking, both in absolute numbers, and as a proportion of the world's population (Sachs, 2005; BAD, 2018). It is more important to understand and solve the problems of the place where economics is not working, like the case of Niger and Burkina Faso, where people are still on the ladder of development, or are on its lowest rungs. Niger and Burkina Faso are among the poorest countries in the world, with more than 80% of households relying on agriculture as their main source of livelihood (OECD/FAO, 2016). Mixed farms combining grain production and livestock farming dominate Niger and Burkina Faso farming systems. Rain-fed agriculture and agro-pastoralism systems are the source of employment for about 80 - 90% of the population (APESS, 2014) and the main sources of both food and income (SAREL, 2015). Despite their importance, these systems have failed to reach their full potential.

Little attention has been paid to the integration and mainstreaming of inclusive and equitable agricultural policy processes and research programs. Furthermore, inequalities and inequitable access to productive capital; market channels, and low participation of women and youth in the economically vibrant segment of the crop and livestock value chains have continued to impede growth, and exacerbate the vulnerability of the marginalized social and gender groups. Despite, governments and international donors continued investment in agricultural R&D; this investment is largely channeled to the production of staple foods. Considering that, crop production alone cannot meet basic human needs for nutrition or income generation. Hence, it is crucial to strengthen the integration of livestock into the farming system because livestock are considered to be catalytic in helping rural households achieve their livelihood objectives (FAO, 2018).

Livestock contributes to 39% of the income of rural households in Burkina Faso, and for 25% of food needs, 15% of household incomes and 40% to agricultural GDP in Niger. In addition, Animal-source foods (ASF) provide more quality protein than plants, as well as important bioavailable micronutrients, which illustrate their importance on growth, nutritional status, psychomotor functions, cognitive development, and health of children, particularly infants under the age of two (Van Horn, 2010; Enahoro et al., 2018). Niger and Burkina Faso have high

potential of animal-source-food production in terms of quantity and diversity. However, livestock sector is facing major problems that hinder the development of the sector. Among the main constraints of the livestock sub-sector in the two countries includes: seasonal and inter annual variability of pastoral resources, leading to regularly negative feed balances. It is estimated that 40% of the feed deficit is compensated by crop by-products in Burkina Faso (IEPC, 2006), showing the importance of crop-livestock integration in improving of the productivity of the farming systems. Therefore, developing well strategized integrated crop-livestock systems would not only improve the productivity of both crop and livestock productions, but also address the problem of nutrition and food security. Integrating and intensifying crop and livestock systems do allow for more efficient use of natural resources and inputs through recycling and increasing the overall output, efficiency and resilience of the system (Thornton and Herrero, 2014). This project was funded to conduct more research on integrated technologies; practices or management options to improve the inclusive crop-livestock systems value chains, increase incomes, reduce poverty and improve nutrition and health. The project baseline study aimed at understanding crop-livestock value chains in Burkina Faso and Niger. The specific objectives of this study included the following:

1. To collect information on crop and livestock production systems and understand farmers' perception on possible interventions of improving the system;
2. To gather information on crop and livestock market conditions;
3. To assess the level of households' access to productive capital;
4. To understand the role of household's members in decision-making;
5. To understand the level of households' food security.

This baseline report presents the project sites and their selection criteria, in addition to the approach adopted in the collection of the study data. The report will then involve the presentation of the results, ending in conclusion made based on these study results.

2. Description of project sites

The project was conducted in Burkina Faso and Niger, two neighboring Sahelian countries with similar constraints in their agro-pastoral systems.

2.1. Selection of the Study Sites: Selection of the region

The study sites in Burkina were Kaya in the region du centre nord and Dori in the Sahel region, while in Niger, the study site included Torodi, a rural site in the Region de Tilabery and Maradi, an urban city in the Region de Maradi (Figure 1). These study sites were selected based on agro-ecological zone and market opportunity.

2.1.1. Study area in Burkina Faso

Kaya is located in North-Sudanian agro-ecological zone (600 - 700 mm of annual rainfall) while Dori is in the Sahelian zone (400 - 600 mm) of Burkina Faso. The region du Centre Nord is one of the most populous in the country with 61 inhabitants/km² and the most affected by food insecurity, while the region du Sahel has 34 inhabitants per km² (INSD, 2015). The main sources of livelihood in both regions are based on agro-pastoral activities, which occupy about 90% of the labor force. The main constraints to agriculture include: unfavorable climatic conditions, poor organization of farmer associations/cooperatives, and limited access to improved technologies.

Livestock husbandry is very important in both the project sites. The region du Sahel accounts for 21% of the cattle and 31% of the small ruminants (14% of sheep and 17% of goat) in the country (Ministère de l'Élevage, 2013). The livestock production systems are mainly extensive and the seasonal fluctuation in feed resources, compounded with acute shortage in the dry season is a major constraint across the region. In both sites, livestock production is very important as a source of food and income of smallholder farmers. Many households often sell their animals to buy grains for household consumption. The livestock marketing system in the Kaya area is well developed with intermediate markets where livestock are collected and transported to the Kaya market, which is of national importance. From Kaya, livestock are exported to other parts of the country, or to neighbouring countries of (Mali, Togo, Benin and Ghana). There is a livestock market in Dori, which is frequented by livestock traders from the country and other neighboring countries (Niger and Mali). The research station of INERA on livestock is located at Dori, offering facilities and technical staff. The vibrant and well-developed livestock markets located near both project sites provides an opportunity for improvement of livestock value chains particularly as this can serve as incentive for producers to improve livestock uptake with improved access to market (Tamini et al., 2014). The presence of USAID REGIS program in

both regions will provide opportunities to build synergies with REGIS in terms of data, information sharing, and capacity building of key livestock actors in both regions.

2.1.2. Study area in Niger

Torodi lies about 50 km east of the border with Burkina Faso in the Sahelo-Sudanian zone (400-600 mms annual rainfall) with 32% of the small ruminant herd of the Tilabery region (20% ovine and 12% goat) in Niger. In the department of Torodi, small ruminants represent 54% of the total livestock (Adamou et al., 2004). Torodi hosts a renowned large weekly market of livestock and is a transit and export center for animals to Côte d'Ivoire, Burkina Faso, Ghana and Togo. Maradi region is located in the Sahelian agro-ecological zone (500 and 600 mm of rainfall) in the central parts of Niger with the highest population in the country of about 3.1 million inhabitants (2011), with an average population density of 75 per km². The Maradi region is the typical agro-pastoralist zone of Niger. The dominant farming systems is mixed crop and livestock systems as nearly all households have at least some heads of sheep and goats (Amole and Ayantunde, 2016). Cattle and small ruminants for sale is common within this region. More than 41% of the country's livestock are located on the transect of Maradi-Zinder (Ministère de l'Élevage, 2014) and bordering Nigeria, the major trading partner. The region is dominated by Hausa ethnic group (about 84% of the population). It has strong historical and commercial ties with the neighboring state of Nigeria.

The major constraints to livestock production on both sites include: diseases, seasonal feed shortage and water scarcity particularly during the dry season. The crop-livestock systems are gradually changing from the traditional extensive system to semi-intensive and intensive system (Mortimore et al., 2001). While only 25% of herders are still using the traditional extensive livestock system, more than 53% of them are using a semi-intensive system and 14% have adopted the intensive system (Hamadou, 2000). Crop residues are an important source of animal feed; leading to the development of markets for crop residues and commercial relations between actors. (Amole and Ayantunde, 2016).

The transect Maradi-Zinder offers the working environment for stakeholder platforms and value chains actors (producers, traders, processors of animal-source food, national health services). The city of Maradi has the major livestock market that attracts traders from other parts of the country, and from the neighboring country of Nigeria as well. The city of Maradi has 61%

of urban households and 81% of peri-urban households involved in small ruminant breeding (Ali et al., 2003). The presence of agro-pastoralist associations such as the Réseau Bilitaal Maroobé (RBM) will help in providing a practical platform for engagement with relevant livestock stakeholders for the improvement of the value chains. Both sites are in USAID/REGIS-ER zones of intervention in Niger. ICRISAT has ample working experience in the region with several ongoing projects, which will facilitate partnership building for the project.

2.2. Selection of Study Sites: Selection of village for project intervention

In collaboration with agricultural/livestock extension agents and National Research Institutions, the project identified 10 and 6 villages in Niger and Burkina Faso respectively. The site selection process involved the following steps:

Step 1- Define the site selection criteria

The project team and partners defined common criteria for selection of villages on project sites. The following criteria was developed for shortlisting villages:

- Integration of crop and small ruminants.
- The representativity of the village.
- Distance to the markets.
- The existence of farmers' organization/Innovation Platform.
- Presence of partners.
- Potential impacts.

Step 2- Identification of potential project sites

The identification of potential project sites was done in collaboration with National Agriculture and livestock extension services and National Research Institutions to ensure effective shortlisting of the villages. Based on the above criteria, many villages in Maradi, Torodi, Kaya and Dori were identified and shortlisted in Niger and Burkina Faso as potential villages where the project could be undertaken.

Step 3- Final selection of community to receive intervention

Prior to the final selection, the shortlisted villages were discussed by the project team members in order to check the necessary information. Taking into consideration the project objective and based on the analysis of the information gathered during the discussion with national institutions agents, the final selection of villages was made. Table 1 &2 below summarize the list of villages selected based on the specified criteria. In addition, the dynamism of the population of the targeted villages offered opportunities to easily engage them in the project activities.

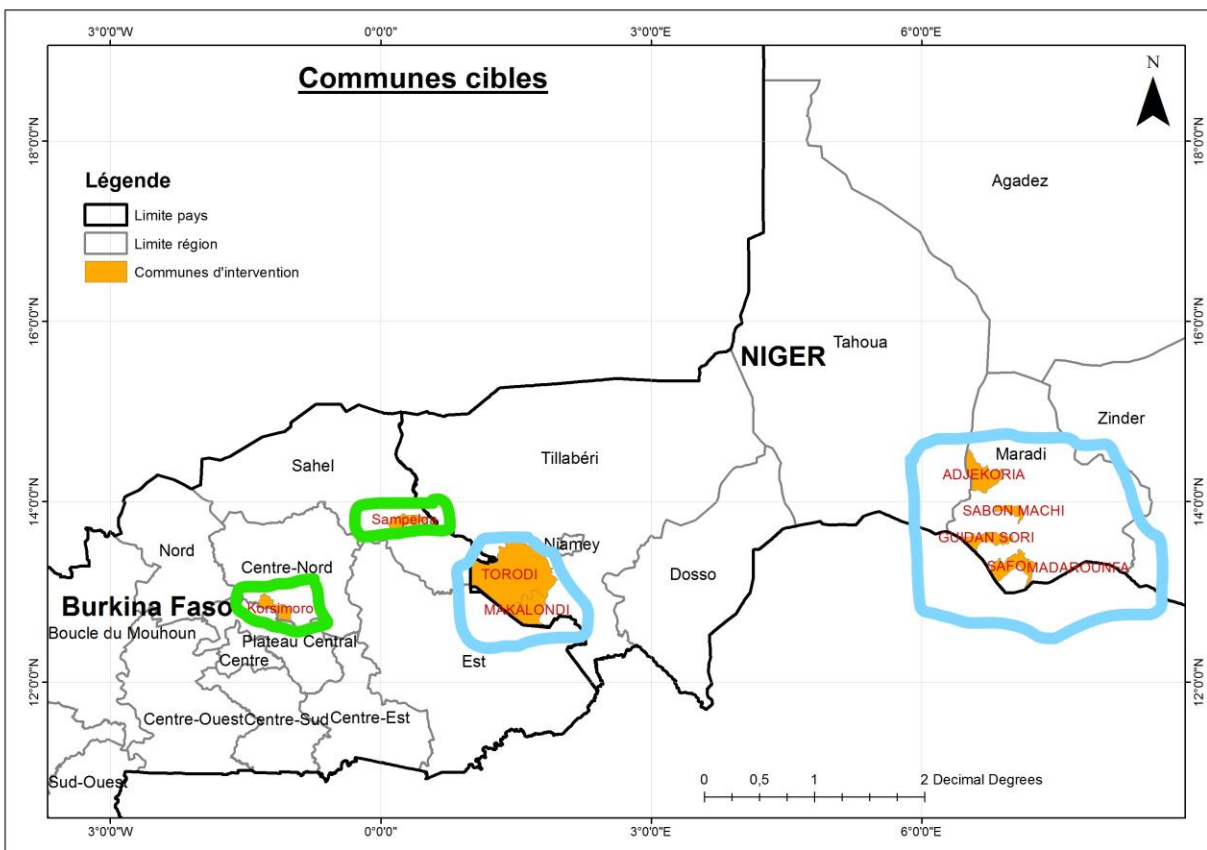


Figure 1. Map of the project study sites in Niger and Burkina Faso

Table 1. Project sites intervention in Niger

N	Region	Department	Village	Distance to Niamey (km)	Market	The potential for integration of Crop and Livestock farming activities	Farmer organization/IP
1	MARADI	Madaroumfa	Safo	670	- Existence of livestock/input market (Kiguel market). - Groundnut haulm informal market.	Potential for integrating small ruminant and crop production.	Existence of women associations producing groundnuts.
2			Bargaja	690	The village is not near or far from Gabi Market.	- Potential for crop and livestock production- - all household have small ruminants.	Existence of groundnut oil processing organization- Women association.
3		Dakoro	Babon Kori I & II	690	Existence of informal market for crop residues.	An agro- pastoral zone ' <i>par excellence</i> '.	-
4			Akora Idi	700	Developed groundnut haulm and cowpea hay informal market.	High number of small ruminant producers.	-
5		Guidan Roundji	Karazomé I&II	680	- Presence of a market not very far from the village. - Possibility for developing trade of animals /animal products with Nigeria.	Integrated small ruminants production and crop production.	Existence of women association.
6			Karo Safoua	690	Existence of a market not far from the village (Guidan Roundji market).	Agriculture and Small ruminants integration	-
7	Tilabery	TORODI	Djoga	30	Well-developed livestock markets.	Opportunities for improvement of crop-livestock value chains.	-
8			Sirimbana	30	Well-developed livestock markets.	Opportunities for improvement of crop-livestock value chains.	-
9			Tiko	50	Well-developed livestock markets.	Opportunities for improvement of crop-livestock value chains.	-
10			Patti	50	Well-developed livestock markets Possibility for developing trade with Burkina Faso.	Opportunities for improvement of crop-livestock value chains.	-

Table 2. The project sites in Burkina Faso

N	Criteria/Details on the site	Region du Centre Nord (Kaya)			Sahelian Region (Dori)		
		Korsimoro Department			Sampelga Department		
		Korsimoro ville	Foulla village	Silemtenga village	Sampelga ville	Bandiedaga village	Gnagassi village
1	Distance to a large livestock market/ input market (Animal feed, etc.)	-30 km from Korsimoro town. -30 km from livestock market of Kaya.	-Located in the East of Korsimore. -12km from Korsimore livestock market.	-Located North-West of Korsimore. -12 km from Korsimore livestock market.	-40 km from Dori. -40 km from Seytenga et Dori livestock markets.	-15 km from Sampelga. -15 km from Seytenga et Dori livestock markets.	-7km from Sampelga. -7km from Seytenga et Dori livestock markets.
2	Representative of the community	x	x	x	x	x	x
3	Existence of Innovation Platform /cooperation framework.	Existence of cooperation framework around Small ruminant value chains/ INERA.	-	-	Existence of elaborated local convention on NRM / REGIS-ER.	-	-
4	Existence of farmers organization.	X (IP-meat VC)	x	x	x	x	x
5	Integration of crop and livestock.	x	x	x	x	x	x
6	Importance of small ruminant livestock.	X (sheep fattening activities well developed).	X (sheep fattening activities well developed).	X (sheep fattening activities well developed).	X (sheep fattening activities well developed).	X (sheep fattening activities well developed).	X (sheep fattening activities well developed).
7	Intervention/presence of partners (if yes, which partners? INERA/ILRI/other USAID funded projects?	x (INERA)	x (INERA)	x (INERA)	x (REGIS ER)	x	x
9	Distance to Ouagadougou (km)	70	78	82	310	325	317

3. Overview of methodology and data collection

3.1. Data collection

The study is based on analysis of quantitative and qualitative data. Quantitative data was gathered from 391 households from four regions, and qualitative information was purposely gathered using group discussions with farmers in each community. Focus group discussions were used to collect general information of the farming system and understand the main drivers of the existing farming system while interviews at household level were used to collect quantitative information on crop and livestock production, understand the constraints of the existing farming system, explore the views of individuals on market channel, households' food security and insecurity, and identify opportunities of improving crop and livestock value chains. Data was collected in all project sites, with the data collection exercise being carried out between August to September in Niger, and between October and November 2019 in Burkina Faso. The survey was conducted in the dominant local language in each study sites by the survey team including two researchers and five enumerators in Niger, and four enumerators in Burkina Faso.

The group discussion involved few crop-livestock farmers selected based on their knowledge of the farming systems and on crop and livestock value chains in order to be able to provide the necessary information. Specifically, the focus group involved around 15 participants in each village. Participants at the focus group were asked to describe their farming system, the main driver of the system, the impact of technology on their yield, to list possible interventions that they think could enhance resilience and profitability of their farming systems. A total of 181 and 200 households, of which 19% and 18% were women-headed households in Burkina Faso and Niger, respectively took part in the study. Table 3 shows the distribution of respondents by region and by gender. Stratified random sampling on the basis of gender was adopted to select the crop-livestock farmers interviewed. Tablets, with CS-pro software, were used to collect data. Information gathered during these interviews included crop-livestock production, farmers' farming practices, main constraints of crop and livestock production, possible interventions to improve the farming systems, market channels, roles in households' decision making, respondents' perception on their household food security and insecurity

Table 3. Number of respondents surveyed in the project sites by gender

Sex	Burkina Faso				Niger			
	Centre Nord		Sahel		Maradi		Torodi	
	Number	%	Number	%	Number	%	Number	%
Male	84	84	78	78	83	80.58	72	81.82
Female	16	16	22	22	20	19.42	16	18.18
Total	100	100	100	100	103	100	88	100

3.2. Data analysis

Quantitative data was analyzed using STATA software version 14 (STATA, 2015) and GENSTAT version 19 (GENSTAT, 2019). All the collected data were processed and analyzed in accordance with the objectives of the study. The analysis was done using descriptive statistics like percentage, frequency, mean, stand errors and rank as necessary. T-test of means was used to compare the mean values of different parameters obtained from the two countries. ANOVA was used to compare the mean values of parameters obtained from the four regions. Level of statistical significance was declared at $P < 0.05$. Principal Component Analysis (PCA) and Regression (PCR) was used to form farm typology. Farm types were identified based on land size, family size, livestock ownership, small ruminant ownership, technology use, and animal traction use.

4. Results and Discussion

4.1. Socioeconomic profile of respondents

4.1.1. General information on respondents

The findings demonstrated that the majority of respondents were married men and in most cases the head of the household. In fact, 81.5% and 81% of respondents were men in Niger and Burkina Faso, respectively. Figure 2 illustrates the repartition of respondents by sex, age, and by country. The results suggested that all women-head of households were widowers, which explains the role they play as household's heads. In terms of age, the majority of households' head were in the age group of 48-57 years. The youngest age group (under 27 years) represented only about 2% and 4% against 29 % and 26 % for the oldest age group (over 57), respectively in Niger and Burkina Faso.

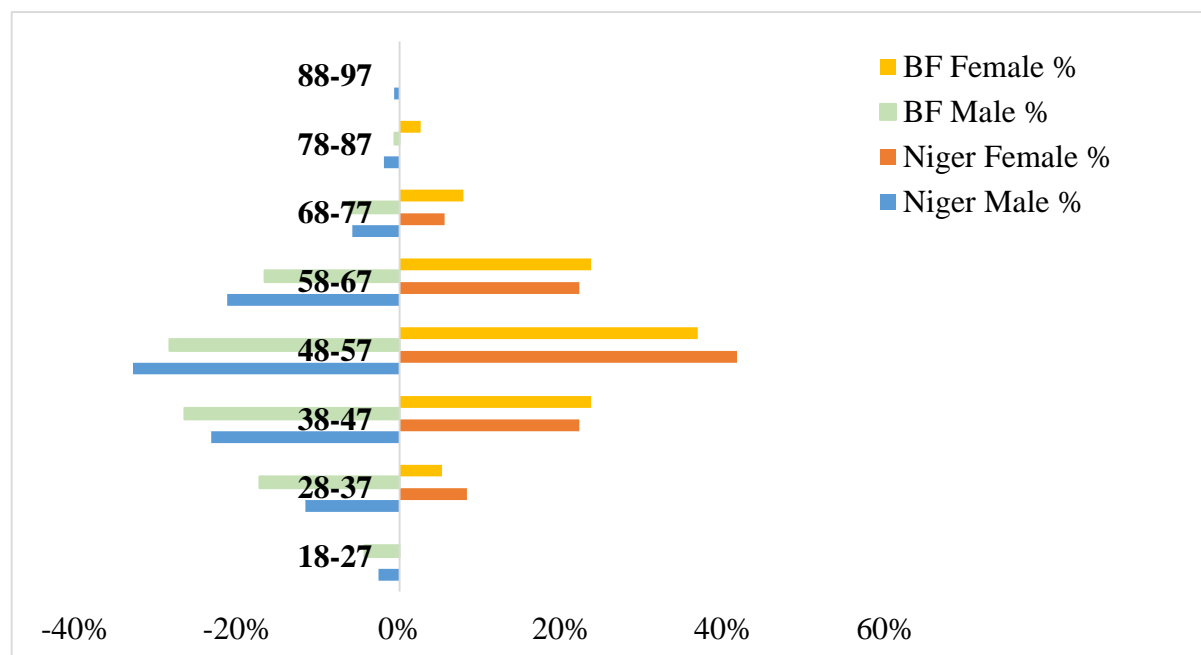


Figure 2. Percentage of respondents by sex and age group.

Table 4. Personal and household characteristics

Parameters	Niger			Burkina Faso		
	Torodi	Maradi	Total	Centre-Nord (Korsimoro)	Sahel (Dori)	Total
Sex						
Female	17.98%	19.61%	18.85%	16.00%	22.00%	19.00%
Male	82.02%	80.39%	81.15%	84.00%	78.00%	81.00%
Respondent's position in the HH						
Head of HH	88.76%	99.02%	94.24%	88.00%	87.00%	87.50%
1 st wife	2.25%	0.98%	1.57%	5.00%	-	2.50%
2 nd wife	-	-	-	-	-	-
Son/daughter	3.37%	-	1.57%	6.00%	9.00%	7.50%
Brother/sister	2.25%	-	1.05%	1.00%	2.00%	1.50%
Step-parents	1.12%	-	0.52%	-	-	-
Other	2.25%	-	1.05%	-	2.00%	1.00%
Marital status						
Married			81.68%	81.00%		79.50%
Single			0.52%	4.00%		2.00%
Divorced			1.05%	15.00%		0.50%
Widowed			16.75%			18.00%
Age of the respondent (years)	52.29±1.08	50.14±1.35	51.30±0.85 ^a	48.14±1.33	50.16±1.09	49.15±0.85 ^b
Years working as a farmer	33.36±1.58	39.06±1.11	36.43±0.96 ^a	26.42±1.30	24.52±1.41	25.47±0.96 ^b

^{a, b} Mean in the same row with different subscripts are statistically different

The household's primary activity was agriculture in all the study sites though household members were also involved in other activities such as keeping livestock, small businesses, etc. to earn additional income (Table 4). The results confirm the role of agriculture in the livelihood of rural population as highlighted in other studies (APESS, 2014; SAREL, 2015). The results of the study indicated that the respondents have been working as farmers for about 40 years in Niger and 25 years in Burkina Faso. The difference was statistically significant ($p < 0.05$). In Burkina Faso, a Work Bank report stated that a poor people was most likely to be employed as farmers.

Box 1

This study shows the evidence of involvement of many rural populations in Agriculture, which attest the opportunity for improving their livelihoods through Agriculture improvement. Large scale investment in Agriculture should contribute in improving the lives of those involved. Investing in technology that boost Agriculture productivity is one of the strategy that can be used to improve household nutrition and livelihood outcomes.

4.1.2. Level of education in the households in the study sites

Although many documents report low levels of literacy in many rural areas of Burkina Faso and Niger, still the findings of this study indicate a high level of literacy in Burkina Faso compared to Niger. This corroborate with the data of World Bank (2016) reporting high rate of education in Burkina Faso compared the rate reported for Niger. The respondents had on average one year, and one and half years of education in Niger and Burkina Faso ($p = 0.057$). Burkina Faso had high number of households with children getting education compared to Niger. Within the country, in Burkina Faso, the region of Centre Nord recorded high number of households with children getting education, while in Niger the tendency was almost the same with 76.1% and 75.7% of households reporting having children getting education, respectively in Torodi and Maradi regions. The proximity of the Centre Nord region to Ouagadougou, the capital city of Burkina Faso can explain the high rate of literacy in this area compared to the Sahel. Children in this region might have access to education facilities that children in the Sahel lack. From all study sites, Maradi recorded the lowest percentage of households with children getting education. However, there was no difference between countries on the average number of children getting education by household ($p = 0.09$) and the average age of children getting education ($p = 0.4$). Women-headed households had low number of children getting education compared to men-headed households.

Table 5. Household's literacy level

Parameters		Niger			Burkina Faso		
		Torodi	Maradi	Total	Centre-Nord (Korsimoro)	Sahel (Dori)	Total
Education of the respondent		0.82±0.26	1.18±0.25	1.01±0.18 ^a	2.42±0.41	0.72±0.25	1.57±0.23 ^b
% of HH with children getting education		76.1%	75.7%	75.9%	93%	76%	84.5%
Number of children getting education by HH		2.21±0.15	2.51±0.14	2.37±0.10 ^a	2.90±0.14	2.26±0.14	2.61±0.10 ^b
Average age of children getting education		12.49±0.44	13.15±0.32	12.85±0.27 ^a	12.19±0.33	12.90±0.53	12.51±0.30 ^b
Average year of education		4.87±0.28	6.09±0.27	5.53±0.20 ^a	5.68±0.28	4.52±0.26	5.16±0.20 ^b
Gender of children getting education							
	Male	64.19%	63.64%	63.87%	51.85%	57.56%	54.07%
	Female	35.81%	36.36%	36.13%	48.15%	42.44%	45.93%
Details on children getting education							
Child 1							
Sex							
	Female	23.9%	19.2%	21.4%	33.3%	27.6%	30.8%
	Male	76.1%	80.8%	78.6%	66.7%	72.4%	69.2%
Age		13.95±0.54	15.00±0.44	14.52±0.34	14.16±0.43	14.42±0.73	14.28±0.41
Year of education		6.12±0.41	7.65±0.37	6.95±0.28	7.25±0.36	5.08±0.40	6.27±0.28
Child 2							
Sex							
	Female	35.5%	35.5%	35.5%	47.4%	40%	44.5%
	Male	64.4%	64.5%	64.5%	52.6%	60%	55.5%
Age		11.58±0.58	12.68±0.43	12.21±0.35	12.25±0.46	11.70±0.53	12.08±0.35
Year of education		4.22±0.36	5.89±0.38	5.19±0.28	5.83±0.38	4.56±0.39	5.33±0.28
Child 3							
Sex							
	Female	54.5%	57.6%	54.4%	63.5%	66.7%	64.6%
	Male	45.5%	42.4%	43.6%	36.5%	33.3%	35.4%
Age		11.91±1.13	11.73±0.55	11.80±0.56	11.48±0.45	9.70±0.62	10.87±0.38
Year of education		3.91±0.60	4.97±0.48	4.54±0.38	5.14±0.36	3.04±0.37	4.43±0.29
Child 4							
Sex							
	Female	66.7%	33.3%	66.7%	68.8%	75%	70.5%
	Male	33.3%	66.7%	33.3%	31.2%	25%	29.5%
Age		9.67±0.78	9.88±0.53	9.81±0.43	9.91±0.50	11.33±0.78	10.30±0.43
Year of education		2.67±0.41	3.06±0.43	2.93±0.32	3.97±0.41	4.5±0.51	4.11±0.33
Child 5							
Sex							
	Female	60%	57.1%	58.3%	46.7%	71.4%	54.5%
	Male	40%	42.9%	41.7%	53.3%	28.6%	45.5%
Age		10.20±1.69	8.71±0.78	9.33±0.82	9.27±0.50	12.43±1.25	10.27±0.60
Year of education		2.80±1.11	2.57±0.72	2.67±0.59	3.07±0.51	5.62±1.29	3.96±0.60

4.1.3. Involvement in farmer, livestock, business or market's organizations

Forty-two and thirty-two respondents reported to be members of a farmer's organization, respectively in Niger and Burkina Faso (Table 6). The high percentage of farmer's involvement in farmer's organization was recorded in Maradi compared to other study sites. This high involvement of respondents in farmer's organizations in Maradi can be explained by the presence of high number of NGO's supporting the establishment of these organizations. Women participated in farmer's associations than men. Generally, many organizations / projects provide support to women groups compared to men groups, which explains high involvement of women in farmer's associations. Agriculture training and financial support were the main services/support received by respondents who reported being members of any organization. For example, in Niger, women had what they called "*Tontine*", every week each women contributes a small amount of money and in case of need, any group' member can request a financial support from the association.

Table 6. Involvement of respondents in any farmer, livestock, business or market organization

Parameters	Niger			Burkina Faso		
Member of association	Torodi	Maradi	Total	Centre-Nord (Korsimoro)	Sahel (Dori)	Total
Yes	36.4%	47.6%	42.4%	34%	31%	32.5%
No	63.6%	52.4%	57.6%	66%	69%	67.5%

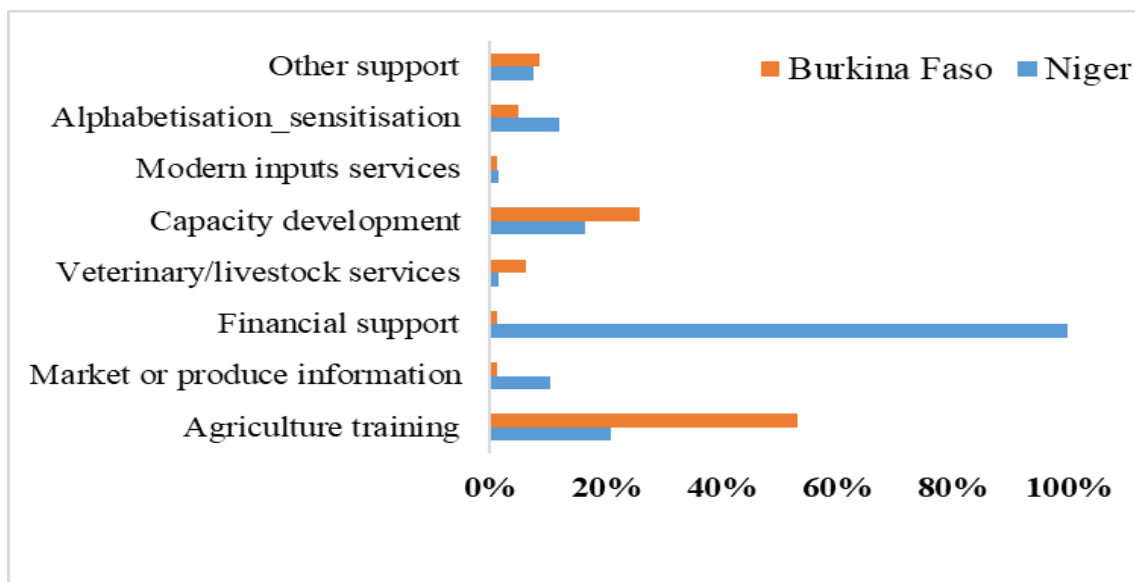


Figure 3. Service provided by associations

4.2. Family size and labour supply in the study area

4.2.1. Family size

Average family size was 10 persons per household in Niger and 12 persons per household in Burkina Faso. The difference between the two was significant ($p < 0.05$). Among the regions, the region du Sahel recorded high family size compared to other regions, with 13.68 (± 0.83) persons against 10.52 (0.43), 10.64 (0.59) and 11.06 (0.62) persons, respectively for the regions of Centre Nord, Maradi and Torodi (Figure 4). The Sahel region is inhabited by Fulani ethnic group, who are known to have big families. Women-headed households had low family size compared to men-headed households (12.96 persons in male-headed households compared to 8.65 persons in women-headed households in Burkina Faso and 11.11 persons in men-headed households compared to 9.26 persons in women-headed households in Niger).

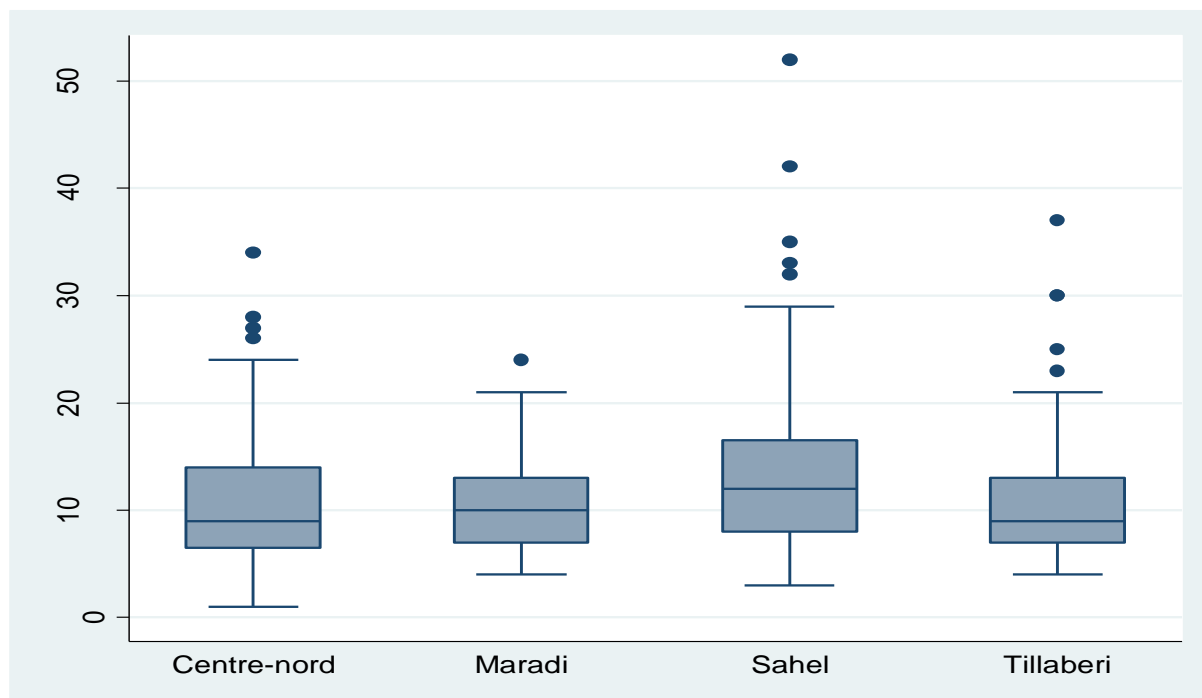


Figure 4. Family size in the study sites

Table 7. Family size by category of age

Country	Adult Male	Adult Female	Elderly Male	Elderly Female	Teenager Male	Teenager Female	Child Male	Child Female
Burkina Faso	2.33	2.33	0.4	0.42	1.37	1.09	2.16	2.22
Niger	2.49	2.14	0.36	0.30	1.35	1.15	1.53	1.49

4.2.2. Family labour available for work

Figure 5 illustrate the family labour available for work in Niger and Burkina Faso. Family labour represents number of days that family members are available for work within a month. The maximum days that family members were available to work was recorded in the period of June-September. The result showed that male aged between 18-55 days worked more days than persons in other age category. This corroborate the findings of many other studies stating the high involvement of men in agriculture activities (Adekunle and Dada, 2012). When compared gender, in Niger male were available for work for more days compared to women throughout the year, while in Burkina Faso the opposite was observed. Male aged between 18-55 years were less available for work compared to women within the same age category. This can be explained by the fact that men are more involved in off-farm activities compared to women and mostly in our study sites, many go to work in gold mining.

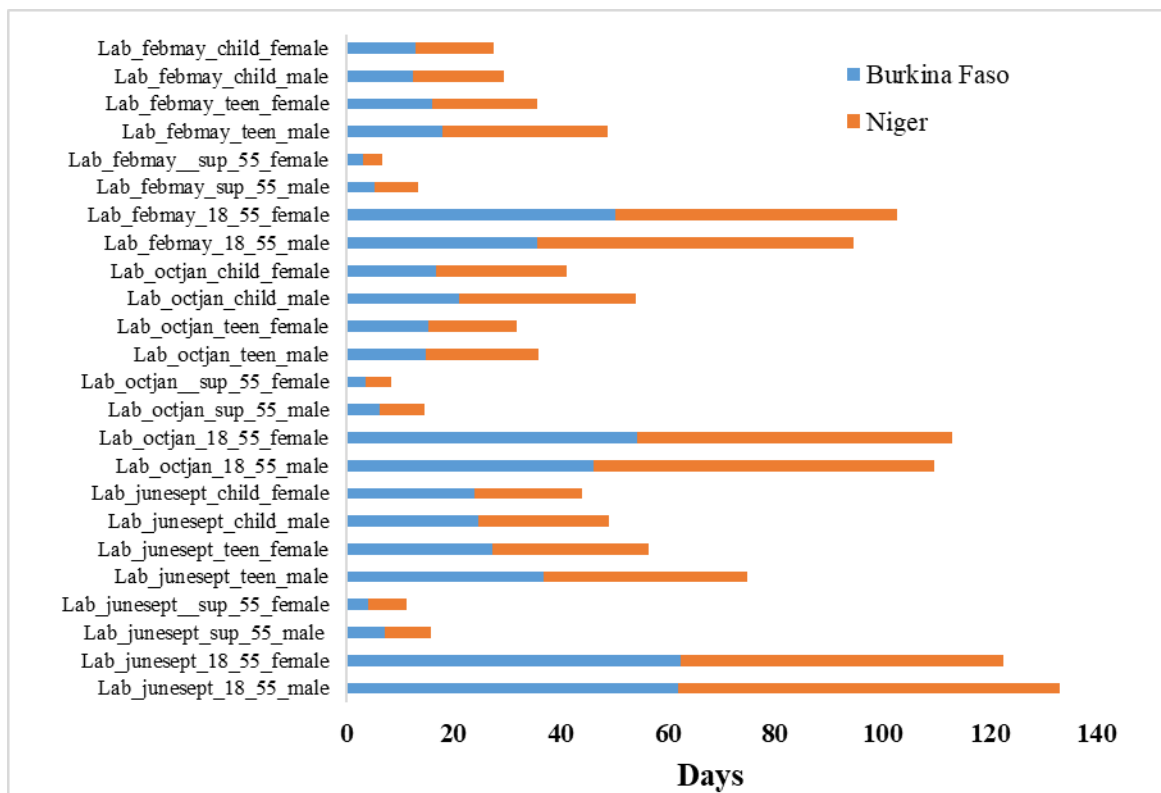


Figure 5. Family labour available for work

4.2.3. *Family labour used off-farm work*

The results demonstrated that household members in Burkina Faso were more involved in off-farm work. 52.5 % against 38.74 % households, was observed in Burkina Faso and Niger respectively, reported having family members working outside their farm to earn some income. While comparing all study sites, the highest number of households with family members doing off-farm work was recorded in the region of Sahel (75%) and Maradi (56.86%). The high percentage of households reporting having family members working outside of their farms in the Sahel can be explained by the existence of Gold mining which attracts many men, especially the young. As for Maradi, the latter share border with Nigeria which gave opportunities to people of Maradi to be involved in off-farm work. The lowest percentage was recorded in Torodi. The world Bank explained the limited expansion of productive non-farm work by a series of supply-side and demand-side constraints. On the demand side, firms are prevented from growing and hiring workers because of the non-conducive business environment, while on the supply side, the vast majority of workers do not have skills required to efficiently establish and manage their own business or to be productive wage earners.

Female-headed households were more engaged in off-farm work compared to male-headed households in both countries. Generally, women have low access to land, so women head of households try to get involved in other types of activities to earn income and be able to secure food for their families since the production from their small land parcels cannot cover their family's food needs. In Niger, persons who were involved in off-farm work were more engaged in small business and activities (soldering, tailor, hair maker, blacksmith, masonry, photographer, pottery, etc.) and labour, and in Burkina Faso, they were more engaged in small businesses, gold mining, small activities and livestock trade. In both countries, some young men undertook rural exodus after the cropping season.

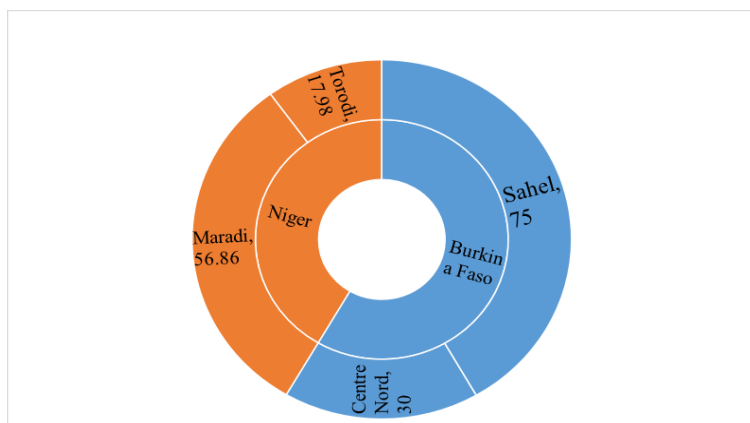


Figure 6. Households engagement in off-farm work (%)

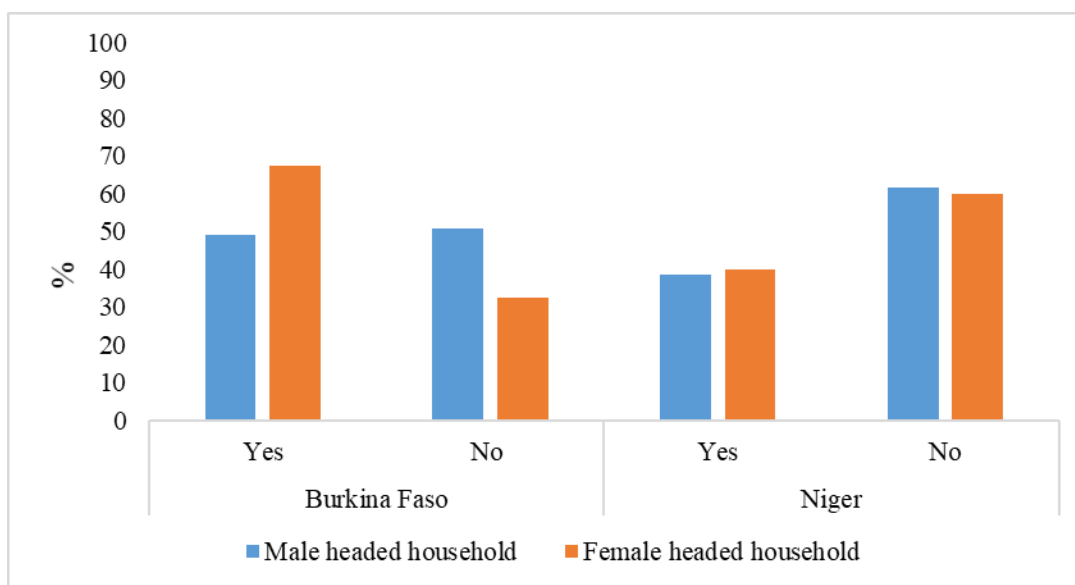


Figure 7. Households engagement in off-farm work by type of households

Amount of income generated from off-farm work was higher in the Sahel region (Table 8). This can be explained by the fact that the region recorded high percentage of households stating having households' members working on off-farm activities. Family members aged between 18-55 years brought more money from their off-farm work compared to persons in the other age groups within the households.

Table 8. Income from off-farm work (CFA)

Region	Income 18-55 male	Income 18-55 female	Income sup 55 male	Income sup 55 female	Income 12-18 male	Income 12-18 female	Average income by HHs
Centre Nord	153656.3	52984.38	281250	10812.5	-	-	498703.1
Sahel	470730.1	20373.56	3019.318	2401.66	2454.55	-	500370.1
Maradi	232985.4	13301.69	42661.02	396.610	6203.39	2237.29	300022.7

1USD= 580 CFA at the time of survey

4.3. Remittance received by the households

On average, household received an amount of 52000 CFA and 73000 CFA per year, respectively in Burkina Faso and Niger. The difference of amount received by country was statistically significant. Women-headed households received low amount compared to men-headed households in both countries. On average, women-headed households received about 20000 CFA and 45000 CFA, respectively in Burkina Faso and Niger, while men-headed households received an average of 60000 CFA and 80000 CFA per year, respectively. When comparing countries, the average amount received by households in Niger was higher than the amount received by households in Burkina Faso, which illustrate how households in Niger depended on external aid for fulfilling their households' expenses and food security.

Table 9. Amount of remittance received by the households

Country	Region	Amount received (CFA)	Average by country
Burkina Faso	Centre-Nord	58 690	52 387 ^a
	Sahel	46 085	
Niger	Maradi	68 603	73 442 ^b
	Torodi	78 989	

4.4. Land size in the project sites

Most of the rural households in Burkina Faso and Niger farmed at a subsistence level, using small plots and depending on seasonal rainfall. In fact, this study revealed that the average land size was 3.61 ha and 3.65 ha, respectively in Burkina Faso and Niger. Almost all land was rain-fed land. Irrigated land was not common in both countries. The average land size was higher for male-headed households compared to women headed household. The difference was statistically

significant ($p < 0.05$). The average land size put in fallow was 0.33 ha in Burkina Faso against 0.15 ha in Niger, this illustrates how fallowing was not a common practice in Niger. The findings showed that the majority of households did not own a home garden, only few reported having a home garden of small hectare. The average home garden owned was 0.55 ha in Burkina Faso against 0.71 ha in Niger.

Table 10. Land size by household (ha)

Country	Region	Total rain-fed land	Total irrigated land	Total land	Total land by country
Burkina Faso	Centre-Nord	3.39±0.25	0.09±0.03	3.48±0.24	3.61±0.22 ^a
	Sahel	3.73±0.36	0.01±0.01	3.74±0.36	
Niger	Maradi	3.75±0.33	0	3.75±0.33	3.65±0.23 ^a
	Torodi	3.51±0.31	0.03±0.02	3.55±0.31	

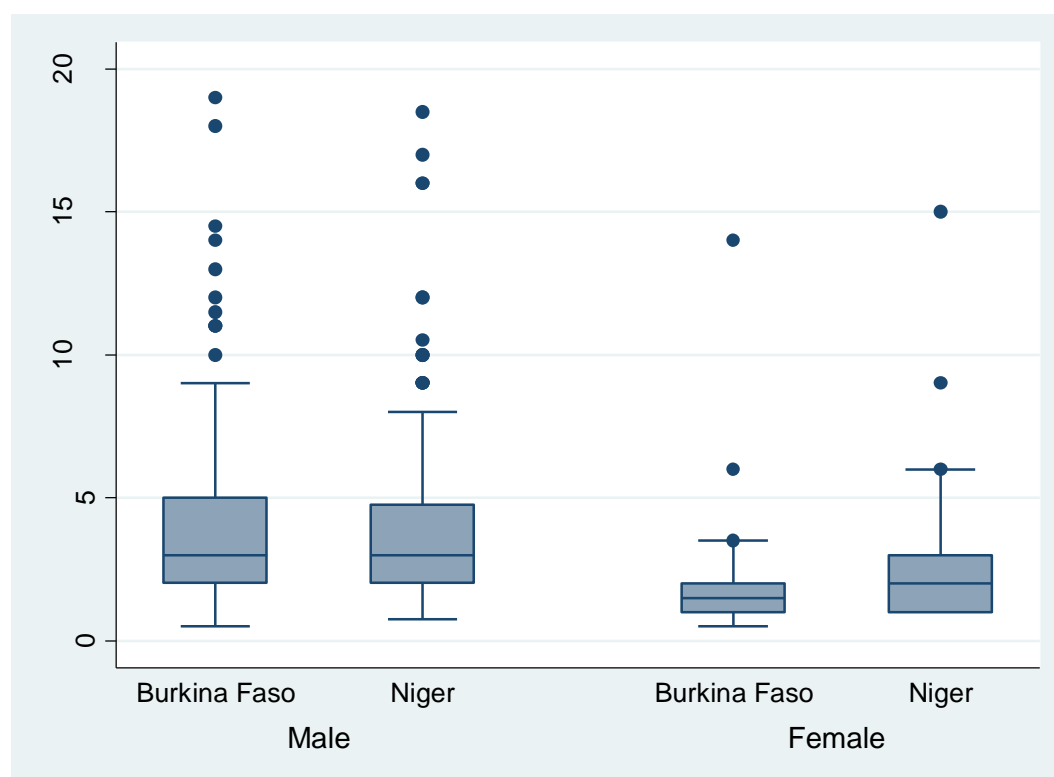
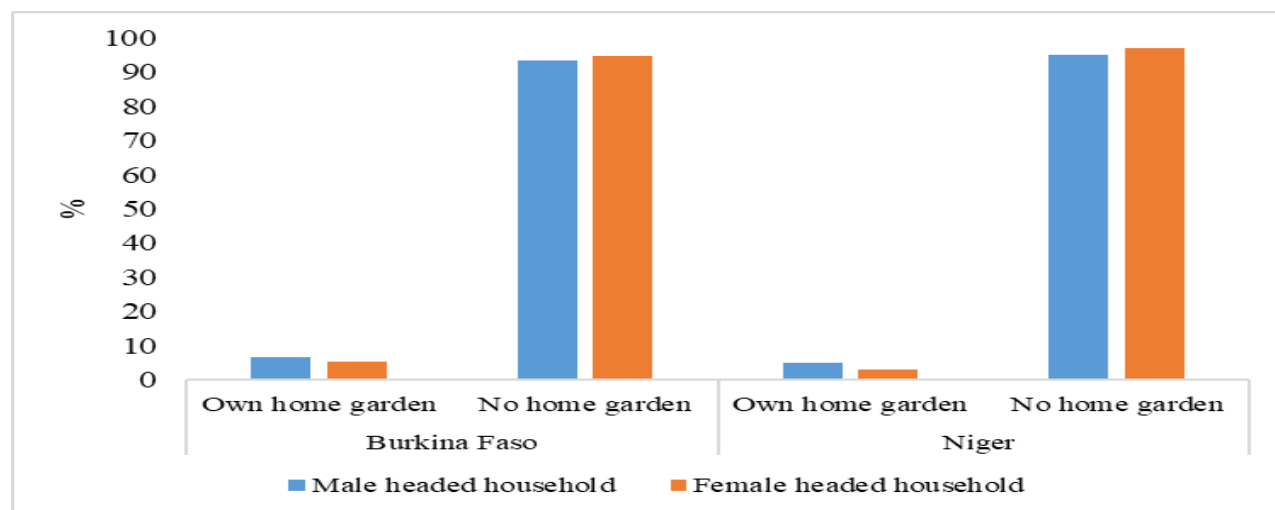


Figure 8. Land size by type of households

Table 11. Fallow and home garden land owned

Country	Region	Fallow land (ha)	Area home garden (ha)	Average fallow land by country (ha)	Area home garden by country (ha)
Burkina Faso	Centre-Nord	0.32±0.06	0.75	0.33±0.05 ^a	0.55 ^a
	Sahel	0.34±0.09	0.31		
Niger	Maradi	0.00	0.00	0.15±0.06 ^b	0.71 ^a
	Torodi	0.32±0.12	0.75		

**Figure 9.** Home garden ownership by type households**Box 2**

The land size owned by households in Niger and Burkina Faso is sufficient enough to produce enough quantity of food for households if well managed. Options aiming at improving and conserving the quality of the land should be the first priority in order to optimize the production from these lands.

4.5. Crop cultivation

The most common crops grown in Niger were millet, sorghum, cowpea, groundnut, maize and sesame. They were all rain-fed crops, especially grown for home consumption. Sesame, groundnut and in minority cowpea were the main crops grown for cash. Millet was the main cultivated crop and occupied the high percentage of total cultivated land area. In fact, the average area cultivated for millet production was higher compared to the area where other crops were

grown. The average production per hectare was about 550 kg for millet and more than 90% of the production were kept for home consumption. The production of sorghum and groundnut was higher in Maradi than in Torodi. The production of cowpea was almost the same in both regions. Households in Maradi sold a quarter of cowpea production to gain income while in Torodi, almost all the production was kept for home consumption. A high proportion of groundnut production was sold for cash generation. Table 12&13 show the main crops grown in Niger, their production and prices. In many cases, households still grow local varieties. Rare were farmers who reported using improved varieties. When comparing regions, improved varieties were more used in Maradi.

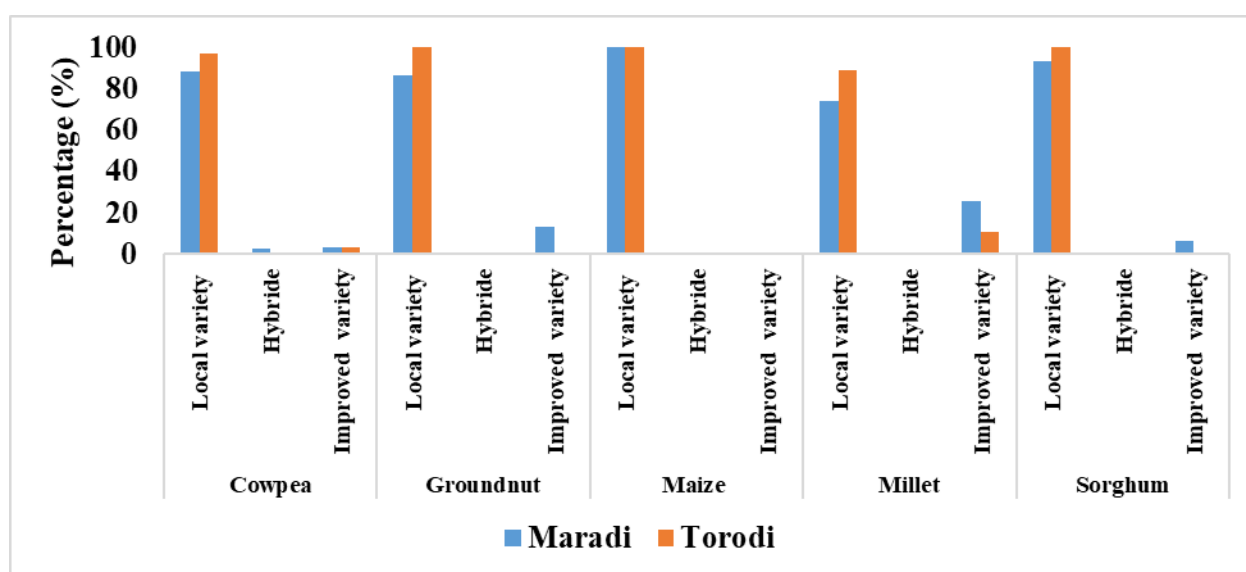


Figure 10. Type of varieties of seed used by farmers

Table 12. Crop cultivation in Torodi, Niger

Crop grown	% of person growing each crop	Area±s.e (ha)	Production/ha	Price/kg	Proportion of production kept for Home Consumption
Millet	100.00	1.59±0.11	566±44.59	168.7±2.73	95%
Sorghum	44.83	1.05±0.16	349.9±49.18	187.1±10.95	72%
Cowpea	89.66	0.64±0.04	192.5±28.2	217.4±7.18	93%
Groundnut	4.60	0.57±0.23	616.7±294.86	350±125.83	8%
Maize	8.05	0.74±0.11	442.3±132.19	190±21.16	46%
Sesame	4.60	0.27±0.04	185.6±62.59	502.9±173.4	67%
Okra	4.60	0.33±0.09	282.9±239.22	325±25	82%

Table 13. Crop cultivation in Maradi, Niger

Crop grown	% of person growing each crop	Area±s.e (ha)	Production/ha	Price/kg	Proportion of production kept for Home Consumption
Millet	99.03	1.38±0.09	559.9±33.21	138.3±0.98	90%
Sorghum	78.64	0.57±0.06	449.7±47	113±4.31	90%
Cowpea	93.20	0.57±0.05	426.8±38.4	206±7.39	77%
Groundnut	58.25	0.76±0.10	792.4±80.71	172.6±13.16	26%
Maize	3.88	0.64±0.28	750±227.1	220±20	96%
Sesame	10.68	0.95±0.40	237.5±89.33	360±40	45%

Sorghum, millet, cowpea, and groundnut were Burkina Faso' principals rain-fed crop. 98%, 93%, 60% and 46% reported growing sorghum, cowpea, groundnut and millet in Centre Nord region in Burkina Faso while in the Sahel 100% reported planting millet, 94 % sorghum, 88% cowpea and 15% groundnut. In the Centre Nord region, households dedicated biggest size of their land to sorghum, cowpea, and millet while in Sahel a big proportion of the land was set aside for millet and sorghum. The production of millet per hectare ranged from 100 kg to 1500 kg, with an average of 439.6 kg in Centre Nord and from 20 kg to 2000 kg, with an average of 1049 kg in the Sahel region. The average production of sorghum per ha was 498 kg and 1295 kg in Centre Nord and Sahel regions, respectively. The results indicated high production in the Sahel region compared to Centre Nord region. Millet and sorghum were mainly produced for home consumption since more than 90 % of the production was kept for home consumption. Sesame and groundnut were grown mainly for income while cowpea was grown both for home consumption and cash income. Table 14 and 15 gives a summary on crop cultivation in Burkina Faso. Like in Niger, majority of households grew local varieties. However, the improved variety were more used by farmers in Centre Nord region compared to the Sahel region.

Table 14. Crop cultivation in Centre Nord region, Burkina Faso

Crop	% of person growing	Area±s.e (ha)	Production/ha (kg)	Price/kg (CFA)	Proportion of production kept for HC
Millet	46	1.11±0.10	439.6±50.62	174.8±4.88	98
Sorghum	98	1.8598±0.18	498.7±31.57	137.8±2.72	99
Cowpea	93	1.7311±0.94	295.2±22.82	285.5±4.63	59
Groundnut	60	0.7605±0.08	551.7±47.1	150.7±3.46	32
Maize	16	0.6893±0.10	439.4±112.28	179.6±5.25	87
Sesame	30	0.5727±0.09	192.3±30.46	408.3±22.33	17
Voandzou	13	0.2±0.12	171.2±60.84	291.6±24.04	95

Table 15. Crop cultivation in Sahel region, Burkina Faso

Crop	% of person growing	Area \pm s.e (ha)	Production/ha (kg)	Price/kg (CFA)	Proportion of production kept for HC
Millet	100	1.54 \pm 0.43	1049.3 \pm 50.99	104.5 \pm 1.64	99
Sorghum	94	1.47 \pm 0.30	1295.6 \pm 196.3	101.2 \pm 3.32	98
Cowpea	88	0.67 \pm 0.24	314.7 \pm 88.91	159.8 \pm 3.62	94
Groundnut	15	0.43 \pm 0.15	554.8 \pm 143.59	164.3 \pm 29.31	49
Sesame	29	0.52 \pm 0.26	228 \pm 77.6	275 \pm 41.06	59

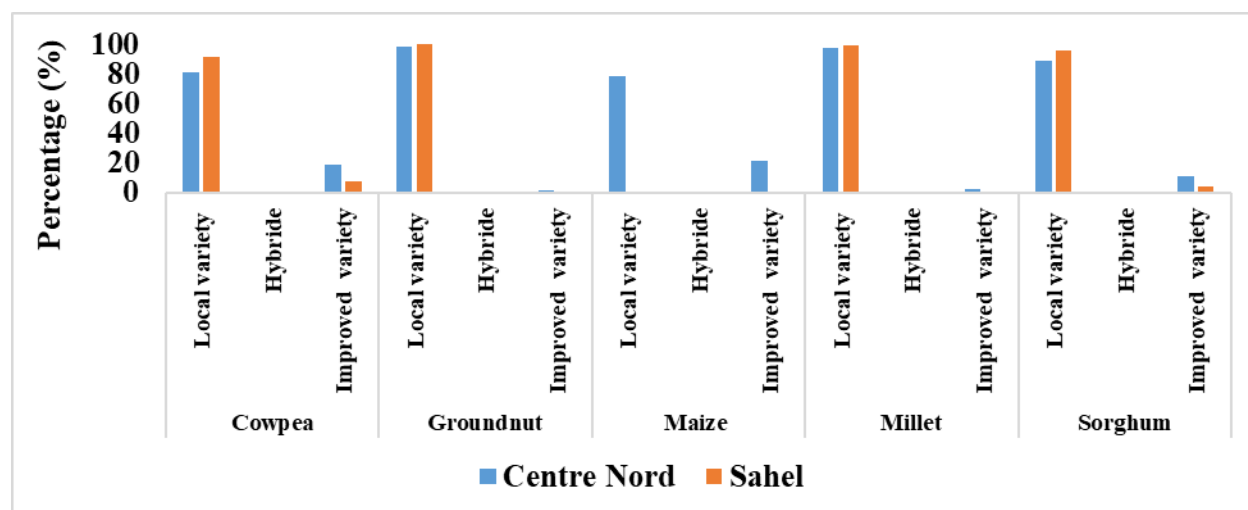


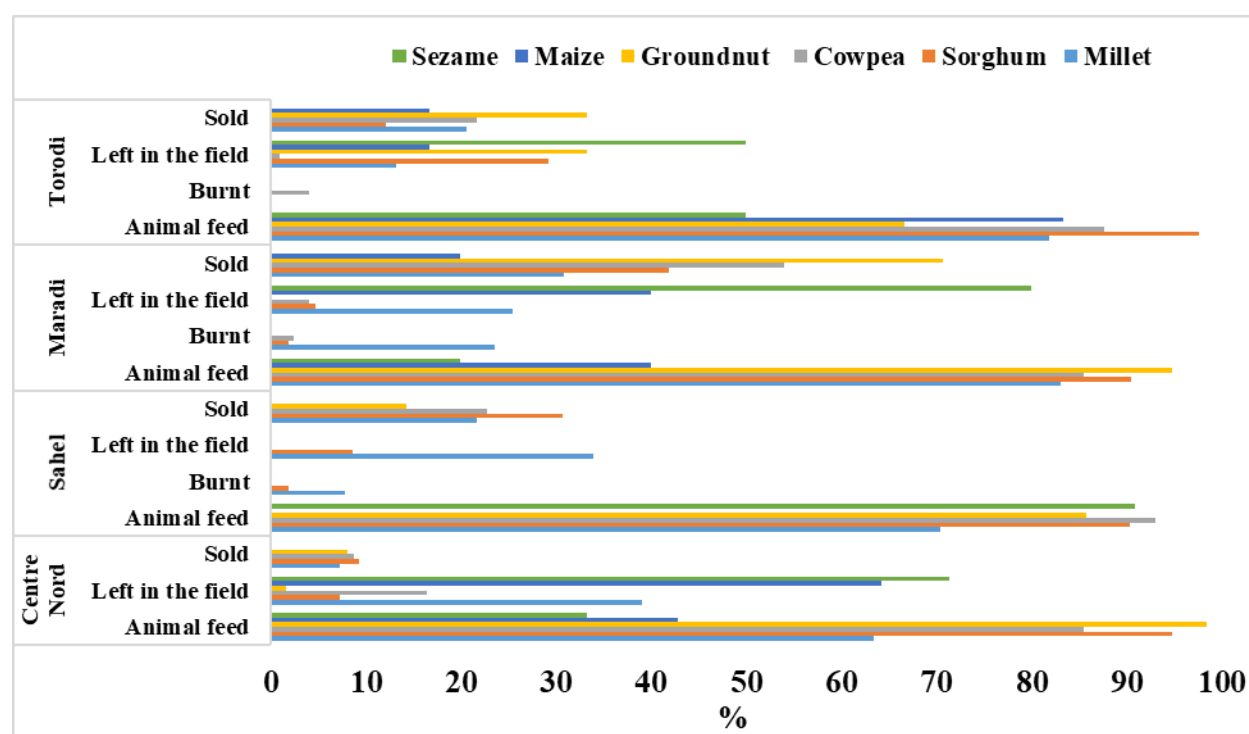
Figure 11. Type of crop variety grown by households in Burkina Faso

4.6. Production and utilization pattern of crop residues

The uses of crop residues are illustrated by the figures 12. Farmers in Niger and Burkina Faso mostly used crop residues either for animal feed or gaining income. In addition, crop residues were also used as organic fertilizer, they were left in the field to be incorporated in the soils. The findings revealed that the highest number of households utilized their crop residues as animal feed followed by selling and use as organic fertilizer. The highest percentage of households reported using sorghum stover, cowpea hay and groundnut haulm as animals feed in all study sites. Maradi region in Niger and the region of Sahel in Burkina Faso recorded the highest number of households that sold crop residues, especially groundnut haulm, cowpea hay and sorghum stover.

Table 16. Rank in order of utilization of crop residues in the study area

Use of crop residues	Rank in order			
	CN	Sahel	Maradi	Torodi
Animal feed	1	1	1	1
Left in the field	2	3	3	3
Sold	3	2	2	2
Burnt	6	4	5	6
Make Sacco and mat	4	5	4	4
Build house's roof	5	6	6	5

**Figure 12.** Utilization of crop residues in the study areas

The production of crop biomass in the study area is discussed in Table 17. It indicates that the average production of millet stover was 1366.4 kg, 1845.9 kg, 589.1kg and 477kg in the Centre Nord, Sahel, Maradi and Torodi regions, respectively. The production of sorghum stover varied from 42 kg to 6000 kg in Burkina Faso and between 50 kg and 6600 kg in Niger. The finding indicates a higher production of cereals stover per ha in Burkina Faso compared to Niger. The production of cowpea hay was 313.6 kg, 572.5 kg, 714.2 kg and 437.6 kg in Centre Nord, Sahel, Maradi and Torodi regions, respectively. Contrary to cereal stover production, Niger recorded a higher production of legumes residues compared to Burkina Faso. The price of cereal stover was

found higher in Niger than in Burkina Faso while that of the legumes residues was generally high in Burkina Faso.

Table 17. Crop residues production per hectare and price of residues

Type of residues	Region	Production of biomass			Price/kg
		Mean \pm s.e	Minimum	Maximum	
Millet stover	Centre-Nord	1366.4 \pm 211.8	90	4167	2.03 \pm 0.03
	Sahel	1845.9 \pm 158.3	30	6000	2.11 \pm 0.09
	Maradi	589.1 \pm 65.7	16.67	6000	4.18 \pm 0.18
	Torodi	477 \pm 53.1	17.86	2500	5.12 \pm 0.15
Sorghum stover	Centre-Nord	1372.9 \pm 138	42.86	6000	2.11 \pm 0.04
	Sahel	2114.3 \pm 155.1	60	6000	2.01 \pm 0.02
	Maradi	875.7 \pm 124.5	62.5	6667	4.34 \pm 0.33
	Torodi	464.9 \pm 114.6	50	4167	5.11 \pm 0.25
Maize stover	Centre-Nord	1242.5 \pm 828.1	150	4500	2.95 \pm 1.31
	Sahel	-	-	-	-
	Maradi	283.3 \pm 133.3	150	417	2
	Torodi	338.4 \pm 168.1	50	1125	2.33 \pm 0.33
Cowpea	Centre-Nord	313.6 \pm 63.3	25	3750	76.75 \pm 2.92
	Sahel	572.5 \pm 48.3	50	2500	50.93 \pm 1.56
	Maradi	714.2 \pm 69.8	39.06	4000	42.05 \pm 2.60
	Torodi	437.6 \pm 39.7	50	2000	58.98 \pm 2.018
Groundnut	Centre-Nord	296.4 \pm 32.8	37.5	938	99.94 \pm 11.98
	Sahel	-	-	-	-
	Maradi	1146.8 \pm 154.1	66.67	5333	34.61 \pm 2.34
	Torodi	458.3 \pm 110.2	250	625	50 \pm 10
Sesame	Centre-Nord	1266.7 \pm 464.8	40	3000	25
	Sahel	1333.3 \pm 332.4	400	3333	33.83 \pm 16.17
	Maradi	200	200	200	50
	Torodi	833.3 \pm 251.4	250	1500	-

1USD= 580 CFA, the price given here were price of residues immediately after crop harvest

4.7. Use of agriculture technology in the study area

On average, 92.5% and 97.38% of farmers reported using at least one agriculture technology to increase crop yields in Burkina Faso and Niger, respectively. The findings revealed that male-headed households seemed to use more agriculture technology than female-headed households. On average, a household used 1.47 and 1.49 technologies, respectively in Burkina Faso and Niger.

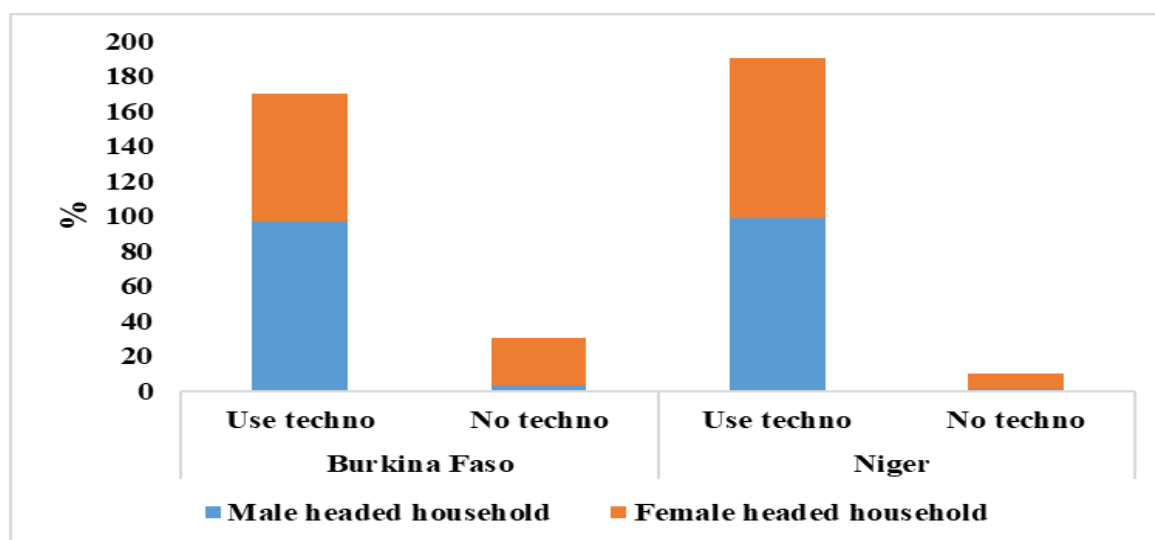


Figure 13. Use of agriculture technology by farmers

The results from different study sites showed that the region of Centre Nord in Burkina Faso and Maradi in Niger used various agriculture technologies compared to other regions. The high use of technology in these regions may be explained by the existence of many NGOs and research organizations since both zones are considered to be most affected by food insecurity. Crop and livestock integration was the main technology used by farmers. Literally, 89% and 96% of respondents in Burkina Faso and Niger, respectively, confirmed using crop and livestock integration technology to improve their yields. Improved varieties were more used in Niger (25.1%) compare to Burkina Faso (8%) and micro-dosing. Farmers had not yet embraced technology to irrigate their crops, since the result revealed that irrigation was not common practice in the farming systems of Burkina Faso and Niger. Approximatively, only 1% of households surveyed in Niger practiced supplemental irrigation, while in Burkina Faso, no household practiced supplemental irrigation.

Table 18. Average number of technology used per households

Region	Number of technology (mean)	s.e
Centre Nord	1.75	0.08
Sahel	1.18	0.07
Maradi	1.73	0.07
Torodi	1.21	0.05

Table 19. Agriculture Technology used by farmers

Technology used	Burkina Faso	Niger
Crop and livestock integration	89% (n=178)	96.3% (n=184)
Micro-dosing	2.5% (n=5)	10.5% (n=20)
Improved varieties	8% (n=16)	25.1 % (n=48)
Supplementary irrigation	0	1% (n=2)
Mulching	2.5% (n=5)	3.7% (n=7)
In situ conservation moisture	5.5% (n=11)	1 (n=2)
Other (demi-lune, Zai)	39 (n=78)	11 (n=21)

BOX 3

Generally, the results of this study validate the findings from many research studies stating low adoption of agriculture technology by farmers. However, the findings clearly show that the sites where many project or NGOs works tend to use more technologies than others. Nevertheless, the impact of these technologies remain very low. The question is why? The main challenge is to find ways to integrate appropriately the technologies brought by different partners at farm level, and their combined effect will result in improved productivity.

4.8. Horticultural crops and multipurpose trees

The figure 14 illustrates the horticulture crops grown in Niger. It is clear that guava, balanites, doum palm and mango trees were the main fruit trees grown in the country. The data revealed that horticultural crops were not common in the study sites in Burkina Faso, only mango trees were grown by few households. The households who grew mango trees in the region of Centre-Nord owned an average of 15 trees of mango. In Niger, households owned almost 10 and seven fruits trees, in Maradi and Torodi respectively. Mango, Doum palm, Guava and Ziziphus trees recorded high annual production yields compared to other trees in Maradi, while in Torodi, Baobab, Doum palm, Mango and Tokoye trees produced high quantity of fruits compared to other fruits trees available within the area. On average, two persons were the labour required per year to work on horticulture crops per household.

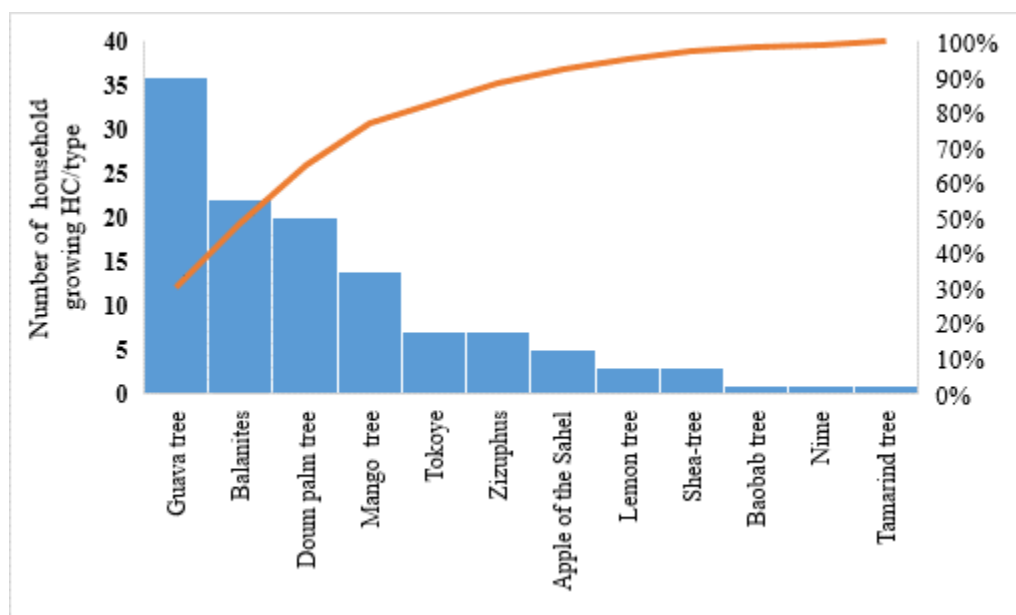


Figure 14. Horticulture crops in Niger

Table 20. Number of fruits trees grown by a household in Niger

Region	Number of tree	Area covered (ha)	Area needed per tree (Sqm)
Maradi	9.34	3.32±0.28	16.10±1.0
Torodi	6.95	1.52±0.14	11.73±1.1

Farmers in our study sites have adopted conservative agriculture farming practices where trees are used as a technological element within the practice. According to farmers, these trees were planted either in their plots or on the bunds in order to contribute to three key principles, namely, reducing soil disturbance, maintaining soil cover and improving soil fertility. Another benefit of this practice is that it provides continuous supply of fodder. It is known that some of the tree leaves are nutritious fodder for livestock. This supports the work of ICRAF on Conservation agriculture with trees in the West African Sahel (Bayala et al., 2011). On average 12 and 9 trees were planted in the field and on the bunds of plots respectively in Burkina Faso, while in Niger, farmers had on average eight trees in their field and three trees on the bunds. The planted trees were higher in Burkina Faso compared to Niger. The difference was significant.

Table 21. Estimate of annual yield of fruits trees by household

Fruit crop name	Yield (kg/tree/year)-Maradi	Yield (kg/tree/year)-Torodi
Balanites	74.88	69.17
Baobab tree	-	500
Lemon tree	-	1.67
Guava tree	115.3	83.5
Shea-tree	-	116.67
Mango tree	187	192.8
Nime	50	-
Doum palm tree	173.85	342.86
Apple of the Sahel	53.33	0
Tamarind tree	-	100
Tokoye	51.33	162.5
Zizuphus	101.86	-

Table 22. Multi-purpose trees planted by households in their farm/on the bunds

Country	On the bunds	In the field	Region	On the bunds	In the field
Burkina Faso	9.17±0.73 ^a	12.25±0.68 ^a	Centre Nord	5.86±0.88	8.46±0.74
			Sahel	13.88±1.03	16.48±1.01
Niger	3.59±0.22 ^b	8.51±0.54 ^b	Maradi	3.06±0.24	8.09±0.72
			Torodi	4.21±0.39	9.00±0.82

4.9. Machinery usage and bullock power in agriculture

Farm power in Burkina Faso and Niger relied on an overwhelming extent on human muscle, based on operations that depended on the hoe, other hand tools and the use of bullock. In the farming system of Niger and Burkina Faso, draught animals were the most commonly used for agricultural operations and land-use intensification. Households either used their own bullock or hired bullock at a price of 6800 CFA and 4700 CFA, respectively in Burkina Faso and Niger.

The findings demonstrated that the level of mechanization is still very low in the farming system. The most common machine used was sprayer. On average, households hired a sprayer once and twice, in Niger and Burkina Faso respectively and spent like 1250 and 2500 CFA. The result of the study revealed that no farmer was using tractor in their farming activities in Niger and only 10 households out of 200 surveyed in Burkina Faso used a tractor in their farming activities. They spent like 10 000 CFA for hiring a tractor to plough a 1 ha piece of land.

Table 23. Machinery usage in agriculture

Country	Spray number	Cost spray	Cost for hiring bullock for ploughing (bullock + man)
Burkina Faso	2.07±0.10 ^a	2485±189 ^a	6806±599.8 ^a
Niger	1.4±0.10 ^b	1248±52.6 ^b	4734±299.9 ^b

4.10. Labour use in agriculture (per ha) and wage rate in the study area

Table 24 shows the tendency of labour use in farming activities in Niger and Burkina Faso. It reflected the level of participation of men and women workers in farming activities. Results indicated that adult male labour accounted for the largest proportion of total labour-use in all study sites. It almost required two persons and 1.5 persons to prepare a land of 1 ha. In many cases, land preparation was done by male. The sowing was done by both male and female and sowing one hectare required about seven people in Burkina Faso and four people in Niger. From the results analysis, it is clear that weeding was done by both male and female in Burkina Faso while in Niger it was mainly male who did it. The post-harvest activities were mainly done by females.

Table 24. Labour use in agriculture (number required per ha)

Parameters	Burkina Faso			Niger
	Centre Nord	Sahel	Maradi	Torodi
Land prepa_Male	1.71±0.08	2.81±0.04	1.30±0.05	1.31±0.07
Land prepa_female	1.48±0.18	0.71±0.19	0.12±0.03	0.35±0.06
Sowing_Male	3.57±0.09	3.01±0.09	2.68±0.09	2.09±0.10
Sowing_Female	4.51 ±0.23	3.75±0.30	2.42±0.16	1.86±0.10
Ferti app_Male	0.84±0.07	0.53 ±0.15	0.73±0.06	0.11±0.03
Ferti app_Female	0.69±0.09	0.35±0.15	0.09±0.04	0.01±0.01
Manure app_Male	2.68±0.30	2.74±0.26	1.04±0.06	0.80 ±0.05
Manure app_Female	1.69±0.25	0.61±0.27	0.03±0.01	0.05 ±0.02
Weeding_Male	5.33±0.09	5.59±0.07	2.63±0.10	2.24±0.11
Weeding_Female	5.12±0.11	4.43±0.15	0.91±0.08	0.47±0.08
Irrigation_Male	0	0.13± 0.09	0	0.09±0.05
Irrigation_Female	0.07±0.07	0	0.06±0.05	0.02±0.01
Harvesting_Male	4.39±0.07	3.33±0.09	2.58±0.09	1.99±0.10
Harvesting_Female	4.33±0.08	1.85±0.14	1.90±0.09	1.89±0.09
Posthav_Male	5.86±0.43	2.22±0.16	1.31±0.10	1.18±0.12
Posthav_Female	6.86±0.45	10.87±0.59	1.76±0.10	1.42±0.08

Table 25 clearly states that the wage rate was higher in the cropping season from June to September, and adult male were highly paid compared to other age groups though they did the same type of farming activities. Contrary to other regions, the region of Centre du Nord never paid people for farming activities. They explained that the farming activities in many case was done by family members who were many as it was indicated by their family size and in case the family work force was not enough, the neighbors and friends provided support without claiming a payment (exchange labour). The household that received support only cooked for the people who came to provide support. In most regions, women did not work for money. The rate provided in the table 25 it is the rate of the rare case where women had to be paid for the work.

Table 25. Wage rate for hiring labour for farm work per day (CFA)

Parameters	Burkina Faso		Niger	
	Centre Nord	Sahel	Maradi	Torodi
Wage_june_sept_adult_male	-	1541	1608	1856
Wage_june_sept_adult_female	-	1027	985	1441
Wage_june_sept_eld_male	-	-	1124	1040
Wage_june_sept_eld_female	-	-	680	1000
Wage_june_sept_teen_male	-	1376	722	921
Wage_june_sept_teen_female	-	995.2	609.2	652.3
Wage_oct_jan_adult_male	-	1349	1586	1747
Wage_oct_jan_adult_female	-	1029	961	1302
Wage_oct_jan_eld_male	-	783	1060	1167
Wage_oct_jan_eld_female	-	-	669.2	1000.0
Wage_oct_jan_teen_male	-	1193.1	690.1	883.8
Wage_oct_jan_teen_female	-	980.4	561.6	647.5
Wage_feb_may_adult_male	-	1326	1503	1538
Wage_feb_may_adult_female	-	1009	881	1203
Wage_feb_may_eld_male	-	-	1000	1000
Wage_feb_may_eld_female	-	-	568.2	-
Wage_feb_may_teen_male	-	1147.3	638.4	818.2
Wage_feb_may_teen_female	-	970.0	537.5	468.2

4.11. Crop rotation practices in the study sites

Farmers in Niger never practiced crop rotation. They stated that the lands were in short supply, and not sufficient to allow the practice of crop rotation. However, in Burkina Faso farmers practiced crop rotation as a way to improve agriculture productivity. In fact, 91% and 32 % of respondents stated that they practiced crop rotation. In the region of Centre du Nord, male-

headed households practiced more crop rotation than female-headed households, while in the Sahel region, the tendency was the same for both male and female headed households. The main rotations followed in the last three years to maintain soil productivity were millet for the first year, sorghum the second year and cowpea for the third year; or sorghum the first year, cowpea the second year and groundnut the third year. For some farmers who did not have sufficient land, they divided their plot into three parts and then practiced the rotation within the same plot by moving crop from one part to another part of the plot.

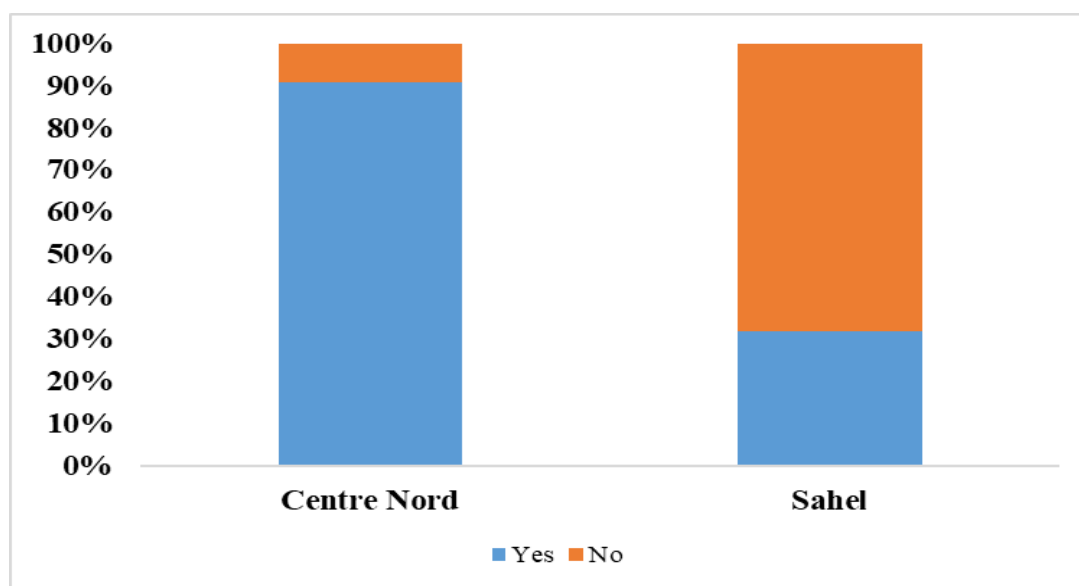


Figure 15. Crop rotation in the farming system in Burkina Faso

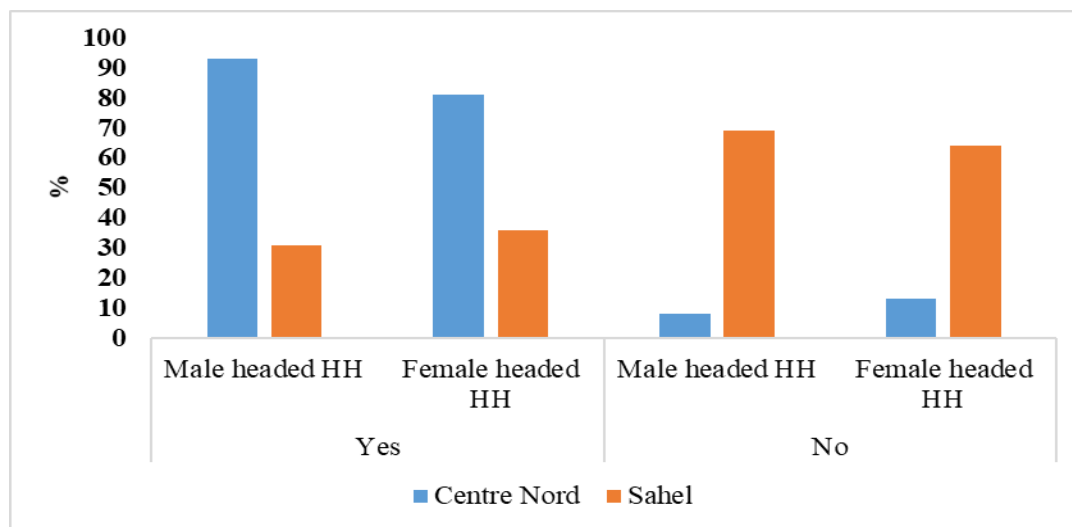


Figure 16. Practice of crop rotation by type of household

BOX 4

Over the context of growing population and growing pressure on land, the practice of crop rotation is not widely practiced by farmers in Niger, as in the past. The alternative strategies should be developed to avoid soil degradation and help farmers conserve the quality of their soil and improve the yields.

4.12. Livestock ownership in the study sites

Table 26 shows the estimates of livestock by household. The average number of livestock owned by household was 2.5 UBT and 2.09 TLU in Burkina Faso and Niger, respectively. The difference was not significant. When considering species, the high number of cattle by household was recorded in the Sahel region in Burkina Faso, while that of sheep was reported in Maradi region in Niger. On average, household owned one donkey (0.4 UBT) in all study sites. The ownership of bullock was common in the farming system of Burkina Faso and Niger. The household owned on average between 1.5 and 2 bullocks.

Table 26. Livestock ownership in the study sites (TLU)

Type of livestock	Burkina Faso		Niger	
	Centre Nord	Sahel	Maradi	Torodi
Bullock	1.78±0.12	2	2	1.5±0.5
Cattle	7.73±2.87	8.53±1.28	2.68±0.35	6.58±0.99
Goat	1.44±0.15	1.7±0.20	1.15±0.10	1.44±0.18
Sheep	1.53±0.13	1.45±0.18	0.79±0.10	1.49±0.20
Donkey	0.59±0.04	0.48±0.03	0.4±0.00	0.46±0.06
Camel	-	-	-	8.4 (n=1)
Horse	1.2 (n=2)	-	-	-

1TLU= 1 cattle or bullock, 0.1goat/sheep, 0.4 donkey; 1.2 horse

Data on milk production showed that production of milk was still very low with an average of two litres per day per cow in Burkina Faso and 1.5 litres /day in Niger (Table 27). The sheep and goat produced between 0.5 and 1 litre per day. The average milking day for a cow per year was higher in the region of Sahel compared to other regions. Still, the lactating period was low compared to the average length of lactation reported in other countries like Nigeria (Shittu et al., 2008). The milking days for sheep varied between 100 and 160 days. It has to be noted that in Burkina Faso, farmers were not used to milk sheep. The milking days for goats were 80, 128 and 96 days, respectively for the Sahel, Maradi and Torodi regions.

Table 27. Milking details

Region	Cow			Sheep			Goat		
	Milking days (j)	Milking yield/day	Price/litre	Milking days (j)	Milking yield/day	Price/litre	Milking days (j)	Milking yield/day	Price/litre
Centre Nord	107.1±28.43	2.00±0.22	492.9±17.00	-	-	-	-	-	-
Sahel	242.9±12.84	2.56±0.09	344.1±3.50	-	-	-	80.4±14.11	0.99±0.01	350.0
Maradi	130.0±26.28	1.44±0.18	437.5±26.31	156.1±16.53	0.93±0.15	227.5±14.27	128.2±6.45	0.86±0.05	198.1±4.57
Torodi	163.6±12.89	1.32±0.06	440.5±19.36	106.3±13.49	0.64±0.08	179.4±10.55	96.4±7.72	0.86±0.07	205.1±8.17

4.13. Animal feeding in the study sites

4.13.1. Details of fodder fed to livestock in the study sites

The sources of animal feed were crop residues, purchased feed, other crop residues and available grass. The majority of households used fodder produced by themselves (from their fields). In Burkina Faso, the common fodder used by households to feed their animals in addition to grazing, were sorghum and millet fodder, cowpea hay and groundnut haulms. Grasses were mainly fed to animals during the rainy season. Livestock keepers rarely bought fodder. The most common purchased fodder were cowpea hay and sorghum residues. In Niger, millet, sorghum residues and cowpea hay were the most common produced fodder at home field and fed to animals by farmers. The cowpea hay and grasses were the most common fodder purchased in Niger by livestock farmers. The findings suggest that herders were more likely to use the fodder from the main crops grown in their areas. The results on details of fodder fed to livestock compliment the results from many studies conducted in West Africa (FAO, 2014; Ayantunde et al. 2014; Umutoni et al. 2015; Amole et Ayantunde, 2016).

Table 28. Details on fodder fed to livestock in Burkina Faso

Name of fodder	Home produced	Home produced and purchased	Purchased	Price/kg (CFA)
Millet stover	52% (n=104)	1% (n=2)	1% (n=2)	2.09
Sorghum stover	71.5% (n=143)	10% (n=10)	2.5% (n=5)	3.20
Rice straw	-	-	0.5% (n=1)	5
Cowpea hay	84.5% (n=169)	-	4.5% (n=9)	67.91
Groundnut haulms	32% (n=64)	0.5% (n=1)	1.5% (n=3)	86.11
Glasses	6.5% (n=13)		3% (n=6)	8.75
Others	4% (n=8)		0.5% (n=1)	

Table 29. Details on fodder fed to livestock in Niger

Name of fodder	Home produced	Home produced and purchased	Purchased	Price/kg (CFA)
Millet stover	70.68% (n=135)	5.24% (n=10)	0.05 % (n=1)	5.18
Sorghum stover	49.21% (n=94)	2.1% (n=4)	1.57% (n=3)	5.25
Rice straw	0.05% (n=1)	-	-	10
Cowpea hay	70.68% (n=135)	4.18%(n=8)	4.18% (n=8)	55.01
Groundnut haulms	27.74%(n=53)	-	3.66% (n=7)	62.97
Glasses	25.65%(n=49)	1.57% (n=3)	5.24% (n=10)	3.87
Others	1% (n=2)	-	7.85% (n=15)	32.22

4.13.2. *Supplements fed to animals in the study sites*

The majority of households used the supplement feeds to provide additional nutritional need to their animals. Cotton seed cake, cowpea hay and cereal bran were the main supplements used by households in Burkina Faso. In Niger, cereal bran, cowpea hay and groundnut haulm were the common supplement feeds among farmers. The figures 17 and 18 display the common supplements used by farmers. The cotton seed cake was mainly used in Burkina Faso and were distributed to bullocks, cattle and small ruminants. On average, bullocks and cattle received 1.5 kg per day while small ruminant received 1kg per day. Bullocks were supplement with almost 3 kg of cowpea while cattle and small ruminant received about two and one kilogram of cowpea per day respectively. In Niger, millet and sorghum bran and legumes residues (cowpea hay, groundnut haulms) were the common supplements used by farmers. Bullocks received at least 1.5 kg per day, while cattle and small ruminants received about one kilogram. Table 38 gives the details about the use of supplements in Burkina Faso and Niger. Many experiments (Hiernaux and Ayantunde, 2004; Dangoma et al., 2004; Ayantunde et al., 2007; Ayantunde et al., 2008) have been conducted to evaluate the effect of different types of supplements on animal productivity performance.

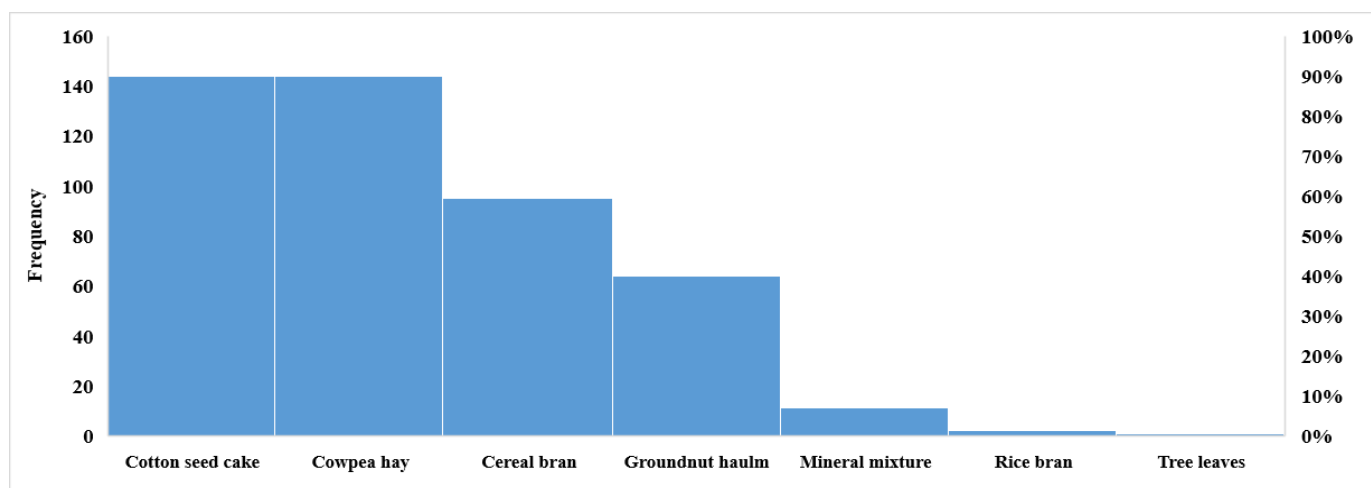


Figure 17. Utilization of different types of supplements in Burkina Faso

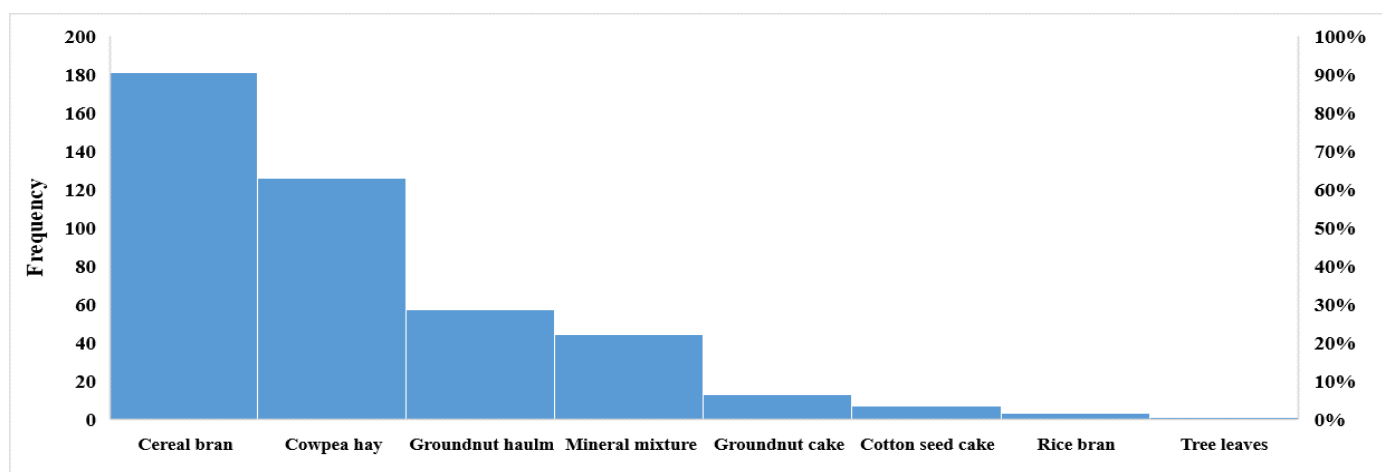


Figure 18. Utilization of different type of supplements in Niger

Table 30. Details on supplements fed to animals

Type of supplement	Burkina Faso			Niger		
	Quantity/day	N°of months	Unit price	Quaty/day	N°of months	Unit price/kg
Cotton seed cake						
Bullocks	1.59±0.09	3.22±0.24	191.7±3.60	-	-	174.3±5.71
Cattle	1.67±0.09	4.8±0.22		1.43±0.30	5±0.58	
Small ruminants	1.05±0.18	4.57±0.74		-	-	
Camel_horse_Donke	-	-		-	-	
Groundnut cake						
Bullocks	-	-		2.31±0.16	4.38±0.32	187.5±12.50
Cattle	-	-		2 (n=1)	12	
Small ruminants	-	-		2.00±0.58	3.67±0.33	
Camel_horse_Donke	-	-		3 (n=1)	4	
Cowpea hay						
Bullocks	2.83±0.75	2.33±0.33	69.3±4.07	1.9±0.24	5.4±0.93	107.8±5.07

Cattle	2.00±0.59	3.63±0.42		3 (n=1)	6.5±0.5	
Small ruminants	1.38±0.10	3.48±0.17		1.18±0.05	6±0.26	
Camel_horse_Donke	4 (n=1)	3		1 (n=1)	11	
Groundnut haulm						
Bullocks	2±1 (n=2)	2.5±1.5	79.6±6.89	2.1±0.24	4.8±0.2	119.3±6.20
Cattle	0.75±0.25	3		-	-	
Small ruminants	1.12±0.19	3.8±0.24		1.23±0.08	5.96±0.36	
Camel_horse_Donke	-	-		-	-	
Sorghum and millet bran						
Bullocks	1(n=1)	4	110.4±4.99	1.52±0.11	6.88±0.65	121.2±2.89
Cattle	1.17±1.11	6.65±0.82		1.44±0.09	5.88±0.45	
Small ruminants	0.89±0.03	5.84±0.37		1.13±0.05	5.32±0.26	
Camel_horse_Donke	3 (n=2)	3.50±0.50		1 (n=1)	7	
Mineral Mixtures						
Bullocks	-	-	277.3±122.36	0.57±0.05	6.48±0.78	111.4±10.97
Cattle	0.45±0.08	4.20±0.79		0.59±0.06	7.73 ±0.87	
Small ruminants	0.25 (n=1)	3		0.47±0.03	2.38±0.26	
Camel_horse_Donke	-	-		-	-	

4.14. Inter-calving length for ruminant and veterinary cost per year

The result of this study showed that the average inter-calving period for the cattle was 12 months and 20 months, for Burkina Faso and Niger, respectively ($p < 0.01$), but ranges widely from 12 months to 25 months. This inter-calving interval for indigenous cattle was in the range reported by Kanuya et al. (2005) in Tanzania, but slightly lower to the one reported by Herrero et al. (2016) in Ethiopia. On average, goats had seven months inter-calving period in both countries, and varied between six months and one year. The inter-calving period for sheep was nine months in Burkina Faso and seven months in Niger. In Niger, households spent much money for cattle health care compared to Burkina Faso. In fact, on average a household spent 2600 CFA for cattle health care per year while in Burkina Faso, a household spent about 1800 CFA. However, households in Burkina Faso spent two time more money than Niger households for the small ruminant health care (Table 31).

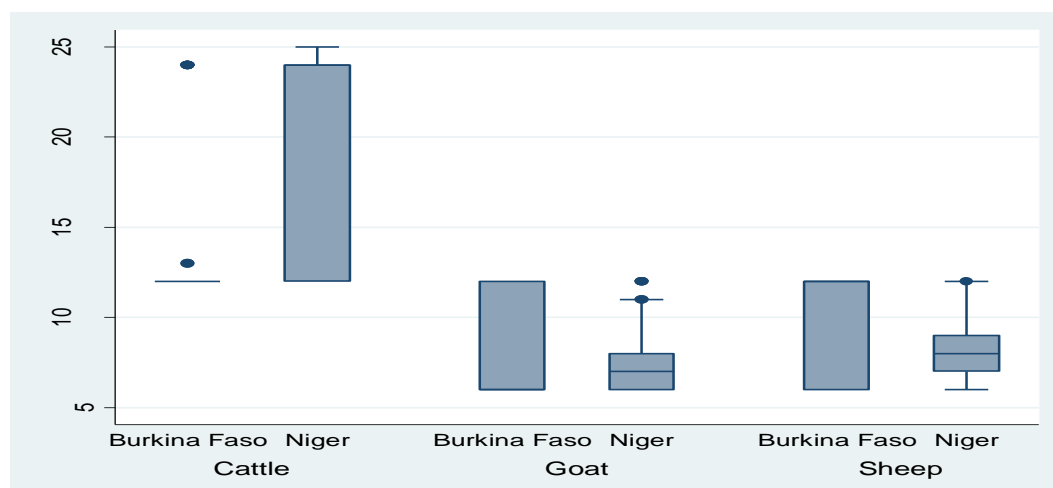


Figure 19. Inter-calving period for ruminant in the study area

Table 31. Amount spent by household for livestock health care per year

Species	Burkina Faso			Niger		
	Mean±s.e	Minimum	Maximum	Mean±s.e	Minimum	Maximum
Cattle	1850±231.9	150	20000	2606±473	500	12000
Goat	802±79.3	125	3400	434±23.4	100	1500
Sheep	936±84.3	100	5000	465±33.1	150	1000
Donkey	1366±103.6	100	5000	1050±341.6	250	2500

BOX 5

The findings of the study highlight the importance accorded to cattle and small ruminants in Niger and Burkina Faso by herders since they were ready to invest in their health care. Niger 'herders gave more importance to cattle while Burkina Faso 'herders provide much care to small ruminants. This provide an idea on what should be the entry point to develop livestock sector in both countries. Herder's already invest some money in health care and in supplement feeds, therefore ways should be developed to provide them the much needed support to gain more outcome in the livestock rearing.

4.15. Labor use for livestock in the study area

The contribution of women labor in livestock management was lower compared to men's contribution in Burkina Faso and Niger. Some studies (Hulela, 2010) on the role of women in sheep and goat's production in Sub-Saharan Africa suggest that women's roles in rearing sheep and goats were not significantly different from that of men's. However, they noted that women

were knowledgeable in rearing sheep and goats than men. Generally, the results indicated that Burkina Faso used more labor for livestock compared to Niger during all seasons. Children and elders' persons were also involved in livestock management but less than adults. Children were more involved in livestock management during the period of June to September, which coincide with their holidays and at that time adults were busy with other cropping activities. The children's workforce for livestock started to reduce during the season of October to January, where it reduces from 24 days and 14 days (June –September) to 17 days and 11 days (October to January) in Burkina Faso and Niger, respectively. As the days of children involvement in livestock management reduces as the season progresses, their hours of involvement per day also reduced. The involvement of elders' persons was very low compared to other age groups. Table 32 illustrates clearly the number of the days and hours that households' members spent on livestock management.

4.16. Animal grazing times in the study sites

Grazing is common practice in Burkina Faso and Niger and is the main source of feed for animals. The results of this study on number of hours' animal grazed in local commons showed that the grazing time depended on species and varied between seasons. The time spent by cattle for grazing during the period of June to September was about 9 hours and 6 hours in Burkina Faso and Niger, respectively. This time was reduced to 8 hours per day in Burkina Faso and increased to 7 hours per day in Niger from October to January. Globally, the number of hours' cattle grazed gradually reduced from the period of June_September to the period of February_May in Burkina Faso. In contrast to Burkina Faso, in Niger the number of hours cattle grazed in local commons increased as the seasons progressed from June to september periods. The results clearly showed that the number cattle grazed in local commons in Burkina Faso was less during the dry season, which means that cattle were moved around in search of grazing area. On the contrary, in Niger cattle spent much time outside the community during the cropping season to avoid crop damages. They then spent more time in the local commons during the harvesting period to graze in the field after harvesting. Animals moved out of the community in search of grazing during the hot dry season. The same trends were also reported for small ruminants.

Table 32. Labor use for livestock

Period	Country	Adult Male		Adult Female		Children		Elder	
		Days	Hours	Days	Hours	Days	Hours	Days	Hours
June -Sept	Burkina Faso	21.63±0.93	2.81±0.20	17.95±1.03	1.67±0.13	24.45±0.80	6.42±0.28	3.99±0.71	0.44±0.10
	Niger	13.21±0.88	3.34±0.18	10.69±0.83	2.79±0.20	14.88±0.86	3.96±0.20	0.92±0.21	0.57±0.09
October-January	Burkina Faso	23.05±0.87	2.62±0.16	20.20±0.97	1.90±0.14	17.17±0.95	5.07±0.30	3.14±0.64	0.48±0.13
	Niger	12.11±0.89	2.68±0.15	11.39±0.85	2.42±0.17	11.79±0.86	3.05±0.20	0.68±0.15	0.60±0.11
February -May	Burkina Faso	21.9±0.92	2.67±0.19	23.74±0.84	1.85±0.11	15.64±0.99	3.62±0.29	3.58±0.69	0.29±0.07
	Niger	12.61±0.86	2.50±0.14	11.19±0.83	2.49±0.17	6.33±0.59	2.31±0.17	2.01±0.41	0.66±0.09

Table 33. Grazing time in local commons per day

Season	Country	Cattle	Goat/sheep	Camel_horse_donkey	Family labour (person involved (no)
June-Sept	Burkina Faso	9.49±0.10 ^a (n=134)	9.34±0.09 ^a (n=177)	9.24±0.16 ^a (n=122)	1.74±0.07 ^a (n=188)
	Niger	6.96±0.15 ^b (n=112)	7.30±0.14 ^b (n=181)	5.91±0.34 ^b (n=23)	1.63±0.08 ^b (n=189)
October-January	Burkina Faso	8.96±0.14 ^a (n=122)	8.59±0.15 ^a (n=168)	9.06±0.18 ^a (n=95)	1.85±0.08 ^a (n=160)
	Niger	7.71±0.15 ^b (n=110)	8.15±0.15 ^b (n=179)	7.13± 0.33 ^b (n=24)	1.46±0.06 ^b (n=186)
February-May	Burkina Faso	4.17±0.33 ^a (n=85)	5.51±0.25 ^a (n=164)	3.15± 0.46 ^a (n=40)	1.74±0.07 ^a (n=143)
	Niger	7.96±0.24 ^b (n=111)	8.19±0.18 ^b (n=180)	6.92± 0.42 ^b (n=24)	1.63±0.08 ^b (n=186)

4.17. Household living cost in the study sites

The average living cost of household per month was about 80000 CFA and 50000 CFA for Burkina Faso and Niger, respectively. The households living cost was higher for Burkina Faso and the difference was significant ($p < 0.001$). When comparing regions, the high household' living cost was recorded in the Centre Nord region in Burkina Faso. The living cost per person per month varied between 2500 and 40000 CFA in the Centre Nord region and 1600 CFA and 10 000 CFA in the Sahel region. In Niger, the living cost per person varied between 1600 CFA and 15000 CFA in Maradi and between 800 and 18000 CFA in Torodi region. The living cost found in this study is much lower compared to the 1.9 USD per day reported by the World Bank.

Table 34. Living cost by household or per person/month

Country	Region	Living cost/HH	Living cost per person	Living cost/HH/country	Living cost/pers/country
Burkina Faso	Centre Nord	98932±9751	9814±675.5	80658± 6001 ^a	7449± 456.4 ^a
	Sahel	55693±3113	4217±249.8		
Niger	Maradi	45689±2042	4831±226.5	49549± 2057 ^b	5110±209.5 ^b
	Torodi	54068±3727	5436±367.9		

As shown in Table 35, the living cost for male-headed households were higher compared to the living cost of female headed households. However, when considering the living cost per person, the latter was higher in female-headed households in both countries.

Table 35. Living cost per type of household

Country	Living cost/household		Living cost per person	
	Men-headed HH	Women-headed HH	Men-headed HH	Women-headed HH
Burkina Faso	84146±6850	58672±5919	7295±509.7	8417±883
Niger	51198±2384	42200±3408	5067±229.4	5304±517.4

4.18. Access to credit by farmers in Burkina Faso and Niger

Figure 20 illustrates access to credit by households in the study area. The majority of rural households (85%) had access to credit in the Sahel region of Burkina Faso, regardless the source of credit. In Niger, almost 70% and 67% had access to credit in Maradi and Torodi regions, respectively. The lowest access to credit by households was recorded in the region of Centre Nord, where only 25% of households reported having access to credit. In Burkina Faso, male and

female-headed households had the same access to credit, while in Niger, female-headed households had more access to credit than male-headed households. This might be related to the participation of many women in women association called «*Tontin*» that facilitated their access to credit (informal) when needed. In fact, 77% of female-headed household had access to credit while only 66% of male-headed household had access to credit. The majority of credit came from informal sources. De facto, among households who reported having access to credit, 96% and 85%, in Burkina Faso and in Niger respectively got access to credit through friends and family. Only 10% and 2% households got access to formal credit through commercial/cooperative bank. The lowest access to formal credit could be explained by the rate, which in many cases was very high compared to the interest rate from informal sources of credit (Table 36). The interest rate at commercial banks was about 10% and 7%, respectively in Burkina Faso and Niger, while the interest rate from credit taken from friends and families was not even 1%. This is to confirm that farmers in rural areas have low access to formal credit to engage and invest in the Agriculture activities, which hinders the development of Agriculture sector in the rural areas. Other studies, like the investigation done by Ibrahim and Aliero (2012) also noted that rural farmers have little or no access to credit from conventional banks.

The main use of credit taken was to buy food for home consumption, so as to ensure household' food security. The other purpose for taking credit were to secure other family needs, household' health care, engage in small business and buy livestock. The region of Sahel recorded highest number of households who took credit just to buy food for their family, which illustrate the problem of food insecurity in that area. This region also recorded high number of household who took credit from their friends and family to pay for health care of household members. In Niger, households took credit for two main purpose, which were buying food and buying other family needs.

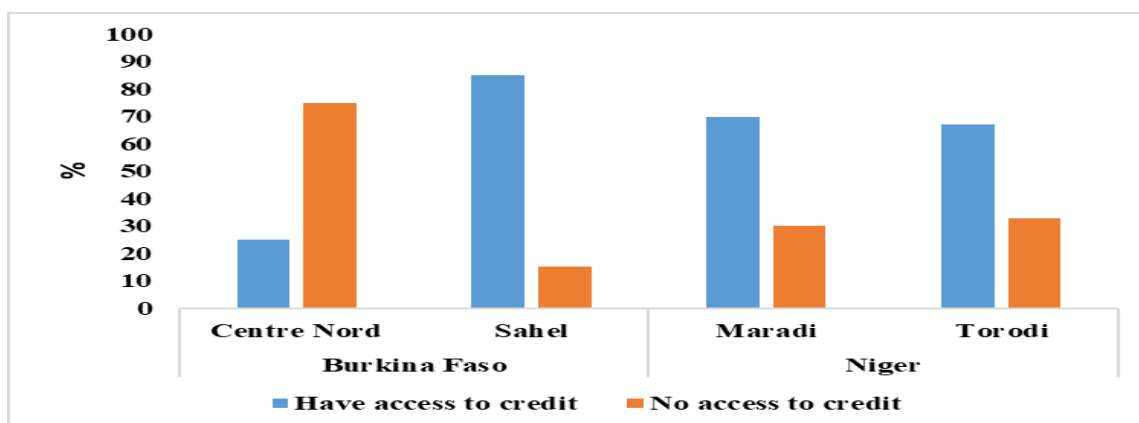


Figure 20. Access to credit by households in rural area of Burkina Faso and Niger

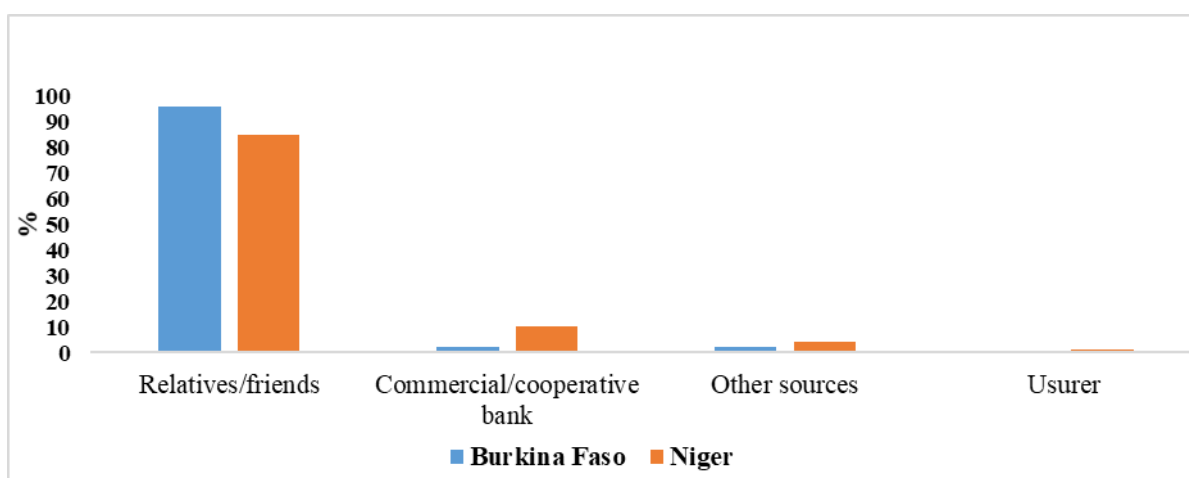


Figure 21. Source of credit

Table 36. Interest rate (%)

Source of credit	Burkina Faso	Niger
Commercial/cooperative Bank	10	7.1±1.27
Friends/Relatives	0.66±0.49	0.09±0.04
Usurer	-	-
Other sources	-	3.3±2.11

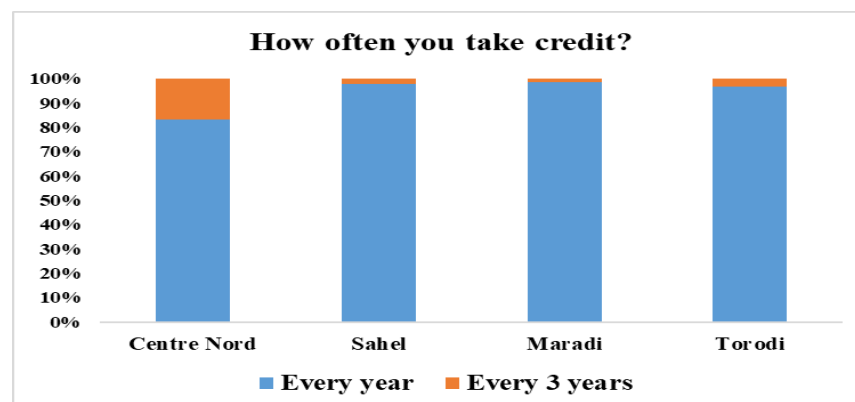
Table 37. The use of credit by households (frequency)

Use of credit	Centre Nord (n=25)	Sahel (n=85)	Maradi (n=72)	Torodi (n=59)
Food	0	65	22	23
Health	6	14	8	5
Education	6	0	0	0
Family need	3	7	20	30
Animal trading	0	2	0	0
Small business	5	4	4	3
Buy animal traction	0	0	1	0
Social ceremony	0	3	1	2
Buy livestock	2	4	1	0
Buy Feed	0	4	0	0
Agriculture	1	0	2	0

The average amount of credit taken by household per year was about 32000 CFA, 49000 CFA, 34000 and 35000 CFA, respectively in the Centre Nord, Sahel, Maradi and Torodi regions and the difference among regions was not significant. When respondents were asked how often they took credit, the majority in all study sites responded that they took credit every year. In fact, more than 80% of households in all study sites stated that they took credit every year. When comparing regions, the frequency of taking credit was low in the Centre Nord region where 17% of households reported taking credit every 3 years.

Table 38. The credit amount taken by household per year

Region	Mean \pm s.e	Minimum	Maximum	Anova Test
Centre Nord	32062 \pm 11330	500	250 000	P= 0.28
Sahel	49141 \pm 5639	2000	300 000	
Maradi	34371 \pm 6629	1000	320 000	
Torodi	35188 \pm 8023	2000	500 000	

**Figure 22.** The frequency of taking credit by households in the study sites

4.19. Information about market conditions for the sale of produce

The majority of respondents sell their produce either at village market or market of the neighboring village. In Burkina Faso, cereal grains and legume grains were sold mostly in the village market while in Maradi, they were sold in the market of the neighboring village. In the study, 100% of the respondents in both study sites of Burkina Faso stated that they sold their cereal grains at the village market, and about 77% and 87% reported also selling their legumes grains at the village market. In Maradi however, respondents stated that they sold the cereals and legumes grains at the market of the neighboring. Small ruminants were mostly sold at the market of the village in all the study sites. In addition to market of the village, respondents in Maradi reported bringing them to the market of the neighbouring village. In Maradi, 54.84% of respondents sold the large ruminants at market of the neighbouring village and about 35% took them to urban market. A small percentage sold large ruminants to the neighbouring country like Nigeria. Crop residues were mostly sold at the village market. The findings clearly indicate the importance of the village market to farmers in Burkina Faso where most of the produce were sold. This suggests that, improving these markets and facilitating access to external markets for farmers would contribute towards the improvement of the well-being of farmers in Burkina Faso.

In Niger, the results show that farmers were open to external market outside of their village. Most of their produce were sold at the market of the neighbouring villages and sometimes at the urban market, which indicates two scenarios. (1) farmers either don't have buyers at their own village and they had to travel away to get access to market or (2) farmers have diversified markets and they have the possibility of choosing the best market. Therefore, improving transport infrastructure (road and means of transport) will help them to access easily the market and earn more income. Table 33 represent different markets where farmers sell their produce.

Generally, in Maradi respondents did not have problem accessing the market for livestock and livestock products. The result indicated that 92%, 74% and 100% respondents did not have problems accessing the market for small ruminant, large ruminants and animal products, respectively. On the contrary, a high percentage of respondents in Sahel reported having problems of accessing markets for small ruminants, large ruminants, and animal by produce. In Centre Nord region, about 67% and 100% of the respondents reported that they were having problems accessing the market for small ruminants and animal processed produce.

Table 39. Access to the market by farmers

Type of produce	Where do you sell produce?	Centre-Nord (%)	Sahel (%)	Maradi (%)
Cereal grain	Market of the neighbouring	-	14.29	62.07
	Urban market	-	-	5.17
	Village market	100	100	43.10
Legumes grains	Market of the neighbouring	23.08	37.5	73.68
	Urban market	-	-	5.26
	Village market	76.92	87.5	23.68
Small ruminant	Market of the neighbouring	21.79	42.86	47.87
	Urban market	-	16.33	7.45
	Village market	80.77	100	51.06
	Neighbouring country	-	-	2.13
Large ruminant	At the abattoir	-	-	1.06
	Market of the neighbouring	13.64	60	54.84
	Neighbouring country	-	-	3.23
	Urban market	-	30	35.48
Cereal by-product	Village market	86.36	100	16.13
	In the field	-	-	3.70
	Market of the neighbouring	-	-	77.78
	Village market	-	-	23.59
Cereal processed produce	Urban market	-	-	1.37
	Village market	-	100	-
	Market of the neighbouring	-	14.29	94.74
Crop residues	At home	-	-	24.66
	In the field	33.33	7.14	1.37
	Market of the neighbouring	-	14.29	26.03
	Urban market	-	-	10.96
Animal by produce	Village market	66.67	92.86	33.25
	Market of the neighbouring	-	-	60
	Village market	-	100	10
Animal processed produce	Market of the neighbouring	-	-	89.47
	Village market	100	-	-

For crop produce, again respondents in Maradi did not report problem of accessing the market. Accessibility to market by farmers in Maradi might be explained by the available market in Nigeria since this region share borders with Nigeria. Conversely, in Burkina Faso especially in Centre Nord region, when respondents were asked if they had problems accessing the market for cereal and legumes grains, more that 60 % responded yes. Likewise, in the Sahel region, farmers have more problems accessing the market for crop residues. So, developing a feed market should be a good strategy to improve crop and livestock integration.

The main problem that faced the respondents who reported having problems accessing the market for small ruminants and crop produce in Burkina Faso were: lack of means of transport, bad condition of the roads, and low price. These problems were hindering the development of crop livestock value chains in the study sites. In Maradi, the big problem that farmers encountered that hindered them from accessing the feed market and livestock market was lack of market information, and no knowledge of the market. Given the above, developing relationship that will connect actors involved in animal feed value chains will improve access to feed market for people from Maradi.

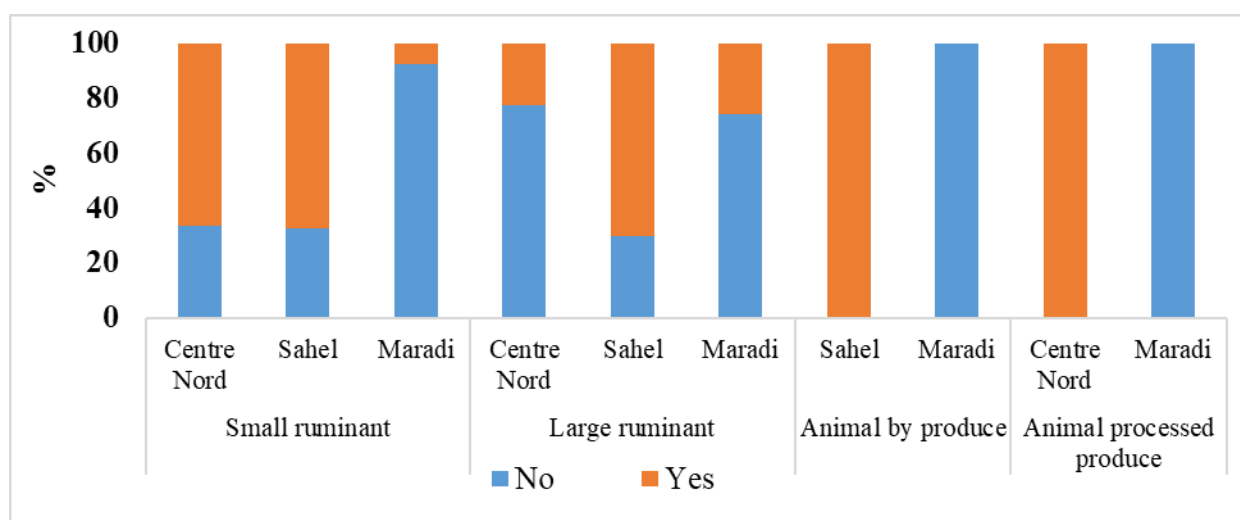


Figure 23. Do you have problems accessing the market for animal and animal products?

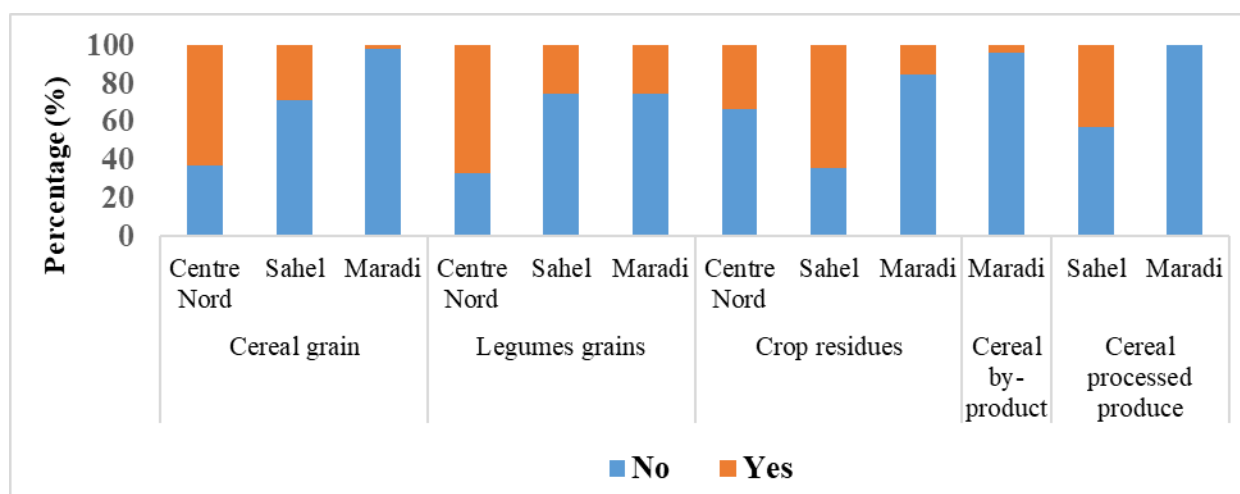


Figure 24. Do you have problems accessing the market for crop grains, residues and cereal products?

4.20. Access to information by households

The majority of households in the study sites got information on market price and technology from neighbors/friends, radio and relatives. The main source of information in all regions was neighbor/ friends. In Centre Nord, farmers were also better informed on market price from the local radio. The latter was also a big source of market price information in Niger. On the contrary, local radio was not among the listed sources of market price information to farmers in the Sahel region. To illustrate, extension staffs provided information on market price and technology to farmers. In fact, 30% and 23% of households, respectively in Maradi and Torodi reported having got information on market price from extension staffs and 68% and 41% got information on agriculture technology from extension staffs. In Burkina Faso however, the role of extension staffs in the provision of information (market price, technology, climate) was very low. In the Centre Nord region, local televisions broadcast weather /climate information, thus 27 % of households stated getting information from local televisions. Table 40, 41 and 42 enumerate the main sources of information on market price, technology and climate in the study sites. Efficient market information provision can be shown to have positive benefits for farmers, traders and policymakers.

Table 40. Source of market price information

Source of information	Burkina Faso		Niger	
	Centre Nord (%)	Sahel (%)	Maradi (%)	Torodi (%)
Radio	90	33	56.31	55.68
Neighbor/friends	99	94	80.58	78.41
Family/spouses	39	47	51.45	26.13
Television	5	8	4.85	0
Association/cooperatives	1	0	0	1.13
Extension staffs	0	1	30.1	22.72
Other	0	2	0	0

Table 41. Source of technology information

Source of information	Burkina Faso		Niger	
	Centre Nord (%)	Sahel (%)	Maradi (%)	Torodi (%)
Radio	79	50	49.5	42
Neighbors/friends	94	85	68.9	69.3
Family/spouses	39	33	35.9	10.2
Television	5	27	1.0	0

Association/cooperatives	3	1	1	1.1
Extension staff	0	12	67.9	40.9
Project	0	4	1.9	0
Other	0	0	0	0

Table 42. Source of weather/climate information

Source of information	Burkina Faso		Niger	
	Centre Nord (%)	Sahel (%)	Maradi (%)	Torodi (%)
Radio	76	53	92.2	84.1
Neighbors/friends	91	74	47.	39.8
Family/spouses	34	25	43.7	17
Television	4	30	1	1.1
Association/cooperatives	6	0	1	0
Extension staffs	0	8	24.2	20.4
Project	0	0	0	0
Other	0	2	0	0

4.21. Respondent involvement in crop livestock activity

4.21.1. *The area of respondents' involvement in crop livestock activity*

This section documents patterns of small holders' participation in crop livestock channels. The findings noted how involvement of farmers in crop and livestock value chains was centered at almost the same level of value chains. This is to mean that farmers' involvement was not very diverse along crop livestock value chains. The figure 25 illustrates respondents' involvement in crop-livestock activities. When asked, what was their areas of involvement in crop-livestock activities, the majority of respondents stated that they were involved in crop production. In fact, the results showed that 97%, 98%, 99% and 100% of respondents reported being involved in crop production. Respondents were also mainly involved in livestock management, especially in the Sahel and Torodi regions. The results revealed that 81% and 67% of respondents in the Sahel and Torodi regions, respectively were involved in livestock management. In addition, 63% reported being involved in feeding management. Maradi and Sahel regions recorded high number of persons involved in livestock trading. The high involvement of person in Maradi in livestock trading can be explained by the fact that Maradi shared borders with Nigeria, so there exist huge opportunity to earn more income from trans-border trading. The results revealed that the processing of crop and livestock produces was very low, less households were involved in

processing, especially of livestock produce, which means, there is need to improve crop and livestock sector by improving the processing of produce.

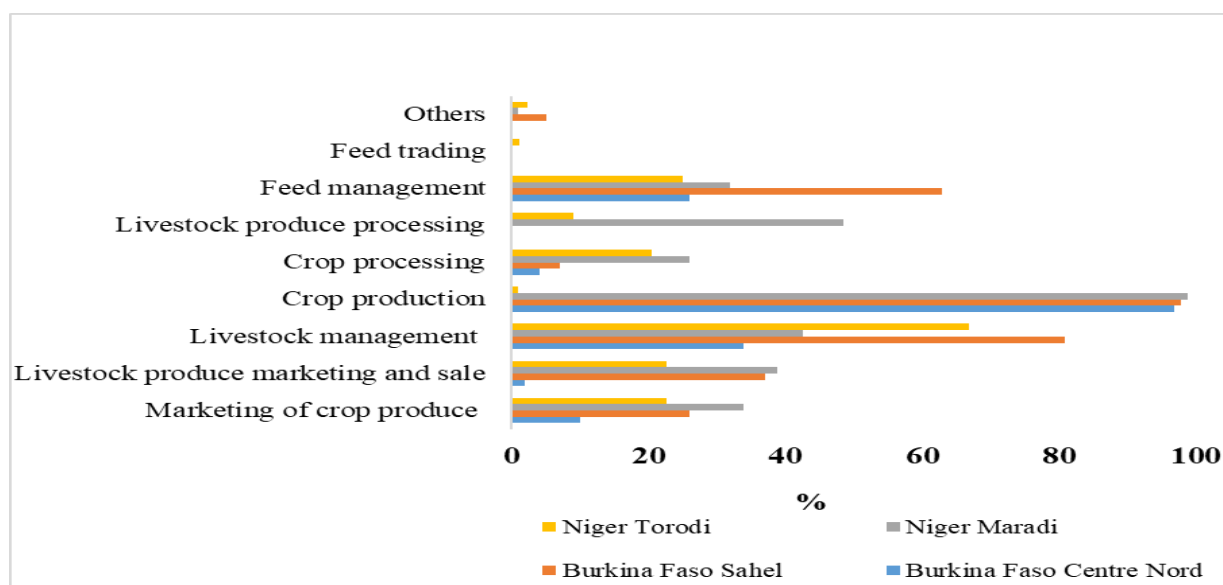


Figure 25. Respondents' involvement in crop livestock agricultural activities

4.21.2. Reasons of respondents' involvement in crop livestock activity

The major reasons for households' involvement in crop livestock activities were household's food security and source of income. 75% and 86% of households stated being involved in crop livestock activities to secure food for their households' consumption. Only 24 % and 13 % reported being involved for earning income.

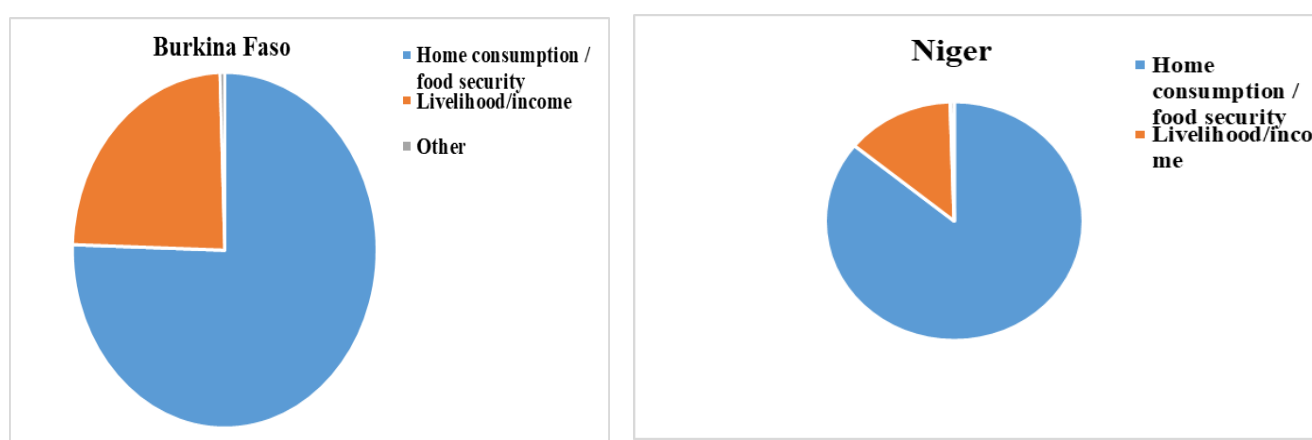


Figure 26. Reasons of households' involvement in crop livestock activities

These results highlight that farmers were more concerned about finding food for their families. In addition, the findings attest the level of food insecurity in both countries, especially in Niger,

where most of the farmers practiced subsistence farming, instead of commercial farming. Their first priority was to find food for their families.

4.21.3. Farmers' perceptions on input required to improve crop livestock productivity

The increase of crop productivity and biomass output was the basis for improved integration of crop and livestock. For that, respondents thought that they needed more inputs to improve crop livestock agricultural activities and enhance climate resilience of their farming systems. Table 43 indicates clearly the perception of farmers on different input required to increase their farm productivity. According to the farmers, the major inputs required to improve their productivity were: fertilizers, improved seeds, insecticides/herbicides, farm machines, animal feeds, extension & veterinary support. In all the study sites, fertilizer was the main input reported by respondents as a requirement to booster farm productivity within this context of soil fertility decline due to climate change and overuse of land. Second, farmers reported a high need of improved seeds both for grain and biomass output. 55%, 75%, 74% and 68 % of respondents, respectively in Centre Nord, Sahel, Maradi and Torodi regions stated that they needed access to improved seeds adapted to the current weather conditions in order to improve their productivity. To enhance productivity, insecticide/herbicide were another input required by farmers within this context of climate change where they are experiencing the apparition of new weeds and insects in their farms that are devastating their crops. As part of the system, animal feeds was highly reported by more than 85% of respondents in Niger as input required to improve the productivity of their animals.

Table 43. Major required input for enhancing crop livestock agricultural productivity

Requirement	Centre Nord (%)	Sahel (%)	Maradi (%)	Torodi (%)
Capital	4	36	19.4	8
Fertilizer	92	81	78.6	94.3
Improved seed	55	75	73.8	68.2
Insecticides/herbicides/sprays	24	62	53.4	58
Labor	44	10	15.5	20.4
Equipment/farm machine	15	87	57.2	61.4
Market information	3	1	12.6	6.8
Animal traction	0	4	0	0
Animal feed	37	66	88.3	87.5
Improved animal	0	6	0	0
Veterinary support	21	62	12.6	17
Other (water impro, techno, etc.)	1	12	0	12.5

The use of farm machine was reported by farmers as another requirement to boost productivity. In the Centre Nord however, farmers expressed high need of labor compared to farm machines. Respondents also expressed the need of extension support and officers. As stated in an earlier section, the provision of support from extension staff to farmers was low, especially in Burkina Faso. For example, in the Sahel region of Burkina Faso, 66% of respondents expressed the need for extension/ veterinary support to help in enhancing crop livestock productivity.

BOX 6

To enhance Agricultural productivity, farmers need to have access to input such as fertilizers, improved seed, but also farmers need support from extension services. This study reveals low engagement of extension staff at farmer level or, they play a crucial role in boosting agriculture production, so improving the capacity, skills of extension staff is necessary. Finding a way of energizing extension staff, turn poorly motivated field staffs into effective extension agents. Regular communication with farmers is a key to ensure the flow of information and sustainability of the system.

4.22. Contribution of farming activities on households' income

Farming activities were the main source of households' income. On average, crop_livestock_trees activities contributed to household's income of about 81% and 85 % in Burkina Faso and Niger ($p=0.003$), respectively. Crop_Livestock_Trees contributed less to households' income in the Sahel region compared to their contribution in other regions. Figure 15 illustrates clearly the contribution of household's income. Compared to male-headed households, the contribution of farming activities to household's income was higher in female-headed households. In Burkina Faso, the contribution of crop_livestock_trees to male-headed households was about 80 % compared to 83 % for female-headed households. In Niger, this contribution was 84% and 89%, respectively for male and female-headed households.

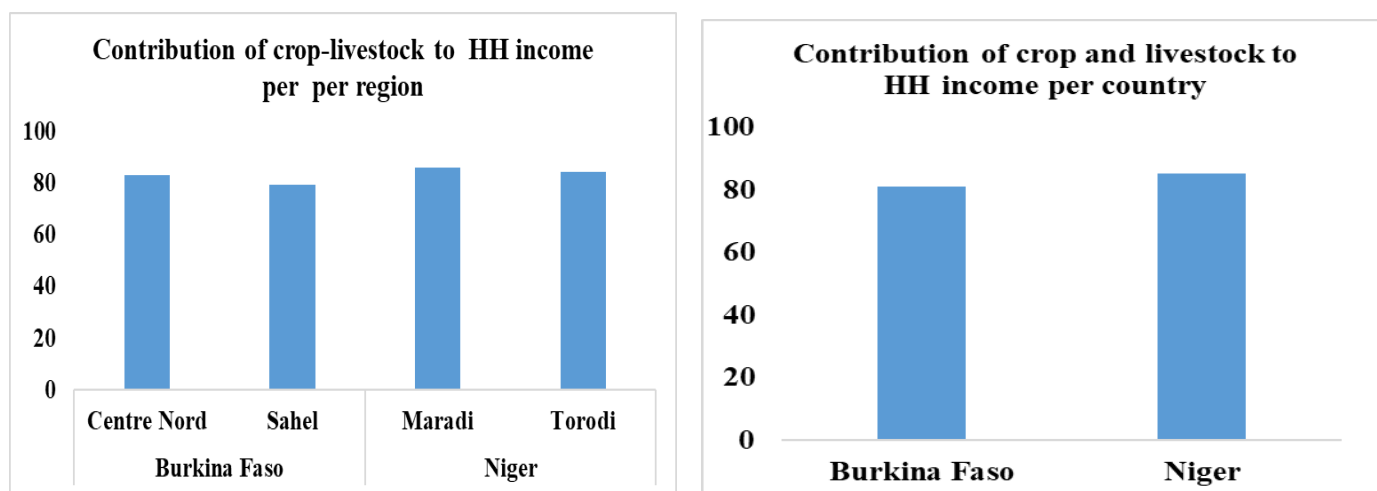


Figure 27. Contribution of farming activities to households' income

4.23. Storage methods of agricultural produces

The findings of this study revealed that storage structures of crop produces were mainly traditional. Crop produces were stored using traditional methods. For example, millet and sorghum were mainly stored in the granary, especially in Niger and sometimes they were stored in the house. The cowpea and groundnut were stored mainly in bags inside the house or in jerrycan. Cereal stover were stored on trees, open shelter, on roof or in the field where an enclosure was built to limit the external use by people from outside. The cowpea hays were stored on open shelter on the roof, inside the house or in a store house. Groundnut haulm were mainly stored in the bags inside the house.

4.24. Post-harvest activity attribution among household's members

The attribution of work in post-harvest activities such storage, processing and marketing depended on types of activity to be performed. In many cases, adult' males were more involved in storage of produces. The results of the study showed that men were involved in storage activity at 57% and 67%, respectively in Burkina Faso and Niger. Adult' females were also involved but not at the same level as adult' males. Adult females were more involved in processing of farm produces, as 74% and 93% of respondents reported that the processing activities were performed by adult females in Burkina Faso and Niger. The selling of grains and processed produces/cereals were performed by both adult males and females. Teenage females were also involved in the selling of grains in Niger. The figures 28 illustrates who does what work most of time in the farming activities.

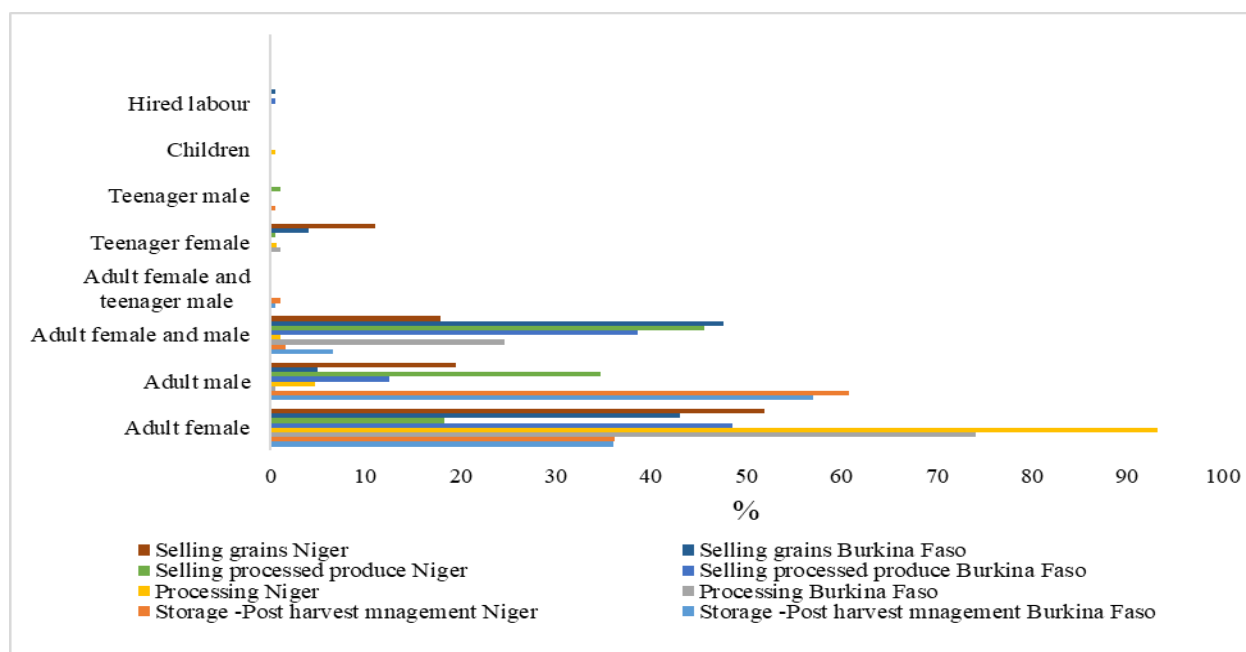


Figure 28. Who does what work most of the time for storage, processing, marketing and sales activities

4.25. Access to productive capital by households in Burkina Faso and Niger

Households' Access to Productive Capital/Resources are presented in Table 44. More than 50% of households in Burkina Faso and Niger owned productive resources such agriculture land, livestock, no-mechanized equipment, house, small durables consumer, phone, etc.. In Burkina Faso for example, 100% owned agriculture lands, 77% large livestock, 89% small ruminant, 84% non-mechanized farm equipment and 92% means of transport. In Niger, 93% owned agriculture lands, 54% large livestock, 94% small ruminant, 81% poultry, 84% no mechanized equipment, 51% means of transport. When comparing Niger and Burkina Faso, households in Burkina Faso owned more productive capital compared to households in Niger. In both countries, majority of households did not own mechanized farm' equipment's, large durables consumer, asset used for income generation, and land not used for agriculture purpose. The results indicated that most of capital resources were owned by adult male or by jointly adult male and female. Rare were the capital owned by only adult females. For example, in both countries,

about 65% of respondents reported that the agriculture lands were owned by adult male. Almost 80% stated that large livestock were owned by adult males. This is to confirm the findings in many studies stressing that assets and their control are unequally distributed in a household between man and woman (Quisumbing et al., 2013). It is reported that equitable growth in household access to and investment of savings in natural and human resources can be imperative for sustainable economic growth and poverty reduction. Santos et al. (2013) in their study in India, showed that including women's names on the land documents can have the additional impact of improving women's tenure security and their ability to influence household decisions. Also, it is widely believed that access to productive assets including land, human capital, livestock, and farm equipment may play a significant role in enhancing the welfare of rural households. In particular, insufficient access to land and low productivity of land are considered to be major causes of rural poverty and food insecurity (Melmed-Sanjak & Lastarria-Cornhiel, 1998; Holden et al., 2008a).

Table 44. Households' Access to Productive Capital/Resources

Type of productive resources	Ownership of productive capital/HH				Who own the resources?					
	Burkina Faso (n=199)		Niger (n=191)		Burkina Faso			Niger		
	Yes	No	Yes	No	Adult male	Adult female	Jointly	Adult male	Adult female	Jointly
Agricultural land (pieces/plots)	199	0	178	13	65.8%	15.1%	19.1%	66.3%	7.3%	26.4%
Large livestock (oxen, cattle)	154	45	104	87	85.7%	7.1%	7.1%	78.8%	5.8%	15.4%
Small livestock (goats, sheep)	177	22	180	11	55.4%	16.9%	27.7%	21.7%	39.4%	38.9%
Chickens, Ducks, Turkeys, Pigeons	172	27	156	35	29.7%	9.3%	61.0%	8.3%	34.0%	57.7%
Farm equipment (non- mechanized: hand tools, animal-drawn plough)	188	11	161	30	48.4%	8.0%	43.6%	72.0%	13.0%	14.9%
Farm equipment (mechanized: tractor-plough, power tiller, treadle pump)	0	199	3	188	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
House or other structures	199	0	191	0	77.4%	12.1%	10.6%	39.3%	6.8%	53.9%
Large consumer durables (refrigerator, TV, sofa)	3	196	3	188	33.3%	66.7%	0.0%	66.7%	0.0%	33.3%
Small consumer durables (radio, cookware)	153	46	178	13	11.8%	11.1%	77.1%	30.3%	15.7%	53.9%
Cell phone	185	14	182	9	39.5%	4.3%	56.2%	67.6%	9.3%	23.1%
Asset (sheller, a processing machine, any capital asset used for income generating activity)	2	197	52	139	100.0%	0.0%	0.0%	13.5%	63.5%	23.1%
Other land not used for agricultural purposes (pieces/plots, residential or commercial land)	80	119	38	153	73.8%	12.5%	13.8%	44.7%	13.2%	42.1%
Means of transportation (bicycle, motorcycle, car)	185	14	99	92	51.4%	5.9%	42.7%	91.9%	0.0%	8.1%

4.26. Role of households in decision-making around production and income generation

When respondents were asked their role in household's decision making, the majority of respondents stated that they had participated in the decision making over certain types of work/activities (Figure 29). In Burkina Faso for example, 79 respondents out of 199 stated that they had participated in wage and salary employment in the past 12 months, and 52% of them added that when the decisions were made regarding the salary employment, they were the ones who took decisions.

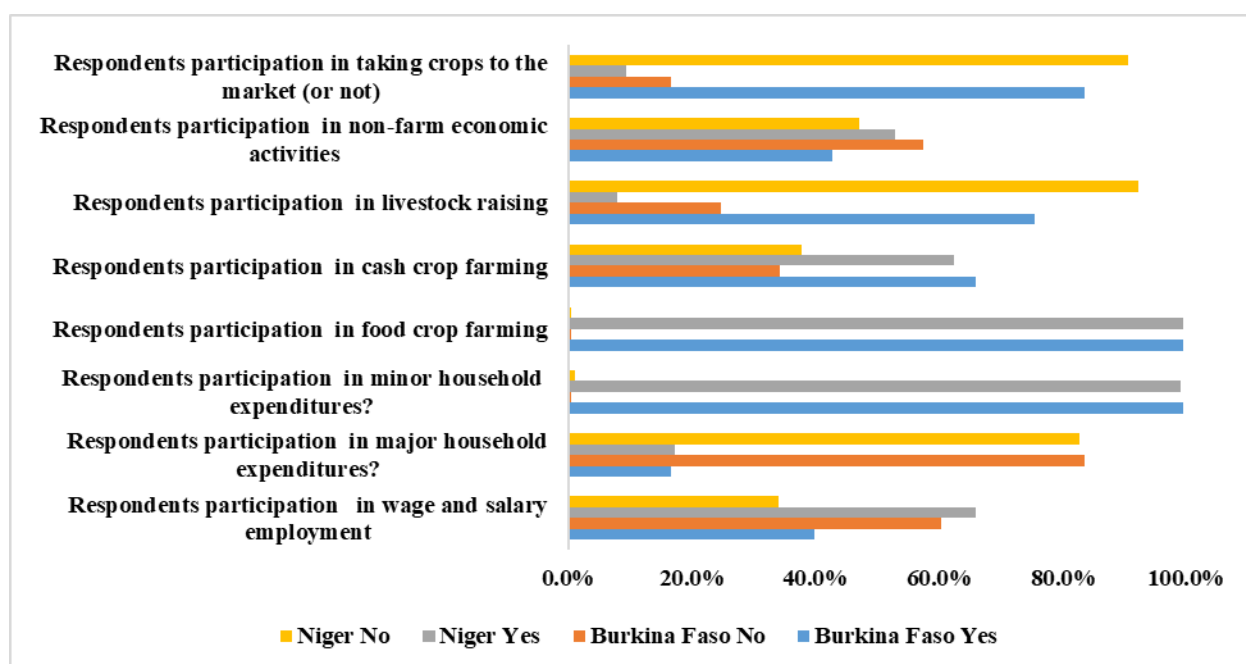


Figure 29. Respondents participation in certain types of work activities

When they evaluated their input in decisions on the use of the income generated from salary employment, about 44% revealed that they had input into most or all decisions and 41% felt that they can make their own personal decisions regarding the salary employment to a high extent. In Niger, the results indicated that people have participated more in wage and employment salary compared to Burkina Faso. In fact, 126 respondents out of 191 have participated in employment salary in the past 12 months. However, compared to Burkina Faso, they participated less in decision making over wage and salary because only 28% of them stated that they were the ones who took decisions regarding the wage and employment salary, but 47% felt that they had input into most, or all decisions on the use of income generated from wage and salary employment.

Table 45. Decision making regarding certain types of work activities

Decision over certain types of activities	Burkina Faso					Niger				
	Self	Spouse	Other HH member	Other non-HH member	NA	Self	Spouse	Other HH member	Other non-HH member	NA
Decision making regarding wage and salary employment	97	3	16	0	83	88	27	14	0	62
Decision making regarding major household expenditures?	104	0	20	0	75	54	0	5	1	130
Decision making regarding minor household expenditures?	183	0	16	0	0	168	7	12	2	2
Decision making regarding food crop farming	185	4	9	0	1	169	6	15	1	0
Decision making regarding cash crop farming	141	22	20	0	16	100	7	11	0	73
Decision making regarding livestock raising	145	1	11	0	42	128	18	33	2	10
Decision making regarding non-farm economic activities	101	6	19	0	73	80	9	12	1	89
Decision making regarding taking crops to the market (or not)	109	64	15	0	11	122	27	26	0	16

Table 46. Input in decision making regarding the use of income generated from certain type of work activities

Input in decision over certain types of activities	Burkina Faso				Niger			
	No input or input in few decision	Input in some decisions	Input into most or all decisions	No decision made	No input or input in few decision	Input in some decisions	Input into most or all decisions	No decision made
Respondent input in decisions on the use of income generated from wage and salary employment	9	28	87	75	21	36	91	43
Respondent input in decisions on the use of income generated from food crop farming	2	95	101	1	3	30	158	0
Respondent input in decisions on the use of income generated from cash crop farming	6	105	74	14	7	22	88	74
Respondent input in decisions on the use of income generated from livestock raising	11	40	111	37	7	60	114	10
Respondent input in decisions on the use of income generated from non-farm economic activities	11	38	89	61	17	23	75	76
Respondent input in decisions on the use of income generated from crop taken to the market	6	96	87	10	2	55	117	17

Table 47.Extent to which respondents feel they can make their own personal decisions regarding certain types of work activities

Activities	Burkina Faso				Niger			
	Not at all	Small extent	Medium extent	To a high extent	Not at all	Small extent	Medium extent	To a high extent
Extent to which respondents feel they can make their own decisions regarding wage and salary employment	80	9	28	82	59	26	42	64
Extent to which respondents feel they can make their own decisions regarding major household expenditures?	69	16	41	73	102	6	32	51
Extent to which respondents feel they can make their own decisions regarding manor household expenditures?	0	35	78	86	0	7	75	109
Extent to which respondents feel they can make their own decisions regarding food crop farming	1	27	76	95	0	7	60	124
Extent to which respondents feel they can make their own decisions regarding cash crop farming	16	34	79	70	79	2	29	81
Extent to which respondents feel they can make their own decisions regarding livestock raising	43	13	36	107	11	26	52	102
Extent to which respondents feel they can make their own decisions regarding non-farm economic activities	67	19	28	85	87	10	36	59
Extent to which respondents feel they can make their own decisions regarding taking crops to the market (or not)	12	30	81	76	19	23	54	95

When asked to what extent they felt they can make their own decisions regarding the activity, about 34% agreed that they would make decisions to a high extent. Table 45 give a picture of respondents' view on their role in household decision making around production and income generation. Almost all respondents in both countries stated that they had participated in food crop farming. 92% and 88%, in Burkina Faso and Niger respectively, stating that when decisions were made regarding the food crop farming, they were the ones who made the decisions. About 51% and 83% in Burkina Faso and Niger respectively reported that they had input into most, or all decisions when it came to decisions regarding the use of income generated from food crop production. 48% and 65% felt that they could make their own personal decisions to a high extent if they wanted. The results clearly show that the respondents who were mainly head of households had more to say on food crop production compared to salary employment, which they seemed to have no control over. When comparing all activities, the results indicated that the respondents who were mostly head of households participated in all type of work activities. In most cases, they were decision makers over almost all types of work. However, their contribution in decision making was less in some activities such as wage and salary employment, non-farm economic activities and major expenditures, especially in Niger. Their input into most or all decisions was higher in the use of income generated from food crop and livestock raising. Table 46 and Table 47 show respondents' feeling on their contribution to households' decision making.

4.27. Households' food security in Burkina Faso and Niger

This part presents the situation of households' Food Security in Niger and Burkina Faso aiming towards contributing to an improved understanding of access to sufficient food at the household level. The figure 30 illustrates the availability of three good meals to family members per day. When respondents were asked if all of their family members got three meals a day, 9%, 81%, 91.3 % and 84.1 % responded yes, while the remaining said no, in Centre Nord, Sahel, Maradi and Torodi regions respectively. The households that did not get three good meals per day in the Centre Nord reported that they did not have three good meals for about five days in the week before the survey. This was about three days in the other regions.

In Burkina Faso, on average households revealed that they needed about 5 and 7 kg of cereal, about 3 and 2.5 kg of legumes per day for their home consumption in Centre Nord and Sahel,

respectively. In Niger, the expressed needed quantity was low compared to Burkina Faso. 3 kg and 3.6 kg of cereals, 1.6 kg and 1.1 kg of legumes were the quantity needed by households per day for their home consumption, in Maradi and Torodi regions respectively. The results of this study showed that households had access to about 13 kg and 30 kg of rice per month during good times, and this quantity was reduced by half during bad times, in Centre Nord and Sahel regions respectively. The same tendency was reported in Niger (see the Table 49). The latter shows clearly that the quantity of food that households had access to were reduced by half in bad times. It also illustrates that households in Burkina Faso had access to high quantity of food compared to households in Niger.

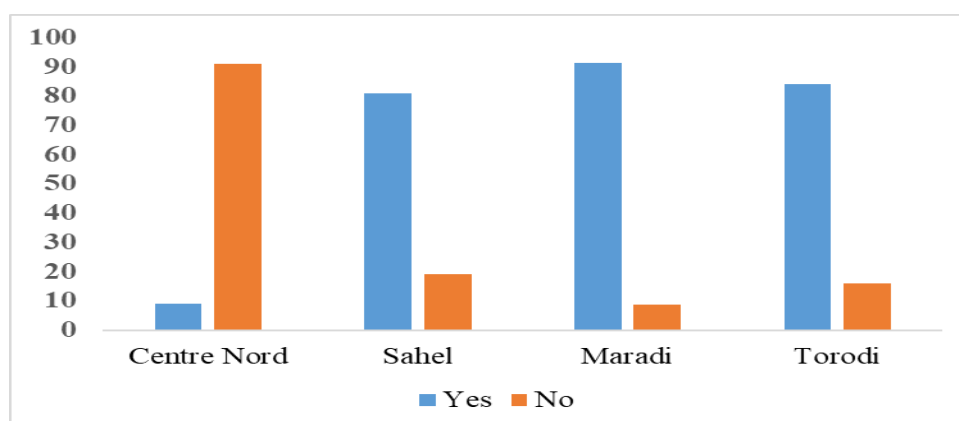


Figure 30. Households' members access to three good meals a day

From respondents perceptions of food availability, majority stated that they would define their household food availability as being normal. The Sahel region recorded the highest number of respondents who termed the food availability for their family as good. The Centre Nord recorded the lowest number.

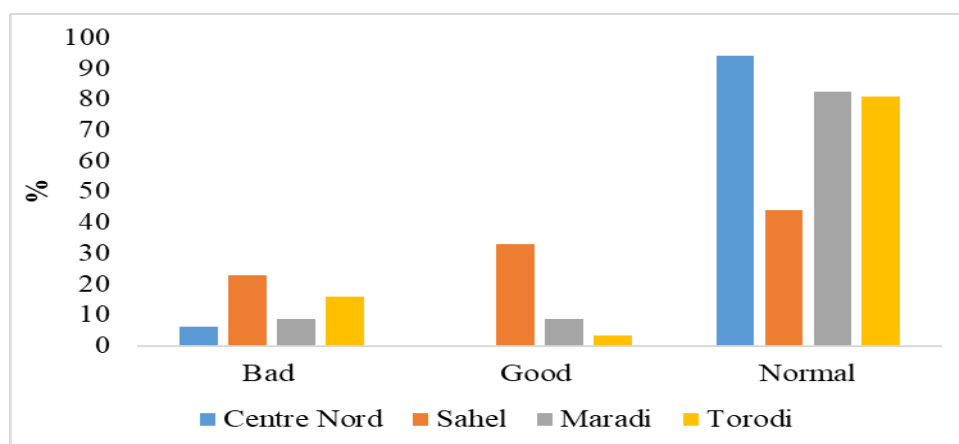


Figure 31. Food availability for households

Table 48. How much cereals/legumes do you need for your household consumption?

Country	Regions	Access to cereal/day	Access to legumes/day
Burkina Faso	Centre Nord	4.9±0.3	2.9±0.1
	Sahel	7.4±0.3	2.5±0.1
Niger	Maradi	3.1±0.1	1.6±0.1
	Torodi	3.6±0.1	1.1±0.1

Table 49. How much of cereals/ animal sourced food do you have access by month

Region	Rice		Flour		Animal sourced food	
	Good time (kg)	Bad time (kg)	Good time (kg)	Bad time (kg)	Good time (kg)	Bad time (kg)
Centre Nord	12.6±1.0	6.0±0.7	132.18±7.1	75.27±4.3	2.51±0.2	1.0±0.1
Sahel	30±1.8	14.3±0.98	150.24±5.2	87.7±2.8	3.13±0.23	1.03±0.1
Maradi	2.27±0.1	1.27±0.8	69.9±0.1	50.4±0.1	1.2±0.1	0.49±0.1
Torodi	2.6±0.1	1.5±0.06	78.8±0.1	55.5±0.1	1.17±0.1	0.5±0.1

Table 50. Diversification of type of food consumed by household

Region	Days without three good meals	Days_Consumption of milk/week	Days_Consumption of legumes/week	Days_Consumption of meat/fish/eggs?
Centre Nord	4.56±0.23	1.05±0.16	1.93±0.1	1.6±0.1
Sahel	3.3±0.48	3.86±0.25	3.8±0.34	1.46±0.14
Maradi	2.75±0.28	2.8±0.2	4.1±0.2	0.99±0.15
Torodi	2.9±0.35	1.59±0.24	3.8±0.23	0.84±0.16

For example, more than 70% of respondents stated that they had to skip a meal because there was not enough money or other resources to get food, while this percentage was less than 30 %

4.28. Households' Food insecurity experiences

This section provides information regarding the degree of severity of food insecurity among populations in Burkina Faso and Niger. The tool used was developed by FAO to track progress on reducing food insecurity and hunger. The analysis of perception of respondents on households' food insecurity presented in Table 51, shows that households in Burkina Faso, especially in the Centre Nord region experienced food insecurity more than households in Niger. Many households in Burkina Faso had a time where they were hungry but did not eat because there was not enough money or other resources for food, while this was not highly reported in Niger.

Table 51. Perception of respondents on households' food insecurity experiences scale

Household Food Insecurity	Possible responses	Centre Nord	Sahel	Maradi	Torodi
1. You were worried you would run out of food because of a lack of money or other resources?	Yes	97	91.9	58.3	72.7
	No	3	8.1	41.7	26.1
	Don't know	0	0	0	1.1
2. You were unable to eat healthy and nutritious food because of a lack of money or other resources?	Yes	95	90.9	58.3	69.3
	No	5	9.1	41.7	27.3
	Don't know	0	0	0	3.4
3. You ate only a few variety of foods because of a lack of money or other resources?	Yes	97	91.9	58.3	75.0
	No	3	8.1	41.7	21.6
	Don't know	0	0	0	3.4
4. You had to skip a meal because there was not enough money or other resources to get food?	Yes	71	83.8	30.1	25
	No	29	16.2	69.9	72.7
	Don't know	0	0	0	2.3
5. You ate less than you thought you should because of a lack of money or other resources?	Yes	97	93.9	60.2	69.3
	No	3	6.1	37.9	23.9
	Don't know	0	0	1.9	6.8
6. Your household actually ran out of food because of a lack of money or other resources?	Yes	60	46.5	35	27.3
	No	39	53.5	63.1	65.9
	Don't know	1	0	1.9	6.8
7. You were hungry but did not eat because there was not enough money or other resources for food?	Yes	87	59.6	22.3	21.6
	No	13	40.4	73.8	76.1
	Don't know	0	0	3.9	2.3
8. You went without eating for a whole day because of a lack of money or other resources?	Yes	87	2	13.6	11.4
	No	13	98	85.4	78.4
	Don't know	0	0	1	10.2

4.29. Farm Typology in the study sites

4.29.1. Farm typology in Niger

Four crop-livestock farm types were identified based on land size, family size, livestock ownership, small ruminant ownership, technology use, and animal traction use. These farm typologies were related to specific characters and agriculture practices. These farm typologies explain 80% of variability in the Niger agriculture system. The majority of farmers are represented in type 4 that represent 64% of those farmers.

Table 52. Number of person in each farm typology by sex

Group	Group Composition			Family size			
	Male	Female	Total	%	Mean \pm s.e	Min	Max
1	16	1	17	8.9	12.06 \pm 1.02	6	24
2	2	31	33	17	8.36 \pm 0.54	4	20
3	17	0	17	8.9	15.59 \pm 2.18	7	37
4	120	4	124	64.2	10.57 \pm 0.40	4	25

Type 1 represent 8.9% of farmers surveyed. The average family size was about 12 and farmers in this group have an average of 3 children getting education. The average land area of respondents belonging to this group was about 7 ha and they all used agriculture technology. In fact, most of farmers have adopted on average two technologies. They have low number of cattle, but high number of small ruminant compared to other groups. These farmers, when compared to others surveyed, had low access to credit, only 52% of them reported having accessing to credit. The monthly household living cost was determined to be 54 882 CFA. The food security of the household of individual surveyed in this group was found to be good since they all had access to three good meals a day.

Type 2 represented 17% of farmers surveyed. Farmers in this group were mostly women, and they represented female-headed households. Their average family size was low compared to other groups (8 persons). The school attendance of their children was very low compared to the school attendance from other type of farmers. The average land size was about 2 ha, the lowest from all groups. 90 % of farmers used agriculture technology and had adopted on average one technology. They had on average 3.7 cattle (TLU) and 0.9 small ruminant (TLU). These farmers, when compared to other surveyed, they had high access to credit. This can be explained by the

majority are women and are better organized to have access to credit compared to men. Their households monthly living cost was the lowest among other farmers' typology. They recorded the lowest percentage of respondents who stated having accessing to three good meals a day, which showed their vulnerability and food insecurity.

Type 3 represented 8.9% of farmers surveyed. They had big family size with high number of children getting education. Like group 1, they had big land area size, with an average of 6.7 ha and they all used agriculture technology. Farmers in this group owned high number of livestock. Their household living cost was higher compared to other group and all respondents in this group stated that they had access to three good meals a day which illustrate the level of food security in this groups.

Type 4 represented the majority of farmers surveyed (64%). Their family size was 10 and had two children getting education. The average land area owned was 3 ha, and 98% of farmers in this group stated using agriculture technology. Their ownership of livestock was similar to that of group 2. Furthermore, 69% of respondents in this group stated that they had access to credit.

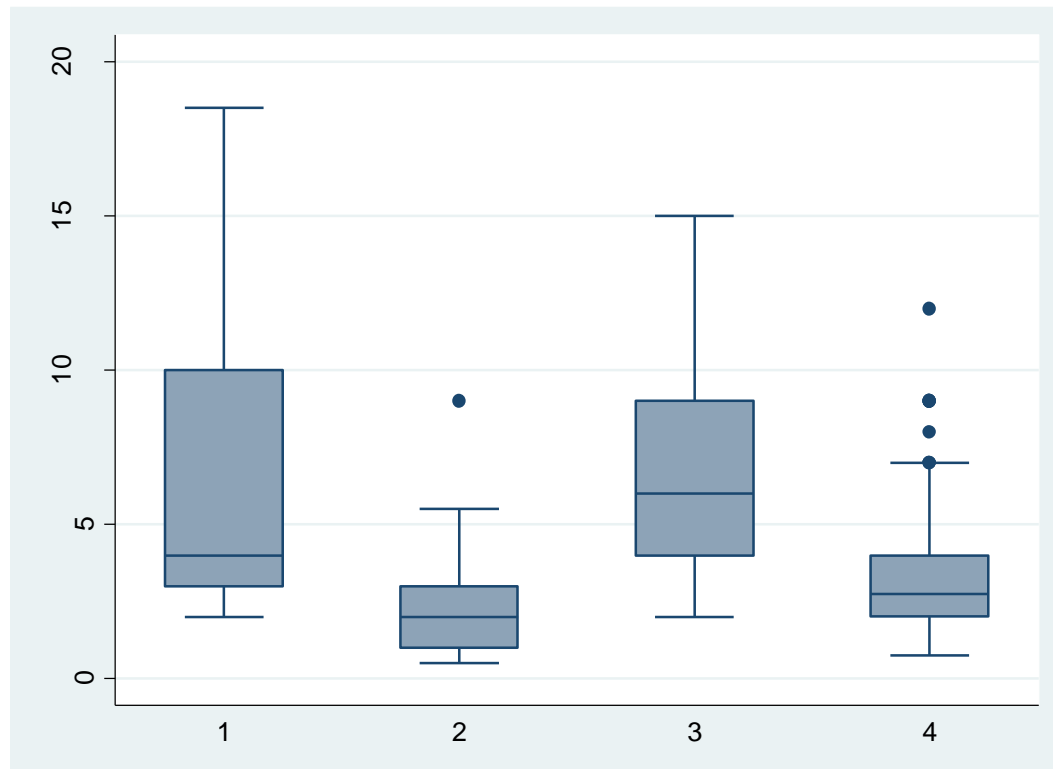
The findings from this study highlighted the importance of livestock on the wellbeing of the family. The results of this typology clearly showed that the type of farmers who owned high number of livestock, especially small ruminant had access to three meals a day, they used more agriculture technology and recorded high number of children getting education. The findings also stressed that there's a good level of organization among women which allowed them to access credit. However, women groups still experienced high vulnerability with low land size, low use of technology, low access to good meals, and low access to education of their children.

Table 53. Number of children getting education

Group	Niger
1	3.07±0.37
2	1.71±0.23
3	3.21±0.33
4	2.29±0.11

Table 54. Land size by farm typology

Group	Land size	Use of technology		Number of technology used
		No	Yes	
1	7.35±1.45	0	100	1.82±0.15
2	2.27 ±0.29	9.09	90.91	1.39±0.14
3	6.77 ±0.90	0	100	1.24±0.11
4	3.10±0.18	1.61	98.39	1.5±0.06

**Figure 32.** Land size in Niger by farm typology**Table 55.** Livestock ownership by group (TLU)

Farm typology	Type of animal	Niger
1	Cattle	1.8±0.2
	Small Ruminant	1.17±0.16
2	Cattle	3.771±0.98
	Small Ruminant	0.929±0.09
3	Cattle	13.1±2.17
	Small Ruminant	2.903±0.33
4	Cattle	3±0.30
	Small Ruminant	0.97±0.06

Table 56. Living cost of farmers by farm typology

Farm typology	Living cost/ month (CFA)	Minimum	Maximum
1	54882±4368	30000	100000
2	42030±3539	25000	123000
3	73882±13352	28000	204000
4	47483±2198	15450	153000

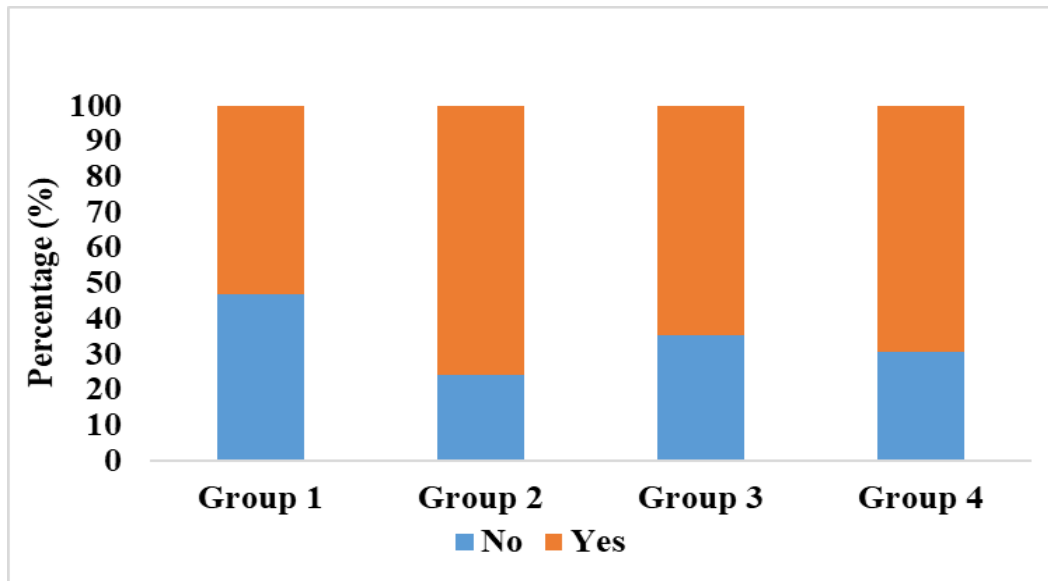


Figure 33. Access to credit by households

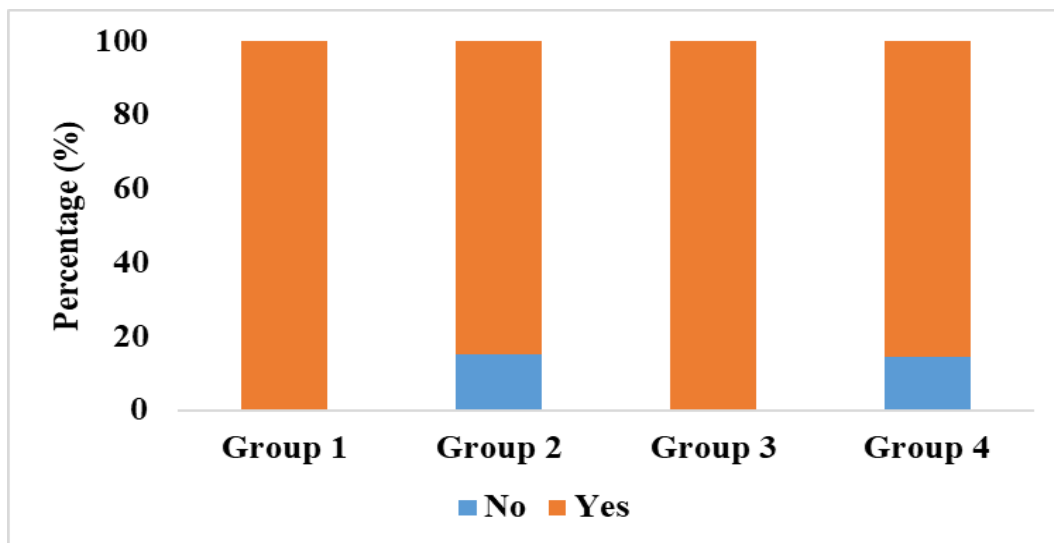


Figure 34. Accessing three good meals per day

4.29.2. Farm typology in Burkina Faso

In Burkina Faso, three farming typology were identified in this study. Type one represented 7.5%. Their average family size was about 23, the highest compared to other groups. The average land size was about 5 ha, the highest from all groups. The percentage of respondents who stated using agriculture technology was 93% and they almost used only one agriculture technology. However, they own high number of livestock compared to other groups. Also, their monthly cost of living was higher compared to other groups. They had higher number of people having access to credit. The level of their household food security was good because 80% of the persons surveyed in this group stated that they had access to three good meals a day.

Type 2 represented more than half of the farmers. Their average family size was about 10, the lowest compared to other groups. These farmers have smaller farms than group 1 and 3. The percentage of respondents who stated using agriculture technology was 88% and they almost used only one agriculture technology. They owned an average of five cattle and one small ruminant. Their monthly living cost was lower compared to the living cost of farmers in other groups. 65% of farmers in this group had access to credit, and only 54% had access to three good meals a day.

The type 3 represented 37.5 % of the farmers surveyed. Their average family size was 12 and had an average of three children going to school. The land area cultivated by this group was 4.7 ha. Farmers in this group used more agriculture technology than others. They had low access to credit and their households were food insecure because only 24 of farmers in this group had access to three good meals.

Table 57. Number of person in each farm typology

Group	Group composition				Family size		
	Male	Female	Total	%	Mean	Min	Max
1	15	0	15	7.5	23.87±3.20	9	52
2	75	35	110	55	10.15±0.53	1	32
3	72	3	75	37.5	12.76±0.70	5	34

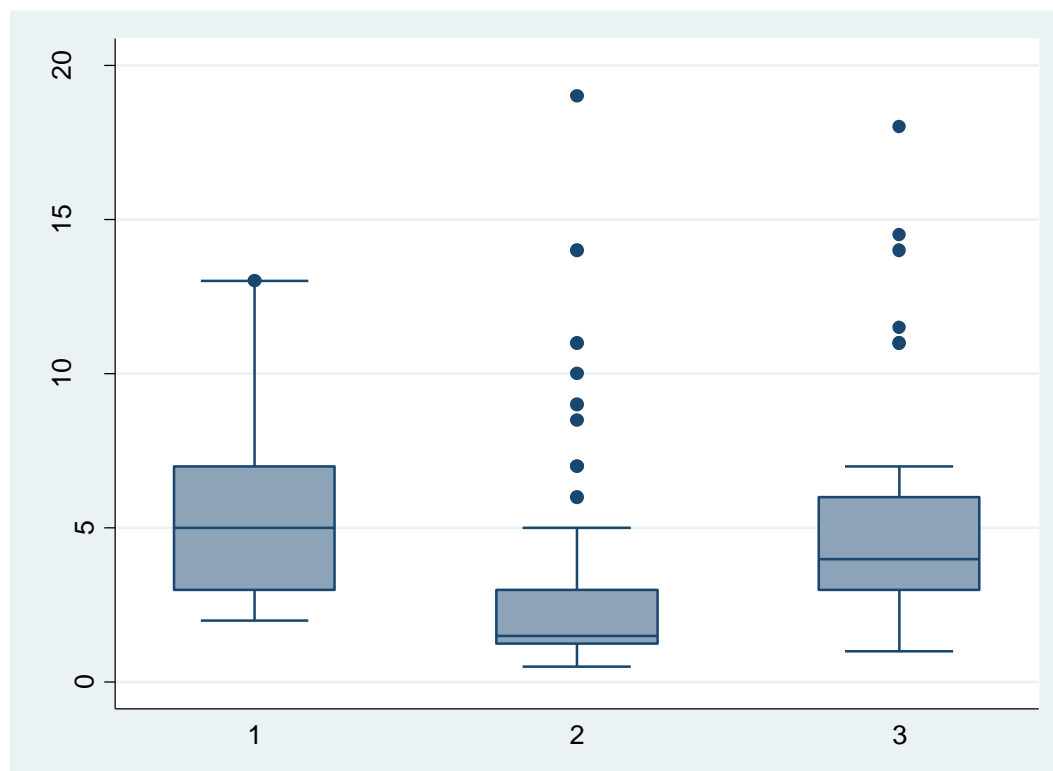


Figure 35. Land size by group in Burkina Faso (the difference is significant: $p=0.0000$)

Table 58. Number of children getting education

Group	Burkina Faso
1	3 ± 0.49
2	2.22 ± 0.12
3	3.01 ± 0.16

Table 59. Land size by farm typology

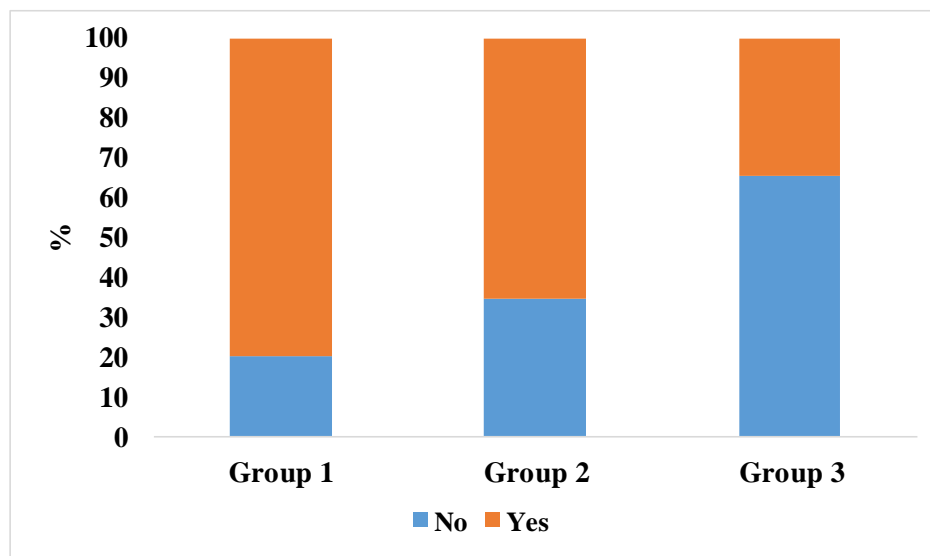
Group	Burkina Faso	Use of technology		Number of technology used
		No	Yes	
1	5.4 ± 0.86	6.67	93.33	1.33 ± 0.19
2	2.58 ± 0.26	11.82	88.18	1.09 ± 0.06
3	4.76 ± 0.35	1.33	98.67	2.04 ± 0.09

Table 60. Livestock number by groups (TLU)

Farm typology	Type of animal	Burkina Faso
1	Cattle	25.957±4.81
	Small Ruminant	4.23±0.41
	Donkey	0.68±0.12
2	Cattle	5.65±0.81
	Small Ruminant	1.07±0.06
	Donkey	0.49±0.04
3	Cattle	4.37±0.81
	Small Ruminant	1.49±0.10
	Donkey	0.57±0.04

Table 61. Households living cost/month

Farm typology	Living cost/ month (CFA)	Minimum	Maximum
1	132231±39831	25000	575000
2	58511±3830	15000	235000
3	97418±10660	20000	725000

**Figure 36.** Access to credit

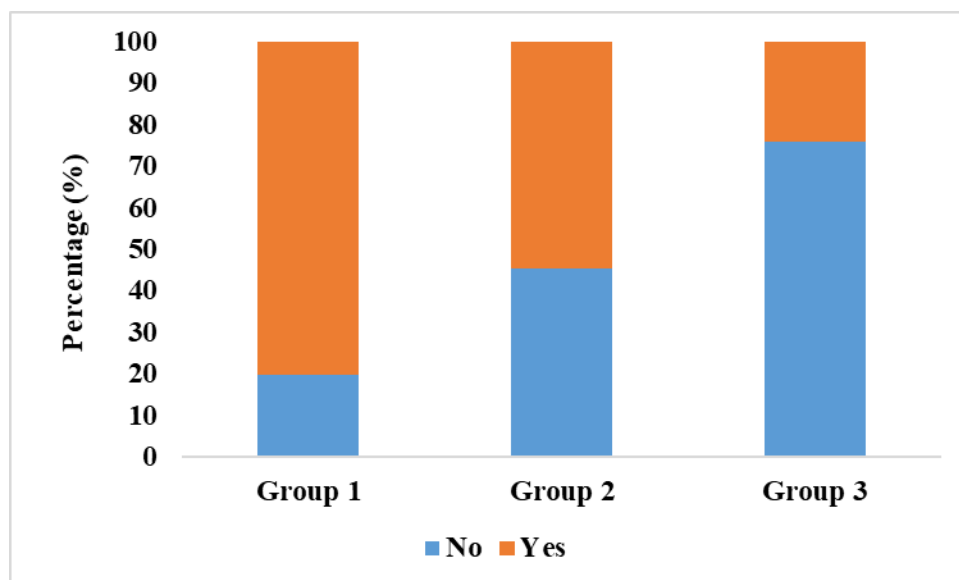


Figure 37. Access to three good meals/day

4.30. Mains constraints of crop and livestock production system in Niger and Burkina Faso

In Niger, the findings of this study revealed that lack of improved seed, low access to animal traction and agriculture equipment were the common constraints of crop production in both Maradi and Torodi regions. Low productivity, low availability of labour, poor distribution of rainfall and weeds in field crops were listed among other common problems in Torodi while in Maradi farmers also stated lack of farmers' organization and poor soil fertility. The poor soil was caused by overexploitation of land and the lack of practice of fallowing land due to land shortage. The livestock production was constrained by the problem of feed shortage, invasion of pasture areas by weeds, animal diseases and high mortality and low support from livestock extension officers. Farmers were also confronted by the problem of low technical capacity in fodder production and conservation. Table 62 provides an overview of constraint of crop and livestock systems in Niger.

In Burkina Faso, the main constraints of crop production reported by farmers were lack of rain, poor quality of soil, plant pest and diseases and low use of agriculture equipment. Low access to market was a problem reported at Sampelga but not at Korsimoro. At Korsimoro, farmers were facing also the problem of insufficient animals for traction. A high demand of animal traction was reported in this area. Water is becoming a huge constraint to crop and livestock production

in Niger and Burkina Faso. The problem of water has been reported in many agriculture system as a bottleneck (Herrero et al., 2010).

Table 62. Constraints of crop and livestock systems in Niger

Constraints in crop production	Constraints in livestock production/fodder	Constraints in fodder conservation and utilization
Torodi		
Low availability of labour	Low technical skills in livestock management	Low technical skills in conservation of fodder
Low productivity	Animal diseases with high mortality rate	Low capacity in the smart use of feed and good knowledge in animal feeding
Irregularity and poor distribution of rains	Lack of grazing and shortage of feed	
Weeds like striga	Water for animals	
Lack of improved varieties	Low access to veterinary products and services	
Low use of mechanization in agriculture activities		
Low access to agriculture equipment		
Lack of bullock		
Low accessibility to phyto sanitary products		
Crop diseases		
Maradi		
Problem of inputs (fertilizer, improved seed, etc.)	Lack or low access to livestock feeds	Reduction of feed quality due to inappropriate conservation techniques
High price of improved seed	Presence of weeds in grazing area	
Damage to growing crop by insect pests	Lack of veterinary products	
Lack of farmers organization for selling their produce and legumes residues	Lack of good livestock equipment	
Low price of crop produce	Lack of organization of livestock farmers	
Low access to animal attraction	Low technical skills in livestock management	
Poor soil and poor soil fertility	Lack of expertise from livestock extension services	
	Insufficient of livestock extension service	
	Low availability of agro –industrial feed	

Table 63. Constraints in Burkina Faso

Constraints in crop production	Constraints in livestock and fodder production	Constraints in feed conservation and utilization
Sampelga, Dori		
Lack of rain	Lack of water for animals	Constraints in storage of residues
Damage caused by birds in the field crops	Shortage of grazing area and shortage of feed	Attack of stored feed by termites insects
Plant pest and diseases	High mortality rate of animals	Inappropriate techniques of feed storage
Low access to market (market are located so far, lack of buyers, etc.)	Bad conditions of transport for livestock	Loss in feed quality due to bad conditions of feed storage
Low price of crop produces	Limited market	
Low use of agriculture equipment	Low price of animals	
Poor quality of soil	High price of animal feeds	
Weeds	Low technical skills in production of fodder	
Korsimoro, Kaya		
Low price of crop produces	Attack of stored feed by termites	Problem of fodder storage (inappropriate storage conditions)
Lack of rain	Animal diseases	Lack of fodder bank
Plant pest	Shortage in grazing area/feed	
Insufficient of manure	High price of feed	
High demand of animal traction	Low price of milk	
Insufficient of animal traction	Lack of improved breed	
Low availability of labour for agriculture activity	Low access to market	
Low productivity	Shortage of land for the fodder production	
Difficult access to fertilizer	Problem in livestock services delivery	
High price of fertilizer	Low price of animals	
Lack of agriculture equipment	Problem of water for animals	
Price instability in the market		
Soil degradation and low fertility of soils		
Crop damage by livestock		
Lack of improved varieties		

4.31. Perception of respondents on possible interventions to enhance resilience and profitability of their farming systems

Table 61 shows the main possible interventions suggested by respondents to enhance the resilience and profitability of crop and livestock system. As it is shown in Maradi, 49 respondents out of 103 surveyed thought improving access to market and organization of livestock producers is a key to enhance the livestock system while in Torodi facilitate access to supplement (price, availability, etc.) and support in fodder production were seen by 35 and 32 of respondents out of 88, respectively as way to boost livestock productivity. Again, this is to highlight the problem of feed at Torodi. In Burkina Faso, on the other hand, specifically in the Centre Nord region respondents thought that facilitate access to credit to engage in livestock business (32/100), linkage to external market (32/100) and organization of livestock producers (30/100) will enhance the livestock system. At Sempelga, the main interventions suggested by respondents to boost livestock system were facilitating access to market through organization of livestock farmers (56/100), improve delivery of veterinary services (43/100) and support in fodder production (82/100). Generally, in all study sites, organization of livestock farmers and improve access to fodder are prerequisite to enhance the profitability of livestock system. Also, market development will be essential to create systems of incentives and reduce transaction costs.

In all study sites, facilitating access to animal traction/ cart/plow/bullock and farm equipment were possible interventions suggested by respondents to improve crop production system. In fact, the use of animal power at this stage can alleviate labor shortages, improve the quality and timeliness of farming operations, and increase farm productivity (in collaboration with the findings of Timothy et al., 2015). Herrero et al. (2010) study suggested that yields of dryland crops such as sorghum, millet, groundnut, and cowpea could easily be increased by a factor of three with appropriate land preparation, timing of planting, and use of fertilizers and pesticides. Improving access to water for crop, livestock and horticulture was reported by many respondents as a way to enhance resilience and profitability of farming system in Niger and Burkina Faso. Table 64 indicate the suggestion of respondents on possible intervention to enhance resilience and profitability of farming system in Niger and Burkina Faso.

Table 64. Possible interventions to enhance resilience and profitability of farming system in Niger and Burkina Faso

Variable	Maradi (N=103)	Torodi (N=88)	CN (N=100)	Sahel (N=100)
Crop production				
Training on agriculture techniques/soil conservation technique	26	17	1	17
Introduction of the use of equipment/machinery (facilitate access)	18	26	1	67
Facilitate access to improved seed	31	19	16	60
Facilitate access to input (manure, compost, pesticide, etc.)	16	16	2	6
Facilitate access to fertilizer and delivery in time	26	17	6	23
Introduction of new technology / facilitate adoption	11	11	0	12
Improving access to water for agriculture activities (dam, etc.), construction of water retention in the field	0	0	0	19
Provision of financial support/facilitate access to finance support	0	2	0	2
Facilitate access to animal traction	0	0	1	4
Livestock production				
Facilitate access to credit to engage in livestock	0	1	32	0
Support in getting animal for rearing	3	5	0	12
Facilitate access to supplement (price, availability, etc.)	25	35	16	18
Construction of fence	0	0	2	0
Support in fodder production (seed, training, capacity building in fodder conservation etc.)	39	32	12	82
Restoration of grazing area	3	9	13	1
Improve delivery of veterinary services	18	34	4	43
Improve access to water for livestock (construction of watering points, etc.)	1	2	0	28
Introduction of improved animal breed	20	10	2	8
Training in livestock (management, feeding, etc.)	37	13	14	0
Facilitate access to information about market	13	5	1	1
Linkage to external market	0	0	32	1
Development of feed market	1	0	0	5
Market access/Organization of livestock farmers to market their animals	49	28	30	56
Provision of finance support to livestock traders	0	17	0	18
Training on livestock marketing	11	5	0	1
Horticulture				
Encourage farmers to plant horticulture tree	38	27	73	54
Provision of training to farmers on horticulture	41	27	2	0
Facilitate access to water for horticulture through creation of dam	0	3	0	22
Support in construction of fence	0	22	3	0
Farm machinery/animal traction				
Facilitate access to farm machinery (tractor, etc.)	39	24	48	91
Training on the use of farm machinery	34	33	0	1
Facilitate access to cart/plow/bullock	70	72	66	100

Facilitate access to milling machine	0	0	0	8
Facilitate access to animal traction	40	10	8	43
Training on the use of farm machinery/animal traction	25	15	0	0
Marketing crop				
Improve road conditions	0	1	1	28
Find external market	0	0	48	9
Improve marketing strategy	42	30	1	3
Provide training on marketing	28	5	0	0
Support for the construction of stores	0	10	0	15
Provide finance support / access to credit	0	5	1	18
Provide market information	2	5	0	1
Stabilize the market price for crop produces	0	0	14	0
Water/soil				
Construction of dam	18	31	0	81
Construction of well	57	39	0	0
Capacity building on soil and water conservation technique	23	18	96	40
Construction of forage	8	10	0	15

5. Conclusion and recommendations

Based on the empirical findings through field survey and personal interview, the following conclusions and recommendations can be made:

- The involvement of youth in farming activities is still very low, so strategies to increase youth involvement in agriculture should be developed. Increased involvement of youth in agricultural activities will help reduce the problems of the aging farm population and increasing youth unemployment;
- Farmers participation in farmers' organizations is very low, which explains the lack of organization in performing activities in agriculture value chains. Enhancing the capacity of farmers to organize themselves and promote their products should boost the Agriculture value chain. There is a need to develop the capacity of farmers in the management of farmers' organizations to ensure their sustainability;
- This study revealed that women are more organized in self-help groups than men. Supporting these women groups should be necessary to improve their participation in crop and livestock the value chains;

- The productivity of main crops grown is very low, especially in Niger. This can be associated with low use of inputs and technologies in the project sites, therefore farmers should be encouraged to use more agriculture technologies and access to these technologies should be facilitated;
- The main utilizations of crop residues were feeding animals and using them as organic fertilizers in the field. However, a big quantity of residues is lost due to lack of skills, bad storage conditions and inappropriate use of residues. Farmers should be encouraged to utilize their crop residues efficiently. Farmers should also be trained in appropriate feeding strategies.
- There is huge opportunity to develop feed market, especially in Niger. Supporting farmers in engaging in feed business should be a way to boost livestock productivity since the main constraint for livestock is lack of quality feed.
- There is a very big gap, especially in Burkina Faso, between farmers and extension officers. Infrastructure and other support facilities should be developed to facilitate the extension officers to be able to reach farmers.
- Farmers should be provided with adequate information and training through various institutions and extensions agents.
- Agriculture and livestock product processing is still very low, training producers in value addition and food processing techniques is mandatory for the development of crop and livestock value chains.

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