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AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
SCHOLARLY, PEER REVIEWED
Volume 24 No. 1
January 2024
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Afr. J. Food Agric. Nutr. Dev. 2024; 24(1): 25333-25352 https://doi.org/10.18697/ajfand.126.23390

CHARACTERISING FAMILY FARMS AND THEIR CONSTRAINTS AND AGROECOLOGICAL INTENSIFICATION OPTIONS: A CASE STUDY FROM THE SAHELIAN ZONE, NIGER

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ABSTRACT

Family farms play an important role in food security and nutrition in West Africa. Family farms are rapidly changing and face many constraints. Thus, characterizing them is necessary for policy purposes. This study aimed to characterise family farms in Niger, focusing on the current constraints to family farms and existing agroecological intensification (AEI) options. A survey was conducted using a questionnaire administered to 108 family farms across the selected six study locations. We used descriptive statistics to characterise the family farms and the factorial analysis of mixed data (FAMD) and the Hierarchical Clustering of Principal Components (HCPC) to identify the types of family farms. Results showed that family farms, on average, encompass three households, and the majority (87.2%) of the family farms surveyed were managed by married persons where 25.7% of whom are female. Agriculture remains the primary source of income for 98.2% of people in the study locations, and the main second source of family income (47.7%) is animal husbandry. Family farms are mainly characterised by the presence of the main field (MF) (98%) led by the heads of households and the presence of the women fields (WF) (78%) led by the women. Regarding farm size, the average MF and the WF farm sizes were 3.0 ha and 1.5 ha, respectively. The main identified constraints to family farms were soil fertility decline (84.33%), a recurrent early end of the rainy season (84.33%), farmers' low income (41.15%), and limited access to the market (24.70%). Twelve potential AEIs options across the study area were explored. In the MF, the major AEI options practised by farmers were: the application of organic manure as fertilizer (73.27%), cereal-legume intercropping (68.83%), and Farmer Managed Natural Regeneration (35.85%). Whereas in the WF, the AEI practices were the application of organic manure (55.28%), and cereal-legume intercropping (28.98%). Co-building an integrative approach that combines multiple AEI options in the same field is necessary to tackle the main drivers of the farming systems.

Key words: Family farms, Agroecological intensification, diversity, farm typology, Niger

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INTRODUCTION

Family farms in the Sahelian zone account for more than 90% of land holdings, use 53% of agricultural land, and produce more than 50% of the region's agricultural output[1, 2]. In sub–Saharan Africa, about 90% of the family farms are smaller than 5 ha, and these represent the majority of the farmland [3]. Besides producing food and animal feed, family farms play a more significant role in maintaining social cohesion and offering health care services for members and beyond [4]. However, family farming systems face many constraints in sub–Saharan Africa. For example, the soils in the Sahel region have poor fertility [5], which remain a major constraint to food security, and sustainability of smallholder agriculture in West Africa [6, 7, 8]. Additionally, the hybrid character of the rainy seasons, including extreme rainfall breaks, wrong onsets and early offset of the seasons cause tremendous risks for rainfed agriculture in the family farming systems of the Sahel [8-10]. The poor performance of many family farms from the socio-economic standpoint resulted in limited access to markets, coupled with low income, the presence of incoherent policies, and insufficient rights to access resources, particularly for women [3, 4, 11, 12].

Several studies highlighted the potential benefits of farm typologies and modelling to tailor promising sustainable intensification options, to identify recommendation domains for farmers, and to enhance innovation processes [13-18]. However, very few studies if any, in the context of the agroecological zones of the Niger Republic have been reported, let alone characterizing the family farms as a baseline study intended to tailor specific management practices as strategic interventions. This paper characterizes family farms focusing on resource endowment, identifying specific key drivers for high productivity of farming systems, and explores the AEI options as potential opportunities of family farms. The hypothesis is that family farms are characterized by the presence of the female field (WF) and the main field (MF) led by the male head of the family.

MATERIALS AND METHODS

Study area

The study was conducted from November to December 2022 across three regions of Dosso, Maradi, and Tillaberi in Niger (1° 42' 40" E to 8° 23' 30" E and 12°52'50" N to 18° 13'30" N). The climate of the study area is generally classified as semi-arid tropical with a long dry season (November to May), followed by a single rainy season (from June to October). Annual rainfall ranges from 300mm in the northern part to 800mm in the Southern part of the study area. The following three

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geomorphological units characterize the study area, namely, lateritic plateaus, sandy hillslopes and valley bottoms. The soils across the study area are sandy, very deep reddish and well-drained [19]. The study area is characterised by smallholder family crop farming practices and animal husbandry.

Study location sampling

A two-stage sampling procedure was used to select the study area, and family farms for each location. The number of the selected family farms was balanced based on the intervention zones of the CowpeaSquare project, and the affiliation status of the village to one of the two farmers' federations (FUMA Gaskiya in Maradi and MOORIBEN in Dosso and Tillaberi). CowpeaSquare is a research project that enhances cowpea varietal diversity and the set of technical practices available to fit farmers' needs of cowpea production (grain, pod) and processing (food, fodder) in a contextualized manner at selected locations in Niger and Burkina Faso [20]. Six villages were selected. Three in the Maradi region affiliated with FUMA (Gade Iya, Saye Sabuwa and Tchake), two villages in Dosso region (Kaboye Koira and Karakara) and one village in Tillabery (Zebane Fiti) all affiliated with MOORIBEN (Fig.1).

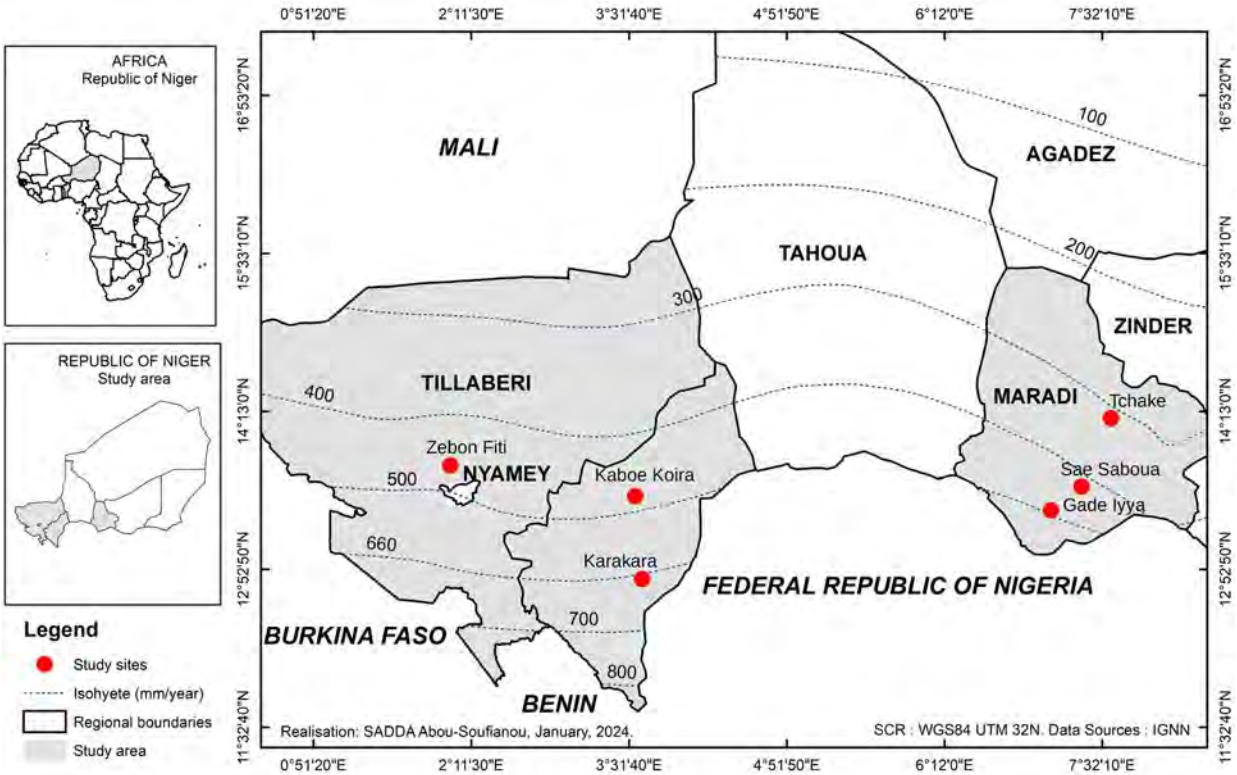

Figure 1: Location of the study sites

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These villages also covered a north to south ecological gradient (the north being more arid). The selection of the respondents was done based on their willingness to participate. These respondents include men and women, without applying a particular quota but remaining as inclusive as possible. The voluntary respondents were 20 farmers per village except for the village of Gade Iya, where only 10 farmers were surveyed because of time constraint during the fieldwork, and 18 farmers in Karakara because of the unavailability of the key respondents to complete the 20 farmers. Farmers were randomly selected from each village based on the lists of the farm members obtained from the two farmers' federations. The questionnaire was administered to 108 family farms.

Questionnaire development and data collection

The baseline survey was carried out in the six selected villages between November and December 2021. There were three parts to the questionnaire used to collect the data for the study. The first part of the questionnaire was on the general information on the household The second part of the questionnaire collected data on family farms characterization, including source of income (main and second activities), household composition, the presence or absence of the main field ("Gandou") led by the head, as well as the presence or absence of the field led by a female in the family, the agricultural land owned by the household, its location in relation to the household's concession, farm size, farming activities and livestock size. The third part of the questionnaire focused on farmers perceived key drivers hindering agricultural production in the family farms and the existing AEI options to enhance crop productivity. In total, the questionnaire encompassed twenty-nine questions and forty-five minutes were the average time of completion with each respondent.

Statistical analysis

Descriptive statistical analysis with Epidisplay and Psych R package combined with the FAMD (Factor analysis for the mixed data) [27] was used to characterise family farms and to identify the key drivers of family farms and the main agroecological intensification options that farmers considered as adaptation measures. Descriptive statistics enabled to generate means, proportions and or frequencies for the qualitative data. FAMD was used to cluster the family farms based on qualitative and quantitative variables. The missMDA method (R package missMDA) was used to imputate this missing information among the 108 observations as a prediction based on the multivariate data. Hierarchical Clustering on Principle Components (HCPC) was used to describe the distinguished clusters (R packages FactoMineR and factoextra) of family farms.

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RESULTS AND DISCUSSION

Family farms characteristics with focus on farming activities and resources endowment

Table.1 and Table.2 show the characteristics of the family farms based on farming activities and resources endowment.

The average age of the surveyed individuals of the family farms across the study location was 47 years old, in the range of 17 years old to 78 years old (Table.1). Most (87.2%) of the surveyed individuals of the family farms were married, the majority (74.3%) being male (Table.2). Agriculture (crop production) was the main source of income for 98.2 % in the family farms.

Fig.2 shows the second sources of income in the family farm. Animal husbandry (47.7%) was the second source of income for members of the family farms, with an average of two cattle per family (Table.1). The number of goats and sheep averaged 4 and 3, respectively (Table.1).

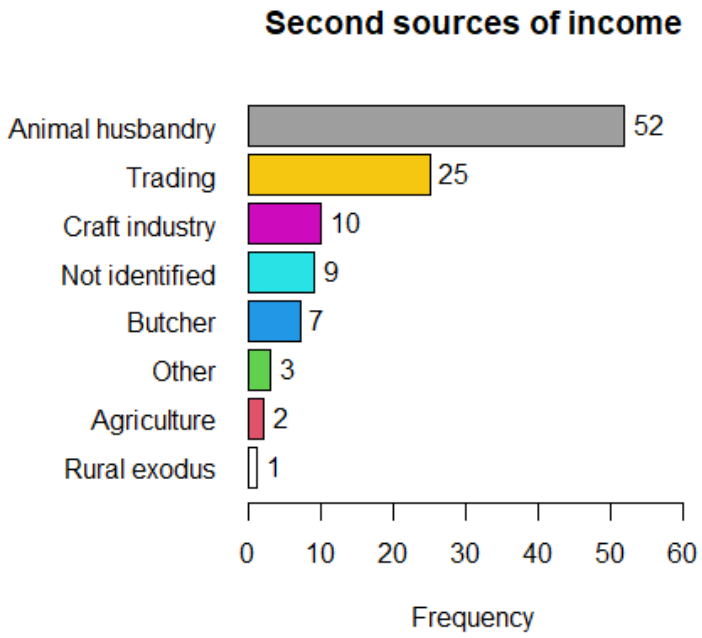

Figure 2: Second sources of income in the family farms

The results showed also that the family farms were also characterized by the presence of the main field headed by the chief of the household in the family farm (98.7%) and other fields in the family farms led by women (78.9%). For the size of the two fields (MF and WF), the MF averaged a size of 3.0 ha and 0.5 ha as the

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least farm size, while the average size of the WF was 1.5 ha with the least farm size also as 0.5 ha.

Key identified drivers hindering crop productivity in the family farms

The three factors (drivers) that limit crop productivity in the family farms are categorised as (i) soil constraints, (ii) rainfall uncertainties and (iii) socio-economic drivers. These are presented in the Table.3, Table.4 and Table.5, respectively.

Farmers indicated low soil fertility as the main soil constraints (84.33%) followed by wind erosion (14.8%), and water erosion (13.73%) (Table.3).

Table 4 shows the rainfall uncertainties which are characterized by i) increase in the frequency of dry spells, ii) increase in flooding frequency, iii) late onset of the raining season, iv) recurrent early cessation of the rainy season, and v), decrease in the rainfall amount. Among those factors, recurrent early cessation of the rainy season (84%) was considered by farmers as the main factor limiting crop productivity.

Finally, Table 5 shows the main socio-economic drivers affecting the family farms. Farmers identified farmers' low purchasing capacity (41.15%) and limited access to the market (24.70%) as the main socio-economic drivers.

Potential options for agroecological intensification explored in the family farms

Table 6 and Table 7 show the identified AEI options in the MF and WF of the family farms, respectively. In total, 12 potential AEI were identified in the family farms on each of the two types of fields.

In the main fields, farmers mainly practiced cereale-legume intercropping (68.83%), organic manure (73.27%) as soil fertility management technics, the FMNR (35.85 %), the use of compost (29.22%) and the mineral fertilizer application technique (29.18%) (Table 6).

While in the fields led by female, they similarly use organic manure (55.28%), practice cereale-legume intercropping (28.98%), and apply micro-dosing mineral fertilization (13.28%) as soil fertility management technics (Table 7).

Overall, the main AEI options practiced in the family farms in both the field types were the intercropping of cereal-legume, the organic manuring application, the mineral fertilizer technique, the FMNR as well as the use of compost. However, in the fields led by women, most of them practice the mixed cropping system as they cultivate many cash crop species unlike the men who often cultivate the main crops for subsistence of the entire household.

Inferring the described characteristics of the family farms with farm typology

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Data on resources endowment and key drivers of family farms, the presence of both main fields and fields led by women and AEI options practiced on both fields were used to infer the family farm typology based on multivariate clustering. The typology allows to infer the characteristics of the family farms that we have already described with descriptive statistics. Two clusters: type 1(n=67 farms) and type 2 (n=41 farms) were identified based on social factors, farms resource endowment and characteristics (livestock, main and second occupation, presence of both main fields and fields led by the female in the family farms).

Fig.4a-b show the discriminant variables that distinguished these two types of family farms shown in Fig.3. Three to four components appear to be the most discriminant: livestock availability, second source of income, the presence of both main fields and the fields led by women as well as the number of fields owned by household.

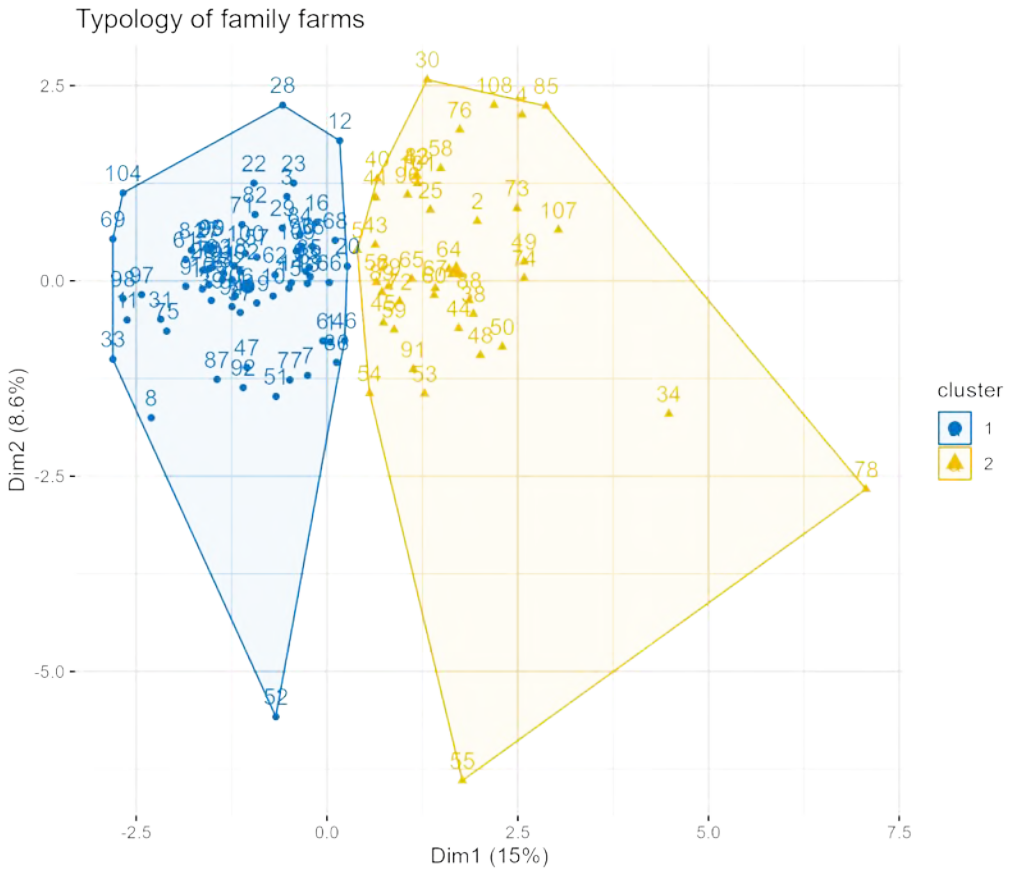

Figure 3: Representation of the family farms types based on hierarchical clustering in the Sahelian farming systems of Niger

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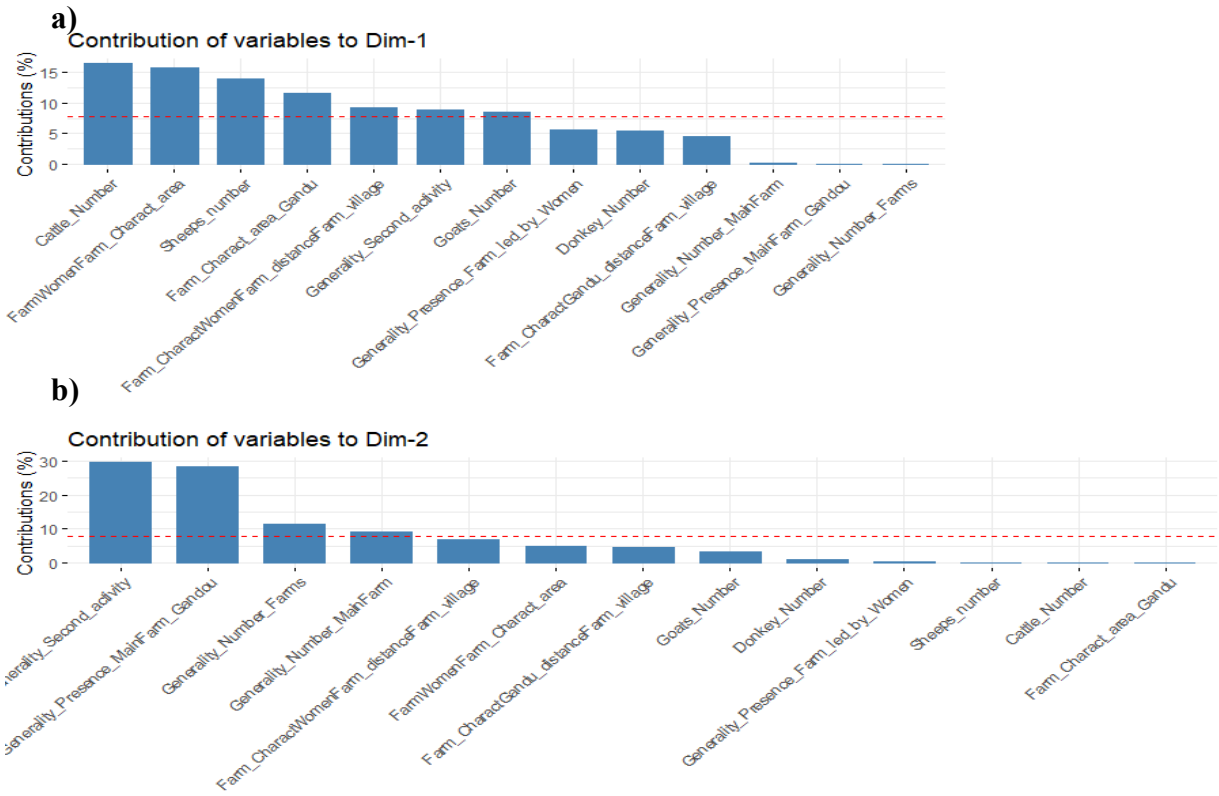

Figure 4: Representation of the variable contributions to the principal component analysis. The red dashed line indicates the expected average contribution (100% contribution divided by the total number of variables available in the datasets)

The information in the Table 8 combined with the Fig.5 and Fig.6 cand allow us to describe the two types of family farms distinguished by the principal component analysis and the hierarchical clustering shown in Fig.3:

- Family farms are characterized by the presence of both the main field (MF) named as “Gandu”: The number of farms led by the head of the family farm are 66 (over 67) in type 1 farms' cluster and 41 (over 41) in type 2 cluster. Both clusters are also characterized by the presence of fields led by women (WF): 48 in cluster 1 (over 67 farms) and 37in cluster 2 (over 41 farms), respectively.
- Type 2 farmers have larger size of cultivated area of the MF than the type 1 farmers with 6.49 and 2.69 ha, respectively. Similar trend was also observed with respect to the size of the WF where, the area of the WF of the type 2 farms and the type 1 farms was 2.54 ha and 1.09 ha, respectively. This average size indicates that smallholder farmers of the type 1 farms face much more land pressure than the farmers of the type 2 farms.

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- For the livestock availability in the family farms, type 2 farms have higher number of cattle, goats and sheep than the type 1 farms. However, the type 1 farmers practiced much more animal husbandry as a second occupation than the type 2 farmers with 44 and 15 family farms, respectively. Whereas the type 2 farms have more butcher than the type 1 with 6 and 1, respectively.

The type 2 farmers are wealthier and more active than the type 1 farmers as result of their livestock density and the size of their cultivated land within their family farms. Nevertheless, the type 1 has higher number of both MF and WF, which indicates that women have more access to cultivated land than in the type 2.

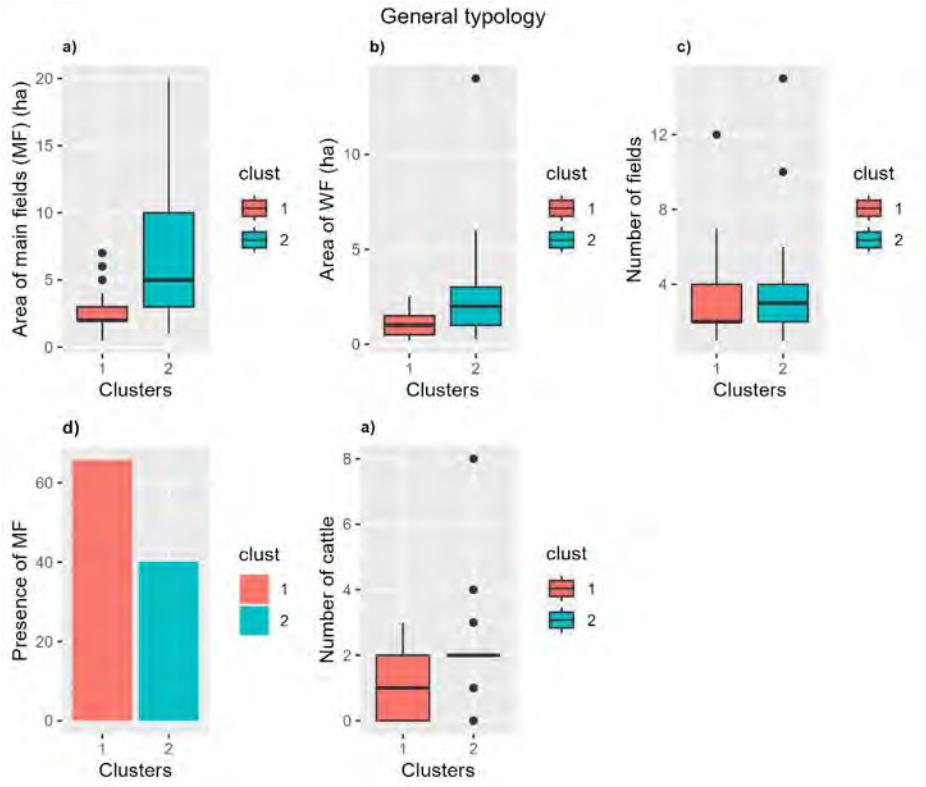

Figure 5: Proportion of the existence of both MF and WF and their size in the identified two types of farms
a) represents the size of the main fields present in the farm type,
b) the size of the fields led by women that exist in the family farms,
c) the number of fields owned by farmers,
d) the relative frequency of the family farms that have fields headed by the chief of the family farms, and
e) the relative frequency of family farms that have fields led by women

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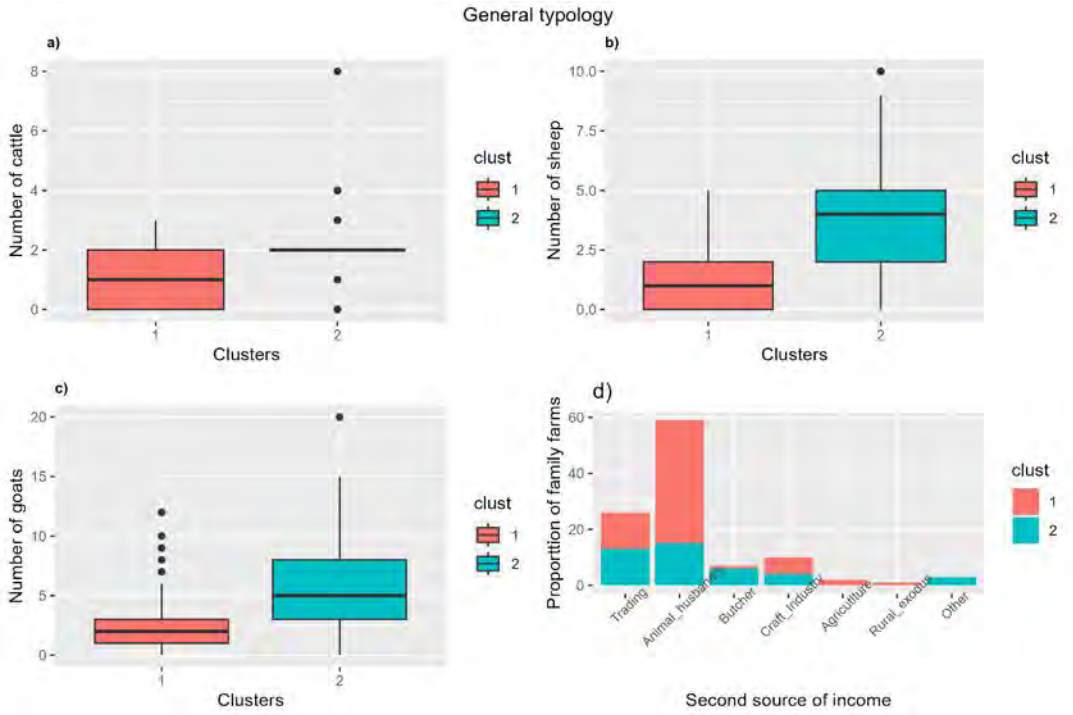

Figure 6: Livestock availability and second source of income of the smallholder farmers in the identified types of farms
a) represents the number of cattle owned by farmers in the family farms,
b) the number of sheep,
c) the number of goats, and
d) the second occupation of farmers in the family farms

The results of the study show that the surveyed individuals in the family farm were young with an average age of 47 years, including 74.3% male and 25.7% female with 87.2% of the members being married. These results are consistent with the last census carried out by the government of Niger, which indicated that the majority of the Nigerien population are young and the proportions of family farms led by male and female were 93.4% and 6.6%, respectively [21]. Additionally, the main activity on family farms is agriculture (98.2%), which the main source of income. The results of this study further revealed that the second major source of income of the family farms members was animal husbandry, and the average number of livestock per family farm was two cattle, four goats and three sheep. This indicates that animal husbandry plays a key role in improving livelihood of the households of the family farms. This result is in line with that of Mutaqin [22] who showed that smallholder farmers (crop producers) also rear animals by diversifying their economic activities as a coping strategy to sustain livelihoods, and minimize the adverse impacts of climate change. Similarly, Rabe *et al.* [23] found that family farms in the Centre-South of Niger practice poultry (40.2%) and small ruminants

rearing (48.9%) to sustain their livelihoods. Additionally, in Niger, Mutaqin [22] pointed out that the main reason why animal husbandry is practiced as part of the family farming system is because of its capacity to generate income by means of selling the livestock and used as animal protein sources from meat and milk, and to produce animal hide rugs. This study showed that the surveyed individuals in the family farm also used the manure from their livestock as the main source of organic fertilizer to increase crop productivity on their farms and use the animals as means of transportation. Thus, animal husbandry can significantly improve the nutritional quality of the diets of farming families, and healthy nutrition also signifies poverty reduction through improved productivity and competitiveness of individuals in the labour market [24].

The results of this study also showed that family farms are characterized by the presence of the main field and the field led by the female, mostly the spouses of the heads of household. The presence of the field managed specifically by female (78.9%) shows that women significantly contribute to increasing crop yield and improving livelihoods in the family farms. This indicates an acceptable level of women access to agricultural land in the study area especially in the Centre-South of Niger. Bocoum *et al.* [24] found that women provide a significant amount of labour input at only 27% in crop production in Niger. Moreover, Hansen *et al.* [25] showed that women contribute to about 43% of the agricultural labour force globally and in developing countries. The FAO report on the international year of the family farms highlighted that woman operates family farms on average only one-half to two-thirds the size of family farms operated by men across sub-Saharan African countries [9]. Further, in most of the family farms, the fields led by the women are often located near the village and are more diverse concerning the cultivation of more crop species than the main field. Therefore, the larger crop diversity found in the family farms could be due to the presence of these fields led by the women (Table 3). Smallholder farmers mainly use the main field to solely cultivate the staple crops such as millet, sorghum and cowpea for the subsistence of the family farming while a diversity of cash crops is grown in the WF to increase their income. Therefore, the WF play a crucial role in not only empowering women, but also improving food security and coping with the climate change impacts. The WF can therefore be considered as home gardens of the study locations, making the WF home gardens as adaptation strategies to climate change, while simultaneously contributing to food security and nutrition among women and young children in Africa [25].

Our study pointed out that size of the main fields and the WF averaged less than 5 ha and 2 ha, respectively. It is, therefore, evident that family farms in the study had

smaller sizes of the fields. Similarly, the FAO [3] found that 95% of farms are smaller than 5 ha and constitute the majority of the farmland in sub-Saharan African, while 20 % of farms are less than 1 ha and represent 20% of farm areas in the same region. It was also estimated that the average farm size decreases in most of the developing countries over time due to many challenges [2].

Furthermore, despite the strength of the family farms based on their structure and resources to limit the adverse impacts of climate change, the context of family farming is rapidly changing as a result of many factors such as the biophysical factors, socio-economic challenges and climate hazards [26].

CONCLUSION, AND RECOMMENDATIONS FOR DEVELOPMENT

The findings of this study revealed that family farms are mainly rainfed-agriculture, which often rely on traditional methods of farming. One of the most important characteristics of family farms in this study is the presence of the main fields, and fields led by women, which indicated that women contributed to food security and nutrition. The sizes of the farms were relatively small, and the smallholder farmers produced mostly for subsistence purposes.

The farm typology used to infer the described characteristics of the family farms revealed that the type 2 farms are wealthier and face less land pressure compared to the type 1 farms as result of their livestock density and the size of their cultivated land within their family farms. Nevertheless, the type 1 farmers have higher number of both MF and WF which indicate that women have more access to cultivated land than in the type 2 family farms. The study showed that the key drivers that significantly impede crop productivity in the family farming are low soil fertility, increase in dry spell frequency, the low income of smallholder farmers, and limited access to local markets. Adaptation measures used by the smallholder farmers to cope with these constraints are the application of organic manure, the micro-dosing technique to improve soil fertility, mixed intercropping, the FMNR technique, and the use of compost to increase soil and crop productivity. Furthermore, new ways of managing these practices are crucial to better increase crop productivity and the resilience of the smallholder farmers at large.

CONFLICT OF INTEREST

The authors declare no conflict.

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FUNDING STATEMENT

This work was supported by the West African Science Service Centre on Climate change and Adapted Land Use (WASCAL) and the Intergovernmental Panel on Climate Change (IPCC) with full PhD scholarship and research grant to the first author. The CowpeaSquare research project II of the Collaborative Crop Research Program, McKnight Foundation supported the team with logistic means and secondary data.

ACKNOWLEDGEMENTS

We are also grateful to the intern students Hamissou Habou Hamidou and Souleymane A for their contribution during the fieldwork. The authors are thankful for the assistance of field technicians and farmers' organisations (FUMA Gaskiya and FUGPN Mooriben) for their full support in the organisation and the data collection. We thank Dr Issoufou Hassane Bil-Assanou (UDDM, Maradi), Dr SADDA Abou-Soufianou, Mahamadou Nourou Saadou and Yacouba Djika for their advice and support in the organisation of the survey. We are also grateful to Dr Martin Wiehle and Dr Thanh Thi Nguyen (University of Kassel), for their inputs through methodological discussions.

AUTHORS' CONTRIBUTIONS

Conception of the approach, review and approval of the submitted manuscript: all authors.
Questionnaire construction: SIMS and AAS
Statistical analysis: SIMS and AAS
Drafting: SIMS and AAS, SNJ and MK

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Table 1: Age of association member, households, livestock availability in the family farms

Variables	N [1]	Average
Age of association member	109	47±1.47
Number of household members	109	03±0.17
Number of cattle	109	01±0.13
Number of goats	109	04±0.38
Number of sheep	109	03±0.34

Table 2: Gender, marital status of association member, presence of both the MF and the WF and the soil fertility level of the family farms

Variables	Modalities	N	Proportion (%)
Gender	Male	81	74.3
	Female	28	25.7
Marital status	Married	95	87.2
	Single	6	5.5
	Widow/er	6	5.5
	Divorced	2	1.8
Presence of main field (MF) in the Family farm	Yes	107	98.2
	No	2	1.8
Presence of the field led by the female (MF) in the Family farm	Yes	86	78.9
	No	23	21.1

Table 3: Main soil constraints identified in the family farms

Soil constraint types	Proportion (%)
Water erosion	13.73±13.57
Wind erosion	14.8±3.9
Soil leaching	6.73±6.0
Soil fertility decrease	84.33±13.3

Table 4: Rainfall uncertainties identified in the family farms

[1] N is the number of the surveyed family farms with no missing data depending on the variables

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Rainfall uncertainty types	Proportion (%)
Increase in dry spells frequency	29.3±29.82
Increase in flooding frequency	29.07±26.28
Late onset of the rainy season	32.2±0.57
Recurrent early cessation of the rainy season	84.33±17.81
Decrease in the rainfall amount	45.82±19.69

Table 5: Socio-economic drivers identified across the family farms

Types of socio-economic drivers	Proportion (%)
Farmers' low purchasing capacity	41.15±28.43
Demographic challenge	9.7±9.10
Crop residue exported from the fields	10.08±11.00
Farmers' inaccessibility to climate info	10.20 ± 8.91
Limited access to the market	24.70 ± 25.03

Table 6: AEI options practiced in the MF in the family farms

AEI options practiced in the MF	Proportions (%)
Compost	29.22 ± 22.81
Biopesticide	3.33 ± 8.16
Cereal-legume intercropping	68.83 ± 16.21
Crop Rotation	8.6 ± 6.92
Seed Balls	5.08 ± 8.43
Mineral fertiliser Microdosing	29.18 ± 29.85
Organic Manure	73.27 ± 16.24
Farmer Managed Natural Resources (FMNR)	35.85 ± 19.31
Sanitised Human Urine (OGA) fertiliser	10.97 ± 20.14
Zai	7.18 ± 10.88
Tolerant to Drought Varieties	5.13 ± 4.59
Resistant to Diseases Varieties	0.88 ± 2.16

https://doi.org/10.18697/ajfand.126.23390

ajfand AFRICAN JOURNAL OF FOOD, AGRICULTURE, NUTRITION AND DEVELOPMENT
SCHOLARLY, PEER REVIEWED
Volume 24 No. 1
January 2024
PUBLISHED BY AFRICAN SCHOLARLY SCIENCE COMMUNICATIONS TRUST
ISSN 1684 5374

Table 7: AEI options practiced in the WF in the family farms

AEI options practiced in the WF	Proportions (%)
Compost	11.67 ± 19.41
Biopesticide	3.33 ± 8.16
Cereal-legume intercropping	28.98± 25.40
Crop Rotation	3.25 ± 3.92
Seed Balls	1.67± 4.08
Mineral fertiliser Microdosing	13.85± 14.18
Organic Manure	55.28± 25.44
Farmer Managed Natural Resources (FMNR)	12.65± 14.04
Sanitised Human Urine (OGA) fertiliser	9.17± 20.10
Zai	0.80± 1.96
Tolerant to Drought Varieties	2.60± 4.26
Resistant to Diseases Varieties	4.08± 2.16

Table 8: Main characteristics of the two types of farms identified in the family farms typology

		Type 1 (n=41)	Type 2 (n=67)
Discriminant variables used for the typology	Presence of MF (frequency)	66	40
	Presence of WF (frequency)	48	37
	Area of MF (average in ha)	2.69	6.49
	Area of WF (average in ha)	1.09	2.54
	Average number of cattle	0.94	2.14
	Average number of sheep	1.25	4.02
	Average Number of goats	2.68	5.51
Other variable of interest: Second source of income (in frequency)	Animal husbandry	44	15
	Trading	13	13
	Craft industry	6	4
	Butcher	1	6
	Rural exodus	1	0
	Agricutlture	2	0
	Other	0	3

REFERENCES

1. **Graeub B, Chappell M, Wittman H, Ledermann S, Kerr R and B Gemmill-Herren** The State of Family Farms in the World. *World Dev.* 2016; **87:** 1–15.

2. **Lowder S, Skoet J and T Raney** The Number , Size , and Distribution of Farms , Smallholder Farms , and Family Farms Worldwide. *World Dev.* 2016; **87:** 16–29.

3. **FAO.** Towards stronger Family Farming: Voices in the International Year of Family Farming, Rome. 2014; 1-39.

4. **Darnhofer I, Lamine C, Strauss A and M Navarrete** The resilience of family farms: Towards a relational approach. *J. Rural Stud.* 2016; *44:* 111–122.

5. **Bationo A, Lompo F and S Koala** Research on nutrient flows and balances in West Africa: State-of-the-art. *Agric. Ecosyst. Environ*. 1998; **71(3):** 19–35.

6. **Bationo A, Buerkert A, Sedogo M, Christianson B and A Mokwunye** A critical review of crop-residue use as soil amendment in the West African semi-arid tropics. Livestock and sustainable nutrient cycling in mixed farming systems of sub-Saharan Africa. technical papers. Proceedings Addis Ababa, Ethiopia. 1995; **2:** 22-26.

7. **Buerkert A and P Hiernaux** Nutrients in the West African Sudano-Sahelian zone: Losses, transfers and role of external inputs. *J. Plant Nutr. Soil Sci.* 1998; **161(4).**

8. **Taylor C, Christopher M, Belusic D, Guichard F, Parker D, Vishel D, Bock O, Harris P, Janicot S, Klein C and G Panthou** Frequency of extreme Sahelian storms tripled since 1982 in satellite observations. *Nature*. 2017; **544(7651):** 475–478.

9. **Salack S, Saley A, Lawson N, Zabré I and E Daku** Scales for rating heavy rainfall events in the West African Sahel. *Weather Clim. Extrem.*2018; **21:** 36–42.

10. **Salack S, Sarr B, Sangare K, Sanda M and H Kunstmann** Crop-climate ensemble scenarios to improve risk assessment and resilience in the semi-arid regions of West Africa. *Clim. Res.* 2015; **65:** 107–121.

11. **Colnago P, Rossing W and S Dogliotti** Closing sustainability gaps on family farms: Combining on-farm co-innovation and model-based explorations. *Agric. Syst.* 2021; **188:** 103017.

12. **Dogliotti S, Garcia M, Pleuffo S, Dieste J, Pedemonte A, Bacigalupe G, Scarlato M, Alliaume F, Alvarez J, Chiappe M and W Rossing** Co-innovation of family farm systems: A systems approach to sustainable agriculture. *Agric. Syst.* 2014; **126:** 76–86.

13. **Kuivanen K, Alvarez J, Michalscheck M, Adjei-Nsiah S, Descheemaeker K, Mellon-Bedi S and J Groot** Characterising the diversity of smallholder farming systems and their constraints and opportunities for innovation: A case study from the Northern Region, Ghana. NJAS - Wageningen *J. Life Sci.* 2016; **78:** 153–166.

14. **Berre D, Adam M, Koffi C, Vigne M and D Gautier** Tailoring management practices to the structure of smallholder households in Sudano-Sahelian Burkina Faso: Evidence from current practices. *Agric. Syst.* 2022; **198(11):** 1-11.

15. **Descheemaeker K, Ronner E, Ollenburger M, Franke A, Klapwijk C, Falconnier G, Wichern J and K Giller** Which options fit best? Operationalizing the socio-ecological niche concept, *Exp. Agric.* 2019; **55(1):** 169–190.

16. **Kuivanen K, Michalscheck M, Descheemaeker K, Adjei-Nsiah S, Mellon-Bedi S and S Alvarez** A comparison of statistical and participatory clustering of smallholder farming systems - A case study in Northern Ghana, *J. Rural Stud.* 2016; **45:** 184–198.

17. **Alvarez S, Paas W, Descheemaeker K, Tittonell P and J Groot** Typology construction, a way of dealing with farm diversity.Rep. *CGIAR Res. Progr. Integr. Syst. Humid Trop*. 2014.

18. **Daxini A, Ryan M, Donoghue C, Barnes A and C Buckley** Using a typology to understand farmers' intentions towards following a nutrient management plan. *Resour. Conserv. Recycl.* 2018; **146 (3):** 280–290.

19. **Sadda A, Malam Issa O, Jangorzo N, Saïdou A, Issoufou H and A Diouf** Striga gesnerioides (Willd.) Vatke infestation and distribution as affected by soil properties and varieties at the plot and landscape scales in cowpea-based cropping systems. *Weed Res.* 2021; **61(6):** 519–531.

20. **CCRP.** CowpeaSquare II Research Project Description. Collaborative Crop Research Program, 2022. ccrp.org *Accessed Nov. 10, 2022*.

21. **INS. '**Enquête Démographique et de Santé et à Indicateurs Multiples', Niamey, 2013.

22. **Mutaqin D** Determinants of Farmers ' Decisions on Risk Coping Strategies in Rural West Java. 2019.

23. **Rabe M, Ibrahim B and S Lawali** Caractérisation et typologie des exploitations agricoles dans le Sud-Est du Niger. OECD Publishing and Club du Sahel. 2022. Accessed: Jun. 07, 2023. [Online]. Available: https://www.agrimaroc.org/index.php/Actes_IAVH2/article/view/1072 *Accessed February 2023.*

24. **Bocoum I, Yahaya S and A L Zezza** Elevage et les conditions de vie des menages au Niger. Niamey, 2013.

25. **Hansen S, Sorgho R, Mank I, Agure E, Bärnighausen T and I Danquah** Home gardening in sub-Saharan Africa : A scoping review on practices and nutrition outcomes in rural Burkina Faso and Kenya. *Food and Energy Sec.* 2022; **11(3):** 1–19.

26. **Duncan T** Chapter 4: Case Study: Taranaki Farm Regenerative Agriculture. Pathways to Integrated Ecological Farming'. Reclaiming Landscapes for a Sustainable Future. *Land Restoration*. 2016; 271-287.

27 **Pagès J** Multiple Factor Analysis by Example using R. 2015. Taylor & Francis Group. 1-268.