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Family Farming Systems and the Contribution of Fonio and Common Bean Production, Neglected Crops to Food Security and Household Resilience in the Amou Prefecture in Togo

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ABSTRACT

Background: Family farming remains an important source of food and income for households in rural settings.

Aim: To improve knowledge on family farming systems and the contribution of fonio and common bean production, the neglected crops, to household food security and resilience in the Amou prefecture in Togo.

Setting: Semi-structured survey in eight villages in the Amou prefecture in Togo.

Methods: 215 farming households were surveyed from October to November 2024. The food security level of households was measured using the "food consumption" and "dietary diversity" scores within the community. Data collected were analyzed using STATA15 software.

Results: The results showed that the areas farmed by producers are small for fonio and common beans, less than 0.25 ha per household. Four Family farming systems have been categorized. 78.60% of households have an acceptable food consumption, thanks to the nutritional importance of fonio and common bean in the daily food consumption of the population in the area. Fonio and common bean are more consumed during the food shortage period within a year, providing resilience for 92% of the community.

Conclusion: The study showed that fonio and common bean play a key role in food security and resilience of rural households in Amou Prefecture, even though the areas farmed are very small.

Contribution: The study recommended to take into account fonio and common bean value chains in the national agrifood policies, as they have high nutritional and medicinal values that could contribute significantly to improving food and nutrition security and resilience.

KEYWORDS: Fonio, common bean, family farming, resilience, food security, Togo.

I. INTRODUCTION

Agriculture remains a central element of the economy of West African countries, providing 30 to 50% of the Gross Domestic Product (GDP) of most countries and representing the largest source of income and livelihood for 70 to 80% of the population. It

is the main source of food supply and export earnings from cash crops (IFPRI, 2004). Agriculture will likely remain central to income and livelihoods for the foreseeable future (Fafchamps et al. 2001).

West African agriculture is mainly based on family farms or smallholder schemes. Family farming is "a mode of organization in which agricultural, forestry, fisheries, pastoral and aquaculture production is managed and operated by a family and is mainly based on family labor, both female and male." The family and the farm are often linked, evolve together, and perform economic, environmental, social and cultural functions (FAO, 2014). In these types of family farms, we often find indigenous crops with high nutritional values usually described as neglected, given the low importance given to them in national agricultural production (Sourisseau, 2015). Nevertheless, these often-underestimated crops play a major role in the food security of rural households (Graeub et al. 2016).

Family farming is the main food production modality in both developed and developing countries. Family farming provides more than 80% of the world's food in terms of value (FAO, 2014). One of the challenges faced by family farmers is to improve their production: "to produce more in the face of demographic and urban growth, but also to produce better and in a more diversified and regular way to meet the expectations of consumers, including themselves. Family farming is a pillar of strengthening food security and sustainable growth, as well as fighting rural poverty and to an extent environmental degradation." Family farmers are at the heart of this transition. They are often poor and themselves suffer from food insecurity.

Despite enormous agricultural potential that is more than enough to feed their populations, many African countries are still deeply affected by hunger and malnutrition. The question that arises is how are family farms structured, what is the contribution of fonio and common bean crops to food security and the resilience of smallholders in the study area?

The general objective of this study is to characterize family farming systems and assess household food security in the Amou prefecture of Togo. Thus, this study sought to (i) Characterize family farms at the socio-economic and technical levels with a view to classifying them into homogeneous groups (ii) Determine the contribution of sovereignty foods, including fonio, and common beans in the formation of household agricultural income, and (iii) Analyze their contributions to food and nutrition security as well as the resilience of rural communities.

II. MATERIAL AND METHODS

Presentation of the study area

The study was carried out in eight (08) villages of the Prefecture of Amou in Togo whose capital is Amlamé. Amou Prefecture is located in the Plateaux Region of Togo (Figure 1), between Ogou Prefecture to the east, Est-Mono Prefecture to the north, Wawa Prefecture to the west, and Agou Prefecture to the south. Latitude/Longitude: 7° 30' 0" N/1° 3' 0". Most of the area is covered by forest. The prefecture of Amou was chosen for this study due to the fact it is amongst the four priority production prefectures for fonio and common bean in Togo and is also an area of action for the development of family farming by certain local non-governmental organizations in Togo. This area benefits from a climatic regime of transition between bimodal in the south and monomodal in the north. The average annual rainfall contrasts between 1350 mm in the mountains and 1200 mm in the plains. The temperature variation during the year varies between 1°C and 5°C, with an annual average of around 27°C. It is part of the agroecological forest zone of Togo, enjoying bimodal seasons characterized by two rainy seasons, with a short dry period from mid-July to mid-August between the main season which begins in March, and the second rainy season which lasts from three and a half months until the end of November.

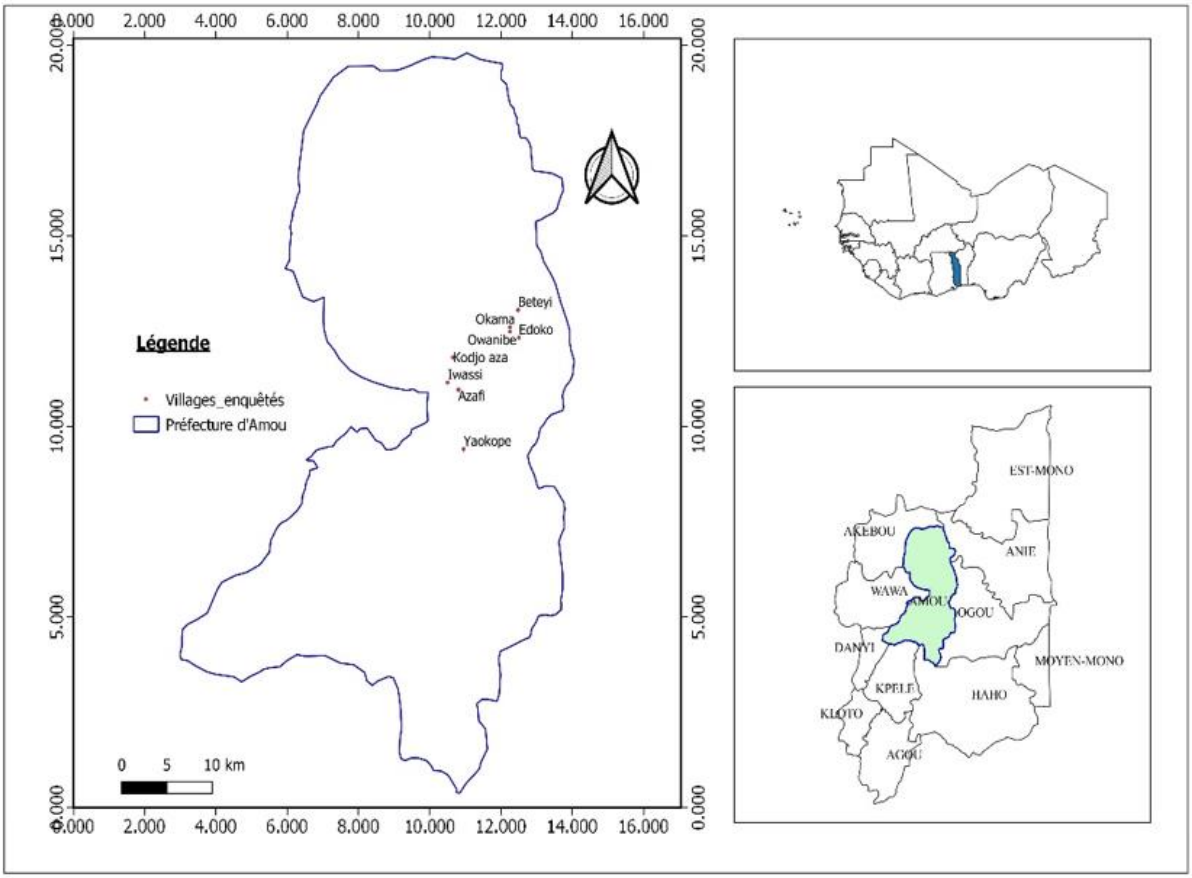

Figure 1. Location of the study area

Socio-economically, the prefecture of Amou is located in the Plateaux region, considered the breadbasket of Togo. The various food crops produced there are used for local consumption, but also supply regional markets and the country as a whole, with some being exported to neighbouring countries, mainly Ghana and Benin. Beans and maize are the main food crops in the prefecture. The main cash crops include coffee, cocoa, cotton and cashew nuts. Fonio, locally called "Ova" is the favorite crop of the Akposso-Akebou people. The prefecture of Amou is a typical prefecture of a rural area full of family farmers.

Data collection

Primary data were collected by individual survey conducted during the period from October 3 to November 15, 2024 by means of a digitized questionnaire on Kobo Tool Box, among 215 sampled farm managers affiliated with households. The questionnaire was administered to the Head of Household (HHH). The data collected, which were used to characterize family farms, concerned, among other things, the general characteristics of households and production factors; information on the farm manager, sources of income, areas farmed, income, persons in charge of the household, number of crops grown, poultry and ruminant numbers.

To determine the minimum sample size, the method was based on three parameters: representativeness, homogeneity and precision. The following formula of Slovin (1960) was used:

$$n = \frac{N}{1 + (Nxe^2)}$$

n: minimum sample size for meaningful results

N: total number of households concerned in the Amou prefecture,

e: +/- 5%, accuracy level.

This formula allowed us to obtain a minimum sample size (n) of 213 households to which we added two households. This brings our sample size to 215 in total. Two-stage stratified sampling was conducted, with village as the primary unit (PU) and household as the secondary unit (SU). Eight (08) of the 15 villages: Edoko, Owanibe, Okama, Beteyi, Kojo aza, Azafi, Iwassi and Yaokopé were selected because they contain many more family producers who are beneficiaries of the project to support the repositioning of sovereignty food in a territorial development dynamic for sufficient, healthy and sustainable food for the populations of the NGO's

Family Farming Development Support Program Inades-Formation-Togo. At the village level, random sampling was carried out. The 215 households were surveyed in eight villages, based on the list of members of the savings and credit groups (GEC) set up by the "Project for the Repositioning of Sovereignty Foodstuffs for a Sufficient, Healthy, Sustainable Food for the Population. These GECs are made up of family farmers who integrate sovereignty foods (fonio, common beans) into their production systems that characterize the area. Thus, in each of the villages, 20 farm managers were surveyed by choosing the serial number from the GEC list without handing over.

The characterization of family farms was carried out using data on the incomes of family farms, including, inter alia, total farm cash income, cash income from maize (the main cereal crop in the study area), fonio and common beans. Agricultural income at the farm level is estimated by the amount of sales of foodstuffs (including animals) produced since the beginning of the 2023 agricultural season using the method of measuring agricultural income, as described by Lourme-Ruiz et al. (2016). This income indicator does not value the quantities produced and not sold at the time of the survey (stored, self-consumed, given or lost). It reflects the availability of money from production. The analysis of food consumption was inspired by the World Food Programme (WFP) method (WFP, 2009). Two key indicators of food security were calculated.

- The Food Consumption Score (FCS) as a proxy for household food security (WFP, 2009). The FCS is an indicator based on the diversity of the diet, the frequency of food consumption and the nutritional importance of the different food groups. The FCS was calculated using the following formula (MAP 2011):

$$FCS = a(cereals) * F(cereals) + a(roots\ crops/tubers) * F(roots\ crops/tubers) + a(legumes) * F(legumes) + a(vegetables) * F(vegetables) + a(fruits) * F(fruits) + a(animal\ proteins) * F(animal\ proteins) + a(sugger) * F(sugger) + a(milk) * F(milk) + a(oil) * F(oil) + F(condiments/spices) * a(condiments/spices)$$

a= weight related to the energy value,

F = frequency of consumption of food groups per day, over 7 days.

The traditional food consumption profiles on the FCS established by the WFP made it possible to distribute the households surveyed according to their calculated food consumption scores.

Information on Table I was used as a reference for the distribution of the dietary profiles of the households surveyed.

Table I. Typical thresholds for FCS (WFP, 2011)

Conventional thresholds	Food Profiles
0-28	Poor food consumption
28,5-42	Limited food consumption
> 42.5	Acceptable food intake

- The Household Food Diversity Score (HFDS) was used to know the overall quality of consumption of rural people. It is also an indicator of access to food, which refers more specifically to the quality and quantity of access at the household level, defined as the ability of the household to acquire food of sufficient quality and quantity to meet the nutrient needs of household members for productive lives (Kennedy & Raz, 2009). This score from 0 to 12 (12 being the maximum possible diversity) is a simple count of the food groups that a household consumed in the 24 hours preceding the survey (within the household). It provides a snapshot of a household's economic capacity to access a variety of foods. The classic dietary diversity profiles (HFDS) established by the Food and Agriculture Organization of the United Nations (FAO) (FAO, 2013) made it possible to distribute the households surveyed according to their calculated HFDS. Table II was used as a reference for the distribution of the dietary profiles of the households surveyed.

Table II. Typical HFDS thresholds

Thresholds for food groups	Dietary diversity
1-3	Poor food diversity
4-5	Medium food diversity
> 6	High food diversity

Statistical analysis

The Statistical Analysis was performed using STATA, version 15. Descriptive statistics were performed to show the mean, the standard error of the mean, the minima and maxima of the general characteristics of agricultural households. Also, the principal component analysis (PCA) and a hierarchical ascending classification (HAC) were carried out using eight discriminating variables (age of the head of household, persons in charge of the household, number of active persons, total agricultural monetary income, agricultural monetary income per active person, number of poultry, number of small ruminants, and total farmed area) to characterize the family farms surveyed. The chi-2 and t-tests were used to establish the relationships between variables related to the evaluation of food consumption and food diversity scores, on one hand, and the relationships between determinants and food consumption on the other hands.

III. RESULTS AND DISCUSSION

Results

General characterizations of family farms

Two hundred and fifteen (215) family farms, 86% of which were run by men and 14% by women, were surveyed (Table III). The age of the respondents varies between 20 and 90 years, with a mean of 44.30±0.83 years (Table III). Of these, only 2.8% are over 65 years old. These holdings have an average of 5.86±0.17 dependents, with a minimum of one person and a maximum of 17 people. The proportion of farm managers who have not received an education is 15.35%, while nearly 80% have received formal education (primary and secondary). As regards their marital status, it should be noted that more than 80% of farm managers are married (Table II). The mean cultivated field area is 1.93±0.69 ha, with a minimum of 0.5 ha and a maximum of 5 ha. These fields are acquired through several methods, including inheritance (83.72% of farms), purchase (2.33%), donation (6.05%) and finally by rental or loan (7.9%). Buying is not very common. More than 75% raise poultry, with an average of 9.00±67 and a maximum of 52 poultry.

As far as small ruminants are concerned, 31% do not raise goats or sheep, 68% raise small ruminants with an average load of 4.42±0.46 animals and a maximum of 65 small ruminants (goats and sheep combined).

Table III. General socio-economic characteristics of family farms surveyed in Amou

Parameters	Minimum	Mean	Maximum
Age of the head of household	20	44.30	90
Household charges	1	5.86	17
Assets	1	3.67	12
Total area farmed (ha)	0.5	1.93	5
Crops grown	2	5.00	8
Poultry	*	9.00	52
Small ruminants	*	4.42	65
Marital status (%)			
Single		6.51	
Married		83.26	
Divorced		2.33	
Widow		7.91	
Educational attainment (%)			
None		15.35	
Primary		40.47	
College		40.00	
High school		4.19	
Land acquisition (%)			
Purchase		2.33	
Gift		6.05	
Inheritance		83.72	
Rental		7.90	

Parameters	Minimum	Mean	Maximum
Second source of income (%)			
Breeding		39.07	
Transformation		12.56	
Trade		18.14	
Sale of firewood		30.23	

** It turns out that many do not breed and therefore those who practice the activity have at least two heads in both cases.*

Characterization of family farms

From the principal component analysis, we can see that 52.36% of family farms are described by the first two axes of the factor plan (Table IV). In addition, households that had more small ruminants and poultry, and many people in charge, had less income. Those with higher incomes had more crops, a large area farmed and cultivated per worker (Figure II).

Table IV. Eigen value, variance and cumulative variance of PCA on the first factor axes

	F1	F2	F3	F4	F5	F6	F7	F8	F9
Eigen value	3.02	1.69	1.20	1.03	0.69	0.58	0.43	0.26	0.09
Variability (%)	33.56	18.81	13.36	11.45	7.67	6.49	4.75	2.92	1.01
Cumulative (%)	33.56	52.36	65.72	77.17	84.84	91.32	96.07	98.99	100.00

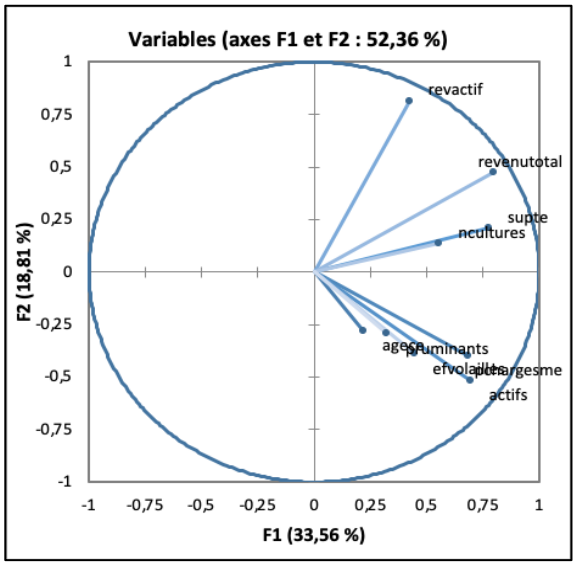

Figure 2. Representation of variables on dimensions

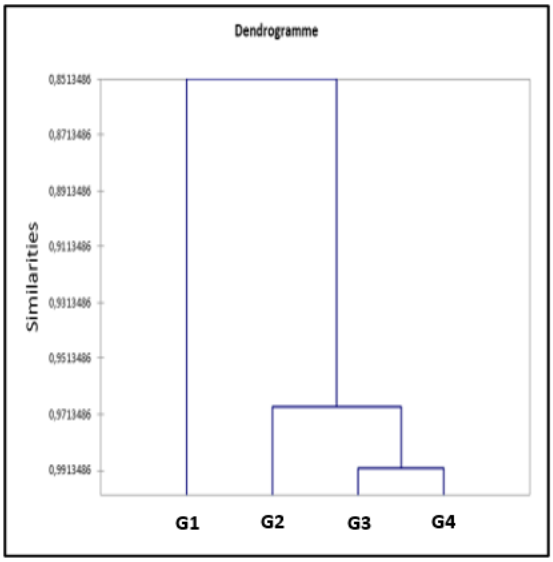

Figure 3. Dendrogram of family farms surveyed

The ascending hierarchical classification (AHC) shows 04 categories of agricultural farming systems (Figure 3). Group 1 (G1) is made up of producers with large agricultural areas (2.29±1.10 ha) and cultivating several crops (5.18±1.11); This group represents almost half of the number of farmers surveyed (41.51%). This category of producers ranks first in terms of agricultural cash income, cultivated area, assets per household, and the number of poultry and small ruminants (Table III).

Group 2 (G2), representing 22.33% of the respondents, is made up of farms with average areas (1.63±0.81 ha) (Table II) and with considerable livestock farming. They generate monetary income of 158708.33±113665.6 CFA francs on average (Table III &Table V). These producers occupy the second position in terms of cultivated area and food coverage in maize and the number of workers per household.

Group 3 (G3), representing 23.72% of the respondents, is made up of households with high incomes, and is in second place in terms of agricultural cash income from maize cover (198549.0±238840.6). The particularity of this group lies in the fact that the heads of farms are very young, with an average age of 38.53±11.66 years (Table III & V).

Finally, group 4 (G4), representing 7.44% of respondents, is made up of family farms with smaller numbers of people in charge, and farming small agricultural areas of the order of one ha on average (1.2656±0.54) and small numbers of poultry. This group has total cultivated areas of the order of 1.63±0.81 ha on average.

Table V. Main characteristics of family farms

Variables	Group 1 (46.51%)	Group 2 (22.33%)	Group 3 (23.72%)	Group 4 (7.44%)
Age of Head of household	46.74±10.19	45,125±14,52	38.53±11.66	44.94±12.58
Persons in charge of the household	7.46±2.27	5.15±1.69	4.24±1.58	3.19±1.60
Number of active persons	5.28±1.78	3.00±0.00	2.00±0.00	1±00
Total cultivated area	2,285±1,10	1.63±0.81	1.52±0.82	1.2656±0.54
Agricultural monetary income per worker	62055.14±54206.41	52902.78±37888.55	99274.5±119420.36	98875±120916,98
Total income	317310±265455,80	158708.33±113665.67	198549.0±238840.62	98875±120916,98
Number of crops grown	5.18±1.11	4.90±1.08	4.76±1.12	4.88±0.62
Number of Poultry	10.87±11.74	7.85±6.79	7.45±8.85	5.63±4.54
Number of ruminants	5.84±9.11	3.46±3.74	$2.88±3.59	3.31±3.7
Number of months covered by maize	8.17±2.35	8.00±2.98	7.27±2.54	7.47±2.29
HFDS	4.91±1.24	4.98±1.04	4.51±1.03	5±1.03
FCS	58.5±16.80	57.47±15.60	60.75±16.85	63.5±15.32
Area farmed with food crops	1.7585±0.73	1.31±0.69	1.22±0.51	1.0313±0.46
Area farmed with Fonio	0.09±0.28	0.03±0.16	0.04±0.14	0.09±0.26

Income structure of family farms

The total average annual agricultural income for the 2020 season amounts to 237 474.42 F CFA, with a maximum of 1 000 000 and a minimum of 12 000 F CFA, including a standard deviation of 236 552.37. This reflects significant differences within households.

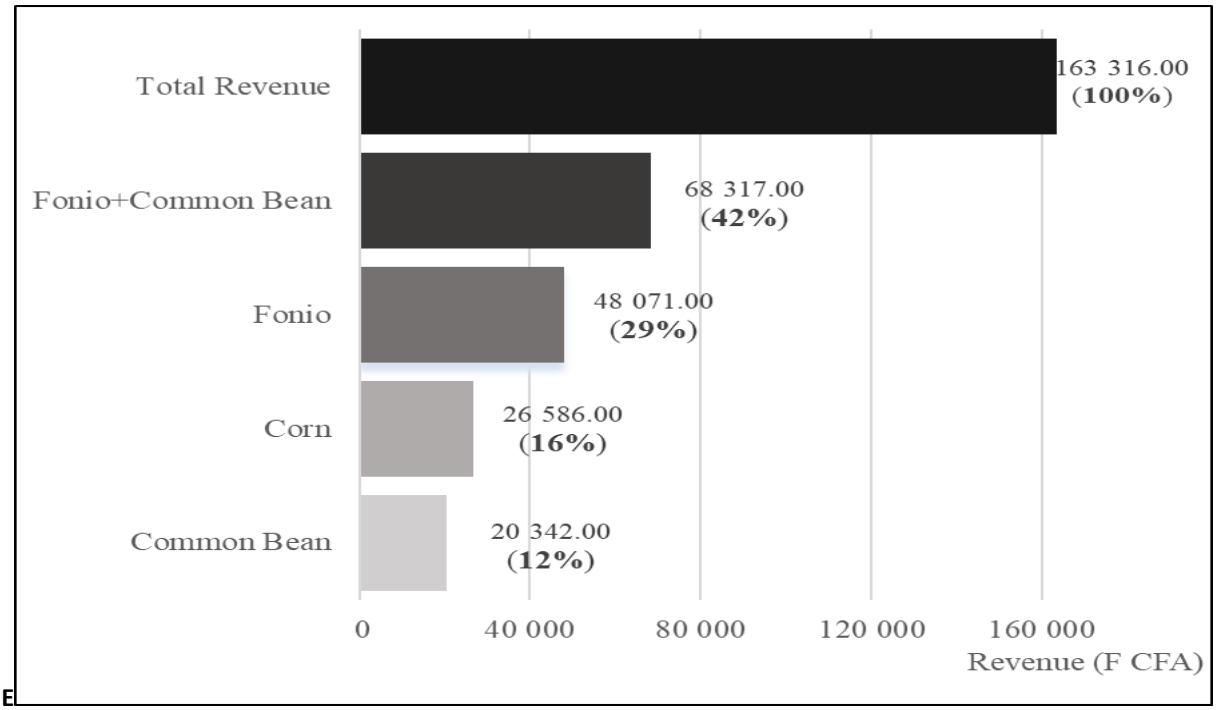

Figure 4. Average annual monetary income structures during the farming year 2023-2024

The total annual per capita income varies between 3 571.43 F CFA and 250 000 and F CFA, with an average of 42 704.64 F CFA and a standard deviation of 42 830.70 F CFA. Half of the households surveyed generate per capita income of between 25 000 F CFA and 250 000 F CFA. On the other hand, the total annual income per worker varies between 5,000 and 450 000 F CFA, with an average of 71 580.67 F CFA and a standard deviation of 79 941.30 F CFA.

The student's t-test showed a significant difference between the average incomes from maize, fonio and common beans. And it is fonio that provides the highest income (29% of the total revenue) compared to income from other speculations (Figure 4).

Shares of crop income in farm cash income

The analysis of the shares of contributions to total income shows that maize contributes little to total income within households. Moreover, 35% of households say they have not sold maize in the past year, despite having produced maize. While 2.80% of households have income (Table VI) from maize that contributes at least 50% of total agricultural cash income. 19.53% of households generate at least 50% of their total income from fonio. Income from common beans is low. Indeed, producers have had a bad year for speculation; Yields have been very low, and others mention losses related to transhumance herders which have also caused damage to the fonio farms of some producers.

Table VI. shares of revenues from sovereignty foodstuffs in total income

Shares	**Maize**		**Fonio**		**Common bean**		**Fonio+Common Bean**	
	Actual	**%**	**Actual**	**%**	**Actual**	**%**	**Actual**	**%**
0%	77	35.80	38	17.67	125	58.14	31	14.42
1-10%	43	20.00	29	13.49	32	14.88	15	6.98
11-24%	56	26.00	46	21.40	35	16.28	40	18.60
25-30%	19	8.80	20	9.30	8	3.72	22	10.23
31-49%	14	6.50	40	18.60	13	6.05	44	20.47
At least 50%	6	2.80	42	19.53	2	0.93	63	29.30
Total	**215**	**100**	**215**	**100**	**215**	**100**	**215**	**100**

NB: Workforce refers to the number of producers who produced the speculation in question according to the shares.

Household food consumption

Food Consumption Score (FCS)

The analysis of household food consumption shows that 78.60% of the households surveyed had an acceptable level of food consumption. This means that these households were food secure. Only 5.60% of the households surveyed had a FCS borderline **below the threshold, indicating a situation of food insecurity (figure 5).**

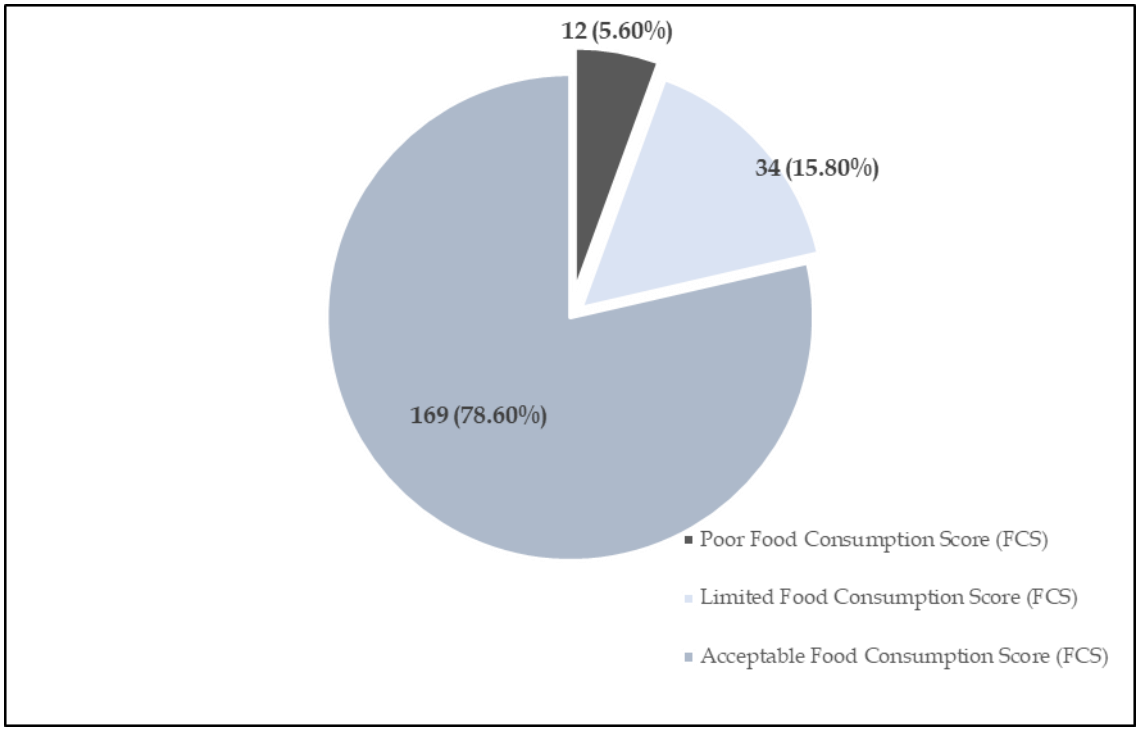

Figure 5. Food Consumption Score (FCS

In addition, factors such as the gender of the head of household, educational attainment, marital status and secondary source of income influence the food consumption index. The cross-analysis between the sex of the head of household and the food consumption index shows that there is no significant difference in the situation of food insecurity (P = 0.44) between households headed by men and those headed by women. This would mean that the head of the household is male or female, it has no influence on household food consumption. The results of cross-analysis between the level of education of the head of household and the food consumption index indicate that the different levels of education have no influence on household food consumption (P = 0.69).

As for the relationship between food consumption ratio and marital status, the chi^2 independence test was not significant (P = 0.25). This means that there was no influencing relationship between marital status and household food consumption.

However, food consumption is significantly influenced by the secondary source of income (P = 0.01). Indeed, households with wood sales as a second source of income are more likely to have acceptable food consumption (92.30%) than households with livestock (70.20%), agricultural product processing (66.70%), and trade (82.10%) as a second source of income.

Table VII: Second source of income and household food consumption

	Poor		Limit		Acceptable	
	Actual	**%**	**Actual**	**%**	**Actual**	**%**
Livestock (breeding)	6	7.10%	19	22.60%	59	70.20%
Transformation	3	11.10%	6	22.20%	18	66.70%
Trade	0	0.00%	7	17.90%	32	82.10%
Sales of wood	3	4.60%	2	3.10%	60	92.30%
Total	12	5.60%	34	15.80%	169	78.60%

Household Food Diversity Score (HFDS)

Household dietary diversity in the 24 hours prior to the survey is good. Indeed, the majority of households surveyed (67%) consumed at least 4 food groups (Figure 5), while 25% of the households surveyed had consumed at least 6 food groups during the 24 hours preceding the survey. The proportion of households with low dietary diversity was only 8% of the households surveyed (figure 6).

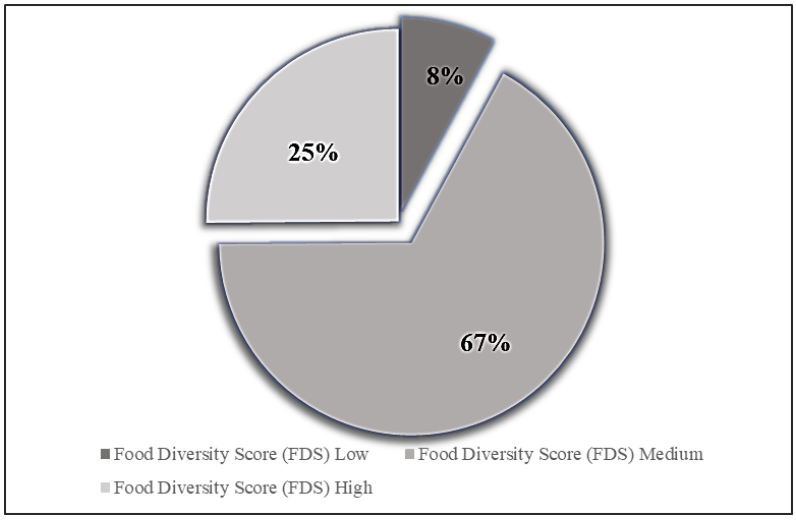

Figure 6. Household dietary diversity score

This situation demonstrates a fairly good dietary diversity, and corresponds to a situation of food security, because the proportion of households with poor food consumption is below the threshold (10%).

The calculation of the FCS takes into account different food groups, namely (i) staple foods (cereals, roots and tubers), (ii) legumes (Peanut, common beans, cowpeas, lentils, peas, groundnuts, sesame), (iii) fruits and vegetables, (iv) animal products, (v) milk or dairy products, (vi) oil and fats, (vii) sugar and (viii) spices. The situation of the consumption of these foods during the last seven days prior to data collection reveals the increased importance of cereals, particularly maize and fonio, in household food consumption in the study area (Table V). Indeed, it appears that all households (100%) have consumed at least one cereal, including maize, rice and fonio. The mean frequency of consumption is 6.62±0.07, showing the daily presence of cereals in the diet of family farmers in the Amou prefecture. Vegetables and leaves, followed by oils and fats, are consumed by more than 90% of the households surveyed. The average frequencies are respectively 4.40±0.14 and 3.64±0.14 meaning a consumption of 4/7 days. Legumes and animal products have also been widely used by households, that is a proportion of more than 90%. On the other hand, milk and dairy products, as well as fruits, have seen low food use at the household level. Indeed, only 2.30% and 16.70% of the households surveyed consumed milk and fruit at least once, respectively. Roots and tubers (especially cassava) were consumed by households, with a rate of 36.70% and a frequency of 1/7 days.

Table V. Proportion of households that consumed foods and food groups, and mean frequency of consumption in the last seven (07) days prior to the survey.

Groups	Details of the group	% Households	Mean (days)
Grain	Maize, millet, sorghum, rice, bread, pasta	100.00	6.62±0.07
Roots and Tubers	Yams, cassava, plantain, sweet potato, potato, etc.	36.70	1.19±0.13
Legumes	Peanut, beans, cowpeas, lentils, peas, groundnuts, sesame	92.10	3.80±0.13
Vegetables and Leaves	Tree leaves, tomato, onion, lettuce, cucumber, eggplant, etc.	94.90	4.40±0.14
Fruit	Mango, papaya, banana, watermelon, avocado, orange, lemon, melon etc.	16.70	0.38±0.07

Animal proteins	Meat, fish, seafood, meat/poultry, liver, offal, eggs	91.90	4.91±0.17
Dairy products	Fresh milk, cheese condensed, yoghurt, cheese, butter	2.30	0.05±0.02
Oils, fats	Palm oil, corn oil, margarine, bacon, shea butter etc.	90.70	3.64±0.14
Sugar	Honey, jam, sugary drinks	29.80	1.23± 0.16

The analysis of consumption according to the origin of the different foods consumed (or not consumed) within the farming households surveyed shows a strong dependence on animal proteins, dairy products and oils and fats. The proportions are 84.20% and 77.20% respectively for animal proteins and oils and fats (Table VI). Everyone who consumed milk had to buy it. More than 50% of households have bought cereals and pulses. But the vegetables and leaves come mainly from family production. The main source of cereals and legumes is the market, as cereals come from family production for only 42.30% of households, compared to 54.90% who buy them. In terms of the origin of legumes, 58.60% of households acquired them mainly through purchase, compared with 32.60% of households that acquired them mainly through family production (Table VI). On the other hand, the main source of roots and tubers is family production; Because 31.20% of households have family production as their main source of roots and tubers, compared to 6.50% of households by purchase.

Table VI. Household consumption and sources of supply in different food groups (%)

	Family production	Purchase	Work for food	Loan/Debts	Gift	Food aid	Barter	Wild Food (Gathering/ Hunting)	Not consumed	Total
Grain	42.30	54.90	1.90		0.90	0	0	0	0	100
Roots and Tubers	31.20	6.50	0	0	0	0	0	0	62.30	100
Legumes	32.60	58.60	0.50	0	0	0	0	0	7.90	100
Vegetables and Leaves	75.30	19.10	0.50	0	0	0	0	0	5.10	100
Fruit	10.70	5.10	0	0	0	0	0	1.40	82.80	100
Animal proteins	5.60	84.20	0	0	0	0	0	1.40	8.40	100
Dairy products	0	2.30	0	0	0	0	0	0	97.7	100
Oils, Fats	13.50	77.20	0	0	0	0	0	0	9.30	100
Sugar	1.90	27.90	0	0	0	0	0	0	70.20	100

Relationship between food consumption and determinants in households on family farms

Multiple linear regression analysis shows that the links between the food consumption of households living on family farms and the factors of production are real and that this is not by chance. A relationship was found between agricultural monetary income and income per worker, showing the importance of income in food. Household food consumption is related to the area under cultivation, the number of persons and the number of active persons in the household (Table VII). Other variables, such as the number of crops grown and the number of poultry, do not appear to have an effect on consumption.

Table VII. Relationship between determinants and food consumption.

	Non-standardized coefficients		Standardized coefficients	t	*P*
	Has	Standard error	Beta		
(Constant)	52.39	6.86	-	7.61	0.00***

	Non-standardized coefficients		**Standardized coefficients**	**t**	***P***
	Has	Standard error	Beta		
Number of persons in charge of the household	1.77	0.64	0.27	2.76	0.01**
Number of active persons	-4.09	1.15	-0.50	-3.55	0.00***
Total area farmed	-5.09	2.82	-0.31	-1.81	0.07
Number of persons in Household	9.50	2.94	0.41	3.23	0.00**
Agricultural monetary income per worker	0.00	0.00	-0.31	-2.03	0.04*
Total monetary agricultural income	0.00	0.00	0.34	2.04	0.04*
Number of crops cultivated	0.67	1.12	0.04	0.59	0.55
Number of poultry	0.00	0.13	0.00	0.03	0.98
Number of small ruminants	-0.12	0.17	-0.05	-0.69	0.49
Total area per worker	1.89	4.91	0.05	0.38	0.70
Number of months covered by maize	0.31	0.46	0.05	0.67	0.50

*Ns :P>0.05 P<0.05 * P<0.01 **: P<0.001****

DISCUSSION

In this work, eight variables were considered to see how farms can be distributed. The classification of agricultural holdings according to the 08 main variables has made it possible to identify four types (categories of holdings, whose constituents, in this case family farms, are similar) of holdings according to the extent of the areas farmed, the number of active persons, and the number of persons in charge of the household. It puts an equally clear classification in terms of agricultural monetary income, where group 1 is in the lead, followed by groups 3, 2 and 4.

Considering income per worker, groups 3 and 4 are in the first place and groups 1 and 2 come in second. The particularity of group 1 lies in the fact that it has the highest number of workers and dependents, while the particularity of group 2 is that it has the lowest income per working person. Group 3 includes very young farm managers. Finally, Group 4 is a group with the highest income per worker. Overall, the differences between classes are due to the result of the skillful combination of the factors of production of land, labour (assets) and invested capital. In any case, this classification based on the statistical method differs from other literary classifications found in literature, where authors describe the exploitations according to the combination of variables. Indeed, Feliho et al. (2020) categorized based on the total farmed area (ha) and identified three categories: large farmers (> 5 ha), medium farmers (1-5 ha), small farmers (< 1 ha) in Benin. The same is true for the typology of farms in Togo (DSID, 2012; RNA, 2012) where a typology is made from the association of agriculture and livestock, farm size, land accessibility and irrigation practices similar to the results obtained in this study.

Similarly, a structural typology was identified through factor analysis in Togo and a hierarchical ascending classification (HAC) by integrating 06 parameters: total surface area of the farm, the number of animals raised, the total cost invested, the number or types of products farmed, the size of the household and innovations used. The results obtained showed the typology of farms in Kabare (Congo) grouped into four main classes according to the classification criteria considered (Ndjadji et al. 2019). Soukaradji et al. (2017) in Niger, based on 11 quantitative variables, found four distinct classes of family farms. Also, a principal component analysis (PCA) followed by a hierarchical ascending classification (HAC) (Koutou et al. 2016) was applied to the economic indicators of the family farming systems (FFS) such as total crop, livestock, and non-agricultural income related to the number of active persons to group the FFS according to their main sources of income. The income-based typology of FFS had highlighted three classes of FFS (Koutou et al. 2016). Low-income farms (farmers), high-income crops (agro-pastoralists) and those with livestock income (pastoralists). Based on the EAF structure criteria, similar typologies had been established in the western cotton-growing

zone of Burkina Faso and in southern Mali (Djouara et al. 2006; Vall et al. 2006). Although the HAC used in this work is also used by other authors cited above, the difference in the variables used as well as the heterogeneous nature of agricultural holdings points to provides additional information concerning family farm analysis in the region as a whole. In Togo, the classification of farms was based on the farm size as well as other farm household variables described in literature. The classification does not allow us to clearly see the level of food security by class. It shows which group would have more food secure households based on averages of food consumption score and dietary diversity.

During the 2023/2024 campaign, the sale of farm agricultural products enabled half of the households surveyed to generate per capita income of between 25,000 and 250,000 FCA. This amount is very low and does not allow us to get out of poverty; because it corresponds to about 68.00 F CFA and 684.93 F CFA per day per person, that is to say between 0.12 and 1.2 dollars per person per day. The level of poverty at the national level was 53.50%, while at the regional level it was 56.60% in 2017 (INSEED, 2017). Thus, to improve farmers' incomes, agricultural practices should be intensified. Within the sample, other crops would contribute much more to agricultural monetary income than sovereignty food. Indeed, 2.80% of households have obtained income from maize that contributes at least 50% of total income and 17% of households generate at least 50% of their total income from fonio. Overall, income from farms is low. In Burkina Faso, farms between 2012 and 2013 generated an average of 75,172±114,783 CFA francs per person (Lourme-Ruiz et al. 2016). These farms earned more than 50% of income from cotton and 11% from maize (Lourme-Ruiz et al. 2016). In Niger, it was found that farms had an average of 217,300 FFCA as agricultural income (Soukaradji et al. 2017). In addition to the sale of sovereignty food, they are also consumed within households because they are staple cereals that are part of dietary habits. As far as important sources of income are concerned, farmers rely much more on other crops like tomatoes to boost their income. Cash crops are poorly represented in households, as most of them have been decimated by fire. Such incomes would not allow households to meet the requirements for the conviviality of household members. The study did not identify income from cash transfers received from other family members or friends, or non-agricultural cash transfers, which should provide clear information on the affordability of family farmers. This is because in this study, emphasis was placed on farm cash income. An exploration of income from other crops would make the questionnaire even heavier and questions of income were difficult in the absence of accounts kept by the farmers.

The results of the food security proxy used here, the food consumption score indicating that 78.60% of households are in a situation of acceptable food consumption, are consistent with the results of the 2020 harmonized framework (DSID, 2020) which classifies the prefecture of Amou in a current situation of food security and a projected phase. The results of our analyses showed that some qualitative household factors have no effect on household food consumption. Indeed, the age of the head of household, the sex, the level of education, the marital status of the head of the household do not predict the household's food situation or household food consumption. However, the second source of income has an effect on household food consumption. At first glance, one might have thought that the level of education would have had an impact, but it must be said that this could be possible if there were large proportions for middle school, high school and university. While the consumption of cereals, vegetables, leaves and animal products is fairly high (more than 75% of households with a frequency of almost 4/7), this is not the case in other parts of the world. Unlike cereals, animal products, fruits and vegetables are consumed at a low level. Low consumption of these foods has also been noted among other rural communities in Sudan and Ethiopia (Workicho et al. 2016; Khalid et al. 2017). But similar studies conducted by Lamboni (2017) had found similar proportions of more than 80% for cereals, vegetables and leaves, and then animal products, in the prefecture of Tône at the end of May in Togo. Also, Lawson (2016) in the Mô plain in Togo found similar results that also showed a high consumption of cereals, vegetables and animal products within households. The preponderant presence of cereals in the diets of rural households has already been reported by other authors (Bidisha et al. 2017).

In addition, links between food security and household characteristics have been found. Household characteristics have an effect on household food security, particularly with regard to household food consumption. On the other hand, Goïta et al. (2018) showed the relationship between food consumption and all sociodemographic characteristics (sex, marital status, age, education level of the head of household, and household size and place of residence).

Speaking of dietary diversity, even if the results show an acceptable level (92% have at least an average dietary diversity score), there is reason to worry for the area. Although the area is suitable for fruit trees, it is noted that only 16.70% of households consumed them, and 2 out of 10 households (2.30%) consumed milk. Similar results have been found in the literature. In Burkina Faso, Sanou et al. (2018) reported low household consumption of animal products, fruits and vegetables. Similarly, Lawson (2016) had already reported the low consumption of fruits, dairy products and non-consumption of eggs within Mô households in Togo. Even if milk is not consumed much because there are no cattle farmers among the households surveyed, and it must be bought, producers could have had orchards that should increase the use of fruit. Indeed, although the area is known for its preponderance

of fruit, this was not reflected in our results. It may be that the use of fruit is more noticeable during the month of April for mangoes, and for other fruits at different times. Even if farmers raise poultry, mainly chickens, the consumption of eggs for all members of a household is not taken for granted. This is why there is no consumption of eggs in households; but an assessment of the food diversity score (FDS) at the individual level that takes into account foods consumed outside the household, could show egg consumption. Poor diets in milk and dairy products, eggs, and fruit would lead to a dietary deficiency of micronutrients. This nutritional deficiency can have a negative impact on the health of children and even adults. Diets based on the consumption of grains or starches as staple foods and low in fruits and animal products are common in low-income countries (Jones et al. 2014). The risk of such a diet is micronutrient deficiency and consequently, malnutrition (Kennedy, 2009; Jones & Wengreen, 2014; Bidisha et al. 2017) and poor health (Payne et al. 2012; McMartin et al. 2013). In principle, studies on dietary diversity as found in the literature always proceed in two periods: a transition to a normal period, and another to a lean season from April to September, such as that of Sanou et al. (2018). Swindale & Bilinsky (2006) suggest two equally distinct passages but during the same moments to bring out the changes. This could not be the case for the present study.

IV. CONCLUSION

The objective of this study was to characterize family farming systems and assess the contribution of fonio and common bean to household food security in the Amou prefecture in Togo. The results of this study have shown a total of four (04) groups of family farming systems. The share of fonio and common beans in the formation of total agricultural income earned by the family farmers surveyed was low. Sovereignty foodstuffs, namely fonio and common beans, even though they are sold, are more self-consumed by households, especially during the lean season. The household food security assessment of these farmers revealed that 78.60% of the households surveyed had an acceptable level of food consumption, regardless of gender, education level and age. In total, 100% of households have consumed cereals, including fonio, at least once. The study revealed a high dietary diversity index of 67%, indicating the consumption of a wide variety of foods, including fonio and common beans among agricultural households in the Amou prefecture of Togo. Fonio and common beans contribute to the resilience of 92% of the agricultural households surveyed. The study recommends considering fonio and common bean value chains in national agri-food policies, as they have high nutritional and medicinal values that could contribute significantly to improving food and nutrition security and resilience of smallholder family farms in Togo.

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COMPETING INTERESTS

The authors declare that they have no financial or personal relationship(s) that may have inappropriately influenced them in writing this article.

ETHICAL CONSIDERATIONS

The study is conducted in a safe and ethical manner. The rights and welfare of both humans and animals are respected and protected during this work. The work received the consent of all the participants in this survey.

AUTHORS CONTRIBUTIONS

- A.O. Designed the study, prepared questionnaires, collected data, analyzed data, prepare the draft of manuscript, edits and finalized.
- E. P. Prepare questionnaires, collect data in the field, analyze data, prepare the draft of the manuscript, edited and finalized the manuscript.
- K. A. Designed the study, prepared the questionnaires, supervised the data collection in the field, analyze the data, prepare the draft of the manuscript, edits and finalized the manuscript.
- A. H. C. Analyzed the data, prepared the manuscript, edited and finalized the manuscript.
- H. B.D. Analyzed the data, prepared the draft of the manuscript, edited and finalized.
- K. K. Z. Designed the study, prepare the questionnaires, collect the data, edited and finalized the manuscript.
- C. M. T. supervised, re-read, edited, and finalized the manuscript.

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DATA AVAILABILITY

Data are available upon reasonable request from the corresponding author.

DISCLAIMER

The views and opinions expressed in this article are those of the authors and are the product of professional research. It does not necessarily reflect the official policy or position of any affiliated institution, funder, agency or that of the publisher. The authors are responsible for this article's results, findings and content.

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