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Family Farming Systems in Northern Central Cameroon: Challenges and Prospects for Food Security

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Abstract

If family farming is supported, it can serve as a foundation for growth and food security. One of Cameroon's biggest development challenges is still food insecurity. Therefore, the purpose of this study was to investigate the situation and key determinants of food security in the northern forest-savanna transition zone of the Central Cameroon Region. To do this, 180 family farmers from Mbangassina, Ntui, Batchenga, and Obala participated in a survey and field observations (January-March 2020; March-May 2021, and July-September 2021). According to this survey and these findings, the useful agricultural area is 4.55 ± 0.21 hectares. Cocoa, yam, cassava, maize, plantain, sweet potato, and peanut are the principal crops mentioned. With a mixed workforce, the vast majority of agricultural work is performed manually (machetes, daba, etc). (Family and external). Seven significant challenges face family farming in these areas: poor market organization, bad road/track conditions, a lack of inputs, seasonal uncertainties/rainfall deficits, challenging access to irrigation, unstable land tenure, challenging access to credit, and challenging access to agricultural equipment. Each community faces unique challenges. The family agricultural industry, which these people rely on for their food security, needs to be saved to overcome these obstacles. According to the findings, expanding access to financial and commercial services will help agricultural operations in the study area increase food security. This will be in line with initiatives made by both governmental and non-governmental organizations to advance agricultural technologies as a way to address the issue of food insecurity.

Keywords: Food insecurity, family farming, agricultural methods, the unreliability of the climate

Introduction

In worldwide development objectives, such as the Sustainable Development Goals, one of the key challenges is food security (SDGs). This indicates how crucial it is for emerging nations. Globally, 815 million people are undernourished, according to (FAO, 2021), and the trend is continuing to worsen in comparison to earlier years. People from developing nations make up the majority of the undernourished.

As a result, research and public policy must reconsider agricultural innovation trajectories to consider their long-term social implications in light of the resurgence of development issues in Africa linked to climate disruption and the crises of the industrial agriculture paradigm (Temple et al., 2018). This rejuvenation is critical because it takes place amid quickening socio-demographic changes, which are evident in Sub-Saharan Africa's explosive population increase and urbanization (Leridon, 2015). Africa's agricultural innovation is still firmly centered on achieving sustainable food security goals, i.e., providing for and maintaining the health of a rising population while protecting the environment.

Indeed, the green revolution of the 1970s and 1980s, which concentrated on intense and highly productive agricultural models, has left its mark on the design of agricultural systems. These models are now under scrutiny, as demonstrated by the research on pesticide contamination of groundwater by (Branchet et al., 2021). Therefore, better defining the innovation processes that will enable the rejuvenation of the agricultural model(s) fit the present and future development problems of the African continent is a key scientific, economic, political, and food issue. With more than 95% of farmers living on rainfed fields, it is the area of the world that is most vulnerable to long-term declines in rainfall and seasonal rainfall variability (Christensen & Christensen, 2007). The agricultural problem in Africa is primarily seen through the lenses of hunger, malnutrition, poverty, and therefore underdevelopment, as stated by (Cervantes-Godoy & Dewbre, 2010).

Due to the negative consequences of climate change, the majority of African countries' currently-cultivated land would be useless by 2050 (Burke et al., 2009). Furthermore, smallholder family farms that employ a variety of cropping methods and products that are geared toward both self-consumption and the market dominate African agriculture. They produce more than 80% of Africa's agricultural output (Ajadi et al., 2015). There are a few small and medium-sized farms nearby these larger farms. They frequently work in unfavorable conditions, such as those caused by bad soil, low productivity, limited access to resources, an unorganized market information system, etc. The environment's social, cultural, economic, and spiritual structure has further effects on them (Ajadi et al., 2015).

Several development methods have been started in response to these limitations, both to help the farms and to integrate them into a context of global and sustainable development. (Knox et al., 2012) project declines of up to 50% in some of Africa's principal crops, particularly the staple foods of the bulk of the population, rice, maize, wheat, sorghum, and millet. Strategies to address the food demands of African populations in rural and urban regions depend heavily on the growth of family farms. Farms, however, come in a wide range of sizes, levels of availability to resources for production, technical options, and sensitivity to changes in the external environment. Because of this variety, government interventions and those of different development assistance groups are complicated (Agossou et al., 2015).

For some, these phenomena will cause recurring food crises in the future, which will have an even greater impact on global food security (FAO, 2016; Y. Allé et al., 2013). The ability to get food will be significantly impacted in several African nations. In most climate scenarios, sub-Saharan Africa will be responsible for 40-50% of the world's hunger by 2080, up from 24% currently (UNDP, 2021).

Due to its cultural, geographic, and economic diversity, Cameroon, which is situated in Central Africa on the Gulf of Guinea, is referred to as a miniature Africa. The nation, which has a total size of about 475,000 km2, has a lot of agroecological potential (WFP, 2016). According to estimates from (IMF, 2022)), Cameroon's population increased significantly between 1980 and 2015, rising from roughly 8823000 to 23100000. More than half of Cameroon's population lives in rural areas, according to the general population and housing census conducted in 2005 (BUCREP/INS, 2005). This compares to 48.8 percent who live in urban areas. When considering the population's contribution to the expansion of agriculture, this represents a comparative advantage.

Cameroon is not immune to these problems, and the northernmost sector of its central region is particularly vulnerable. The nation faces the threat of climate change in addition to the weight of demographics. Additionally, roughly one million people, or 9.6 percent of households, experience food insecurity in rural areas as a whole (2.2 percent severe and 7.4 percent moderate). This national average conceals significant regional variation and especially high rates in the country's north (WFP, 2016). Because approximately 86 percent of the working population is employed in agriculture, which depends on rainwater, the nation's food security is more vulnerable to the negative consequences of climate change (MINEPDED, 2015).

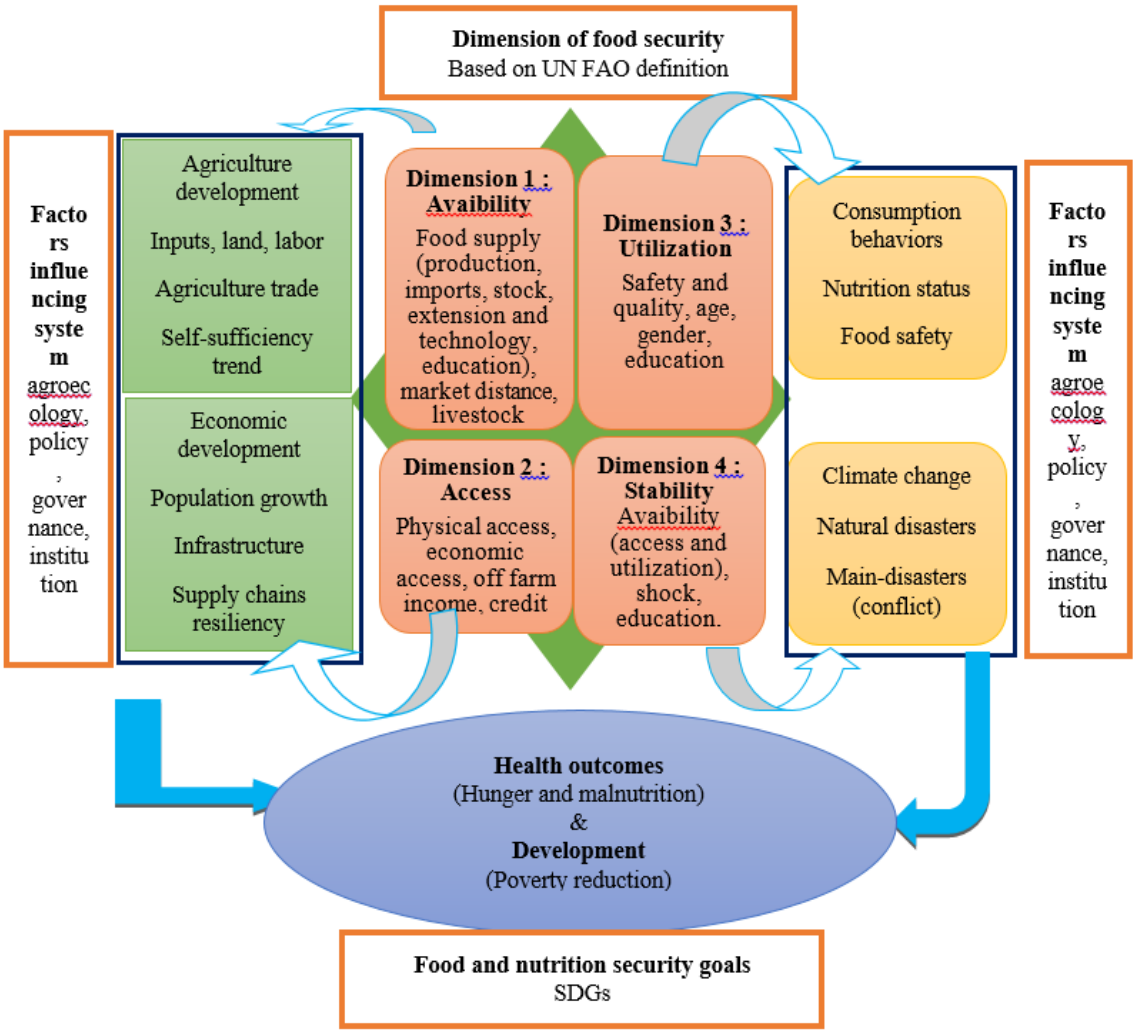
Therefore, several studies on the determinants of adaptation to climate change have been conducted, including (Chimi et al., 2022)), and food security management strategies have been developed by the state and development organizations. These studies have helped to better understand the concept of food security that suits the adverse effects of climate change (WFP, 2016). The majority of this research is devoted to figuring out how to adapt to changing climes and build resilience to them.

This study expands upon the body of previous research in this area by utilizing distinctive primary data from the Central Region. As a result, it made an effort to assess the situation and key determinants of food security in the forest-savanna transition zone in the northern Central Region of Cameroon. To do this, it had to look at the socioeconomic circumstances of agricultural households, their production practices, and their access to key production inputs. Several theories were advanced, including the following: (i) experience, wealth, and decision-making are significantly influenced by age; (ii) production systems in the four districts are highly variable; (iii) labor types have an impact on yields, and (iv) cultivation practices vary among the study sites. The results will be confirmed after a debate in light of the findings and evaluation of current development challenges, taking into account the agroecological diversity of the forest-savanna transition zones.

Conceptual framework

The intellectual underpinnings of food security are presented in this section. Food security is defined as everyone having access to enough food for a healthy life at all times (Mohamed, 2021; Von Braun et al., 1992). According to (Pieters et al., 2013), this study employs a conceptual framework that takes into account this notion of food security (Figure 1). The household's accessibility to food is referred to as the food availability dimension of food security. In this regard, the current study assumes that crop production and livestock ownership play a significant role in determining this dimension. As a result, consideration is given to both livestock and factors that influence crop output. Access to markets affects food availability, which is also significant (Pieters et al., 2013). Another somewhat similar idea is having access to food. Access to enough food is referred to as this. Off-farm income and credit availability are taken into consideration when calculating households' capacity to buy food. Similar to this, a household's susceptibility to food shortages influences the status of the household's food security, which is heavily influenced by the shock's occurrence, the education level (including analytical and forecasting skills), and the ownership of animals (Muche et al., 2014).). Diet quality is mostly correlated with food usage. The gender and degree of education of the household head may have a significant impact on the decision to consume a

high-quality diet. Additionally, gender and age may have an impact on nutritional requirements (Pieters et al., 2013).



Materials and Methods

Presentation of the study sites

This study was carried out in the Central Cameroon region's two departments: Mbam-et-Kim, namely in the arrondissements of Ntui and Mbangassina, and Lékié, specifically in the communes of Batchenga and Obala (Figure 2). There are two separate rainy seasons per year at these various study locations since they are situated in a bimodal humid forest zone. The agroecological zone (AEZ) that is the largest is this one (Boulaud, 2014). The transition zones between the forest and savanna include both

departments (Letouzey et al., 1985; Onana, 2018). It seems to contain several exemplary agroclimatic systems. These terroirs were selected for more reasons than only the contrasts in average yearly rainfall, demography, access to land, and marketability. The predominance of food crops and cocoa in these departments is their defining characteristic. In fact, (i) this region ranks among the top in the country for production; (ii) this region has diverse agro-ecological characteristics, the dynamism of family farms, and (iv) understanding the individual representations of farmers regarding their means and techniques of production in that the study invokes the notion of perception, and clarifying the meaning of practice.

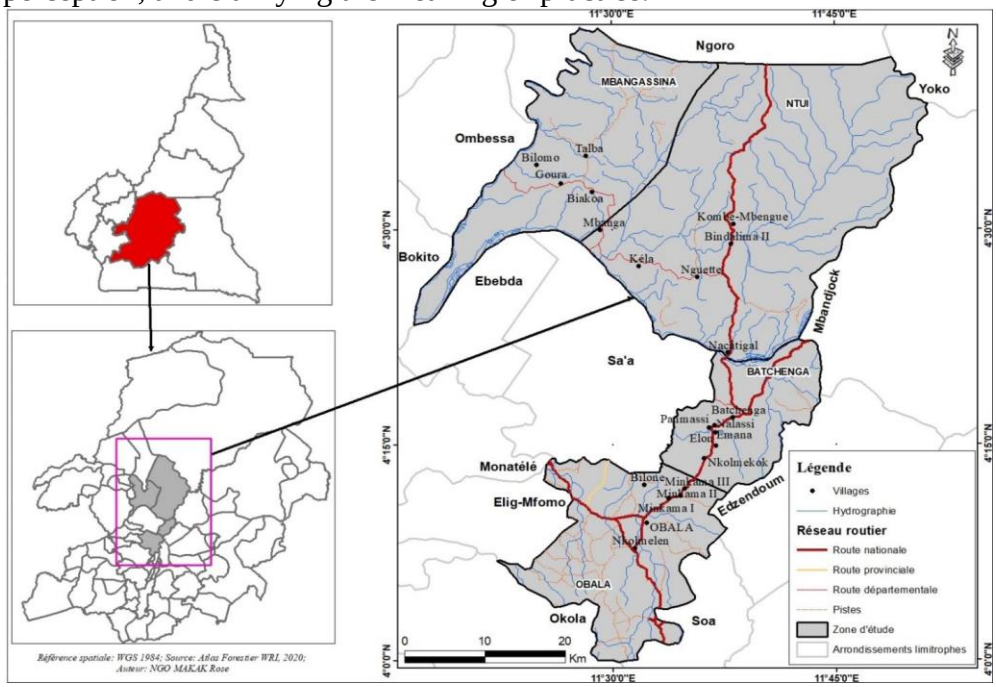


Figure 2. Map of the study area

Methods

Sampling

The intended sample size was used to calculate the number of households (N) to be surveyed in each village for the study's selection of farm households, with N equal to 10, 15, and 20 in villages with more than [0-99], [100-199], and [300-399] households, respectively (Bocquet, 2000; Chimi et al., 2022). A systematic or interval sampling approach was used to sample the entire hamlet. Calculating the number of households in the space (R) between the two households to be interviewed as part of this sampling technique (N). The gap that needed to be filled was calculated using the formula (R = P/N) (Chimi et al., 2022; PAR, 2018).

Where N is the total number of households to be questioned; R is the number of households that make up the gap between the two households to be interviewed, and P is the total number of households in the village.

To determine the number of households in each village, a preliminary interview was held with each chief and the MCHW(s) in charge of their respective regions. Based on origin, gender, age, and length of residence, each responder served as the head of the farm. The requirement for non-origin responders was an independent farm. Surveys were carried out in 17 communities within the study region, which was chosen based on the location of the croplands (dryland and/or floodplain). 180 agricultural homes were chosen as the sample size.

Data collection techniques and tools

The Accelerated Participatory Research Method (APRM), which employs techniques like semi-structured interviews, participatory observation, data mining, revealing quotes, and triangulation, was used to collect the data (Chimi et al., 2022; Mayer et al., 2000). The sampled farm managers were given a semi-structured questionnaire that was used to collect both qualitative and quantitative data. The information relates to the respondent's socioeconomic and demographic traits, the various crops planted, the area sown, and the availability of financial services and agricultural advice throughout the previous agricultural seasons. A semi-structured interview guide was used to create a monograph of each hamlet through a focus group of 10–15 individuals with a range of socio-professional characteristics.

The gathering process was divided into three phases: January through March 2020; March through May 2021; and July through September 2021. The organization of farms provides the foundation for the questionnaire. The socio-demographic characteristics (gender, level of education, marital status, age, and size of the household), as well as the number of farm assets, production equipment, crop areas, inputs used, off-farm activities, the type of laborer employed, crops grown, farm equipment, and issues specific to family farming, were the main variables collected and calculated. The farms' two rainfed crop cycles and off-season crops are the subjects of the data that was gathered there.

In addition, 180 chosen family farmers participated in a survey that used a systemic approach. This strategy involves familiarizing oneself with how farms operate (Mushagalusa et al., 2015). Along with this strategy, observation was more important in comprehending the farming environment. The farmers in the seventeen villages were chosen at random, and the villages were purposefully chosen. The districts of Mbangassina, Ntui, Batchenga, and Obala were picked because they were easily accessible and

because agriculture predominated there throughout the year. Family farmers are preferred because they are the ones who decide on the farming methods to use, as well as the producers and consumers of their farms' food. To achieve this, the study's interest in family farming aligns with the ideas of (Ferraton & Touzard, 2009; Mushagalusa et al., 2015): family farming gathers a sizable portion of the population, then it is impoverished and aids in development, and finally, it provides a variety of services to society, including ensuring food security.

Data processing and statistical analyses

A database produced with the KoBo toolkit was subjected to statistical analyses and tests of average comparison using SPSS 20, Xlstat 2022.2.1.1294, and Rstudio 2022.07.1-554. The latter was utilized to gather data on the ground. For processing, the data was moved to Excel 2022. For calculations and the creation of tables and graphs, this spreadsheet was used. The data was combined using pivot tables.

The information for this task came from the answers to the questions. After obtaining the database, many analyses might be carried out. These were employed to bolster the discussion's point. The primary parameters of position (mean, frequency, maximum, and minimum) and dispersion (variances, standard deviation, and/or standard deviation) were first determined by descriptive studies. Graphical representations were then created (histogram, boxplot, bar, and pie charts). Tests of statistics (pairwise comparisons, association, parametric and non-parametric). Regression analysis was utilized to establish the relationship between household size and family labor, and the Kruskal Wallis test at the 5% level was employed to compare means and village differences. After entering the map data into Excel, Arcgis 9.1 exported it for processing. The primary challenge in doing this research is the dispersed nature of farmer fields, which causes some farmers to underestimate the size of their farms. The interpretation of a figure less than 1' may be unclear because so few farmers in the entire sample had less equipment (a pickaxe, planter, and watering can), especially because rounding has been reserved.

The outcome of the data analysis enables us to characterize the farms' contributions to food security to display the results.

Results

1. Socio-economic situation and production system in the zone

1.1 Socio-demographic characteristics of farmers

The findings indicate that there is a difference between the four localities, with men making up 73.3 percent of FTs and women 26.7 percent (p-value = 0.008). The majority of farm managers are wed (60.5 percent).

Christians make up 83.63 percent of respondents, while Muslims make up 9.45 percent. With 62.2 percent of its sample, the Obala district has the highest percentage of civil and religious weddings. Most males in the EC live monogamous lives—91.93%. With 15.4%, Ntui has the highest polygamy rate. 55.56 percent of FTs do not belong to a cooperative that represents farmers. There is no independent relationship between localities and participation in a peasant group because the calculated p-value (p-value=0.0002) is below the significance level alpha=0.05. Additionally, the p-values (Fisher's exact test) of the no and yes modalities for Mbangassina, Ntui, and Obala are significant at the alpha=0.05 level (0.040 and 0.040, 0.040 and 0.040, and 0.0001 and 0.0001, respectively).

The findings show that while 17.8 percent of respondents lack formal education, 82.3 percent of respondents can at least read and write. Of the respondents, 42.8% have completed at least their elementary schooling. 4.45 percent of farm managers have a higher degree, which is a very small percentage. Additionally, because the computed p-value is greater than the significance level of alpha=0.05, there is no locality difference. With only 1% of the total institutions in the three districts being higher education facilities, there is a notable lack. The socio-demographic profile also reveals significant variations in these districts.

The average age of the 17 villages according to socioeconomic surveys is 49.42 0.93 years, indicating that young people do not have easy access to land and do not inherit relatively young. The typical number of years in farming is 21.17±0.18 years. There are 8 people in the typical home. Additionally, the sample reveals that 69.44 percent of FTs are also responsible for other persons. On average, there are 4 of them. 85 percent of the 180 farmers who were interviewed believe that they are primarily farmers (84 percent of farmers and 1 percent of retired civil servants converted into farmers).

The primary source of income for households in the study region, which has an average area of 4.560.21 ha, is agriculture. The petty trade sector (6%) and employment in public administration follow agriculture (4 percent). The research area's average monthly household income is 777472 - 67510.90 F CFA.

1.2 Agricultural equipment used

Family farms use a variety of equipment. The analysis of variance data revealed a substantial variation in the number of machetes, daba, boots, wheelbarrows, and sprayers owned between the districts. Seeders, files, watering cans, gangs, sprayers, cocoa harvesting hoses, motorbikes, motor pumps, motor tricycles, pickaxes/planters, rakes, tractors, and chainsaws were all reported to be in the same amount of possession. The daba is the

only item held in higher quantities, it is stated (85.55 percent). Only a small percentage of farmers in Batchenga (17.78%) and Ntui (26.67%) have watering cans and hoes, respectively (Table 1).

Table 1. Equipment used on the farms

EAF material	Batchenga	Mbangassina	Ntui	Obala	p-value	Average
Daba	2.3 ± 0.21^{b}	2.69 ± 0.20^{b}	1.33 ± 0.10^{a}	2.32 ± 0.18^{b}	<0.0001	2.20±0.10
Boots	2.27 ± 0.36^{b}	1.65 ± 0.16^{ab}	2 ± 0.33^{ab}	1.33 ± 0.08^{a}	0.037	1.65±0.10
Wheelbarrow	1.67 ± 0.16^{ab}	1.95 ± 0.19^{b}	1.79 ± 0.20^{ab}	1.30 ± 0.07^{a}	0.036	1.68±0.08
Machete	2.4 ± 0.09^{b}	1.52 ± 0.07^{a}	3.31 ± 0.65^{ab}	2.35 ± 0.32^{b}	<0.0001	2.3±0.15
Sprayer	1.09 ± 0.06^{a}	2.52 ± 0.35^{b}	1.67 ± 0.28^{ab}	1.65 ± 0.26^{ab}	0.001	1.78±0.15

The different letters next to the means ± standard error indicate the significant difference at the 5% probability threshold after the two-tailed Steel-Dwass-Critchlow-Fligner test.

1.3. Production Systems

Subsistence agriculture, which is practiced in the northern zone of Central Cameroon, has three main characteristics: small-scale farming; primarily manual labor using basic tools like a machete, daba, boots, wheelbarrow, and sprayer; and the use of high-performance agricultural inputs for cocoa cultivation, such as seeds or cuttings of improved varieties, pesticides, and chemical fertilizers.

1.3.1. Useful agricultural areas and main crops

With a minimum of 0.75 ha and a high of 17 ha, the average size of fields used for farming is 4.55 0.21 ha. There is a significant difference between the localities and the variable useable agricultural area because the estimated p-value is less than the threshold for significance alpha=0.05. According to the data, the major crop's minimum and maximum acreage are 0.25 ha and 15 ha, respectively, with a combined average of 3.12 0.2 ha for the four districts. At the 5% cutoff, there is a considerable discrepancy between the values of the four districts (p-value = 0.0002).

There is a link between the four localities, and the area used for market gardening is 1.09 0.13 hectares. The computed p-value is below the 5 percent cutoff. *Theobroma cacao*, or cocoa, is the primary cash crop and is grown by farmers in the northern section of the Central Region on an average of 3.540.03 ha. The 4 communes are connected (p-value = 0.0003). The producing basins of Mbangassina, Ntui, Batchenga, and Obala are used to grow food crops. This basin is 1.67 0.18 ha on average, with a minimum area of 0.25 ha and a maximum area of 4.5 ha. p-value=0.08; there is no connection between the places because the calculated p-value is greater than the significance level alpha=0.05.

According to the findings, a farmer typically cultivates 0.37 x 0.031 hectares (ha) of *Zea mays* (maize), 0.46 x 0.03 ha of *Manihot esculenta* (cassava), 0.19 x 0.011 ha of *Arachis hypogaea* (groundnut), 0.16 x 0.01 ha of *Ipomea batatas* (sweet potato), 0.28 x 0.03 ha of *Dioscorea* spp. (plantain). *Musa* spp. (sweet banana), *Cucumeropsis mannii* (cucumber), *Xanthosoma* sp. (cocoyam), *Sesamum indicum* (sesame), *Vigna subterranea* (voadzou), and other fruit trees are further crops connected to the latter. Few people farm *Oryza sativa* (rice) on 7 acres of land in the Batchenga district. However, the districts of Batchenga and Obala stand out for the area dedicated to maize, cassava, and market garden crops, while the districts of Ntui and Mbangassina rank second and third, respectively, for cocoa and plantains.

1.3.2. Yields for the main crops

The same key agricultural yields differ per district. The average yield of groundnut is 10.11.3. The highest yield was recorded in Batchenga (0.300.03), and the lowest yield was recorded in Obala. The districts are interconnected. Plantain, cassava, and yam yields are about equal across the study's various locations. The average number of bunches for these crops is 45.44.6, 92.215.5, and 330.635.3, respectively. With a production of 499.1187.4, the district of Batchenga leads the way in maize. The Ntui commune produces the sweetest potatoes. The predominant crop in the study's various localities, cocoa, has an average of 4863.6477.6. The top two producers are Mbangassina and Ntui, with 6106.71088.8 and 5617.51132.6, respectively (Table 2).

According to the analysis, 90% of farmers think that the production rate is irregular, while 10% think that it is normal. There is no correlation between production rate and locales because the calculated p-value is greater than the significance threshold of alpha=0.05. Fisher's exact test results show that the p-values for both modalities are significant for the Obala area (0.047). The level of yield, according to 60.56 percent of FTs, has declined; 35.56 percent say it is constant; and 3.89 percent say it has improved. At the 5% level, there is no difference between the two variables. However, the stable modality is significant at 0.05 in the Batchenga locale, according to Fisher's exact test. The crop has not satisfied 68.33 percent of farmers. As a result, 68.33 percent of the respondents are dissatisfied with their crops. Additionally, the chi-square test indicates that there is no difference between localities at the level of 5%.

Table 2. The yield of the main crops in Kg

District	Groundnut	Yam	Maize	Cassava	Sweet potato	Plantain	Cocoa
Batchenga	12.4±2.5^{b}	37.4±7.6^{a}	499.1±187.4^{b}	62.5±8.5^{a}	40.6±10.5^{ab}	311.1±68.7^{a}	1906.67±430.77^{a}
Mbangassina	12.3±3.08^{ab}	40.6±5.5^{a}	28.6±7.9^{a}	143.6±44.6^{a}	35.1±9.5^{a}	388.3±73.1^{a}	6106.7 ±1088.8^{b}
Ntui	9.5±2.6^{ab}	41.6±8.7^{a}	73.9±40.8^{a}	100.4±36.4^{a}	43.7±7.6^{b}	353.3±73.4^{a}	5617.5±1132.6^{b}
Obala	4.57±1.6^{a}	61.8±13.8^{a}	673.6±186.2^{ab}	55.4±10.1^{a}	23.91±8^{a}	237.2±52.3^{a}	5076.3±634.6a^{b}
Average	**10.1±1.3**	**45.4±4.6**	**324.6±71.6**	**92.2±15.5**	**36.5±4.7**	**330.6±35.3**	**4863.6±477.6**
p-value	**0.005**	**0.81**	**0.0005**	**0.662**	**0.016**	**0.71**	**0.015**

The different letters next to the means ± standard error indicate the significant difference at the 5% probability threshold after the two-tailed Steel-Dwass-Critchlow-Fligner test.

There is a lot of information on the correlation matrix, according to the Pearson correlation test at the 5 percent threshold between the variables of area, the yield of the various crops, and variables like labor, household size, age, and several years of experience in agriculture. The correlation coefficient (r) between cocoa area and yield is 0.67, indicating a relationship between the two. With correlation coefficients of 0.78, 0.54, and 0.69, respectively, the acreage and yields of maize, plantains, and yams are likewise related. Consequently, the yield rises as the area does. Additionally, peanuts, sweet potato, and cassava yield and area had positive correlations with $0.46 \leq r \leq 0.42$. Additionally, there is no connection between household size, age, years of agricultural expertise, or yield characteristics (Figure 3).

Legend: SCR (cocoa area); RCR (cocoa yield); SMA (cassava area); RMA (cassava yield); SMS (maize area); RMS (maize yield); SPL (plantain area); RPL (plantain yield); SPA (sweet potato area); RPA (sweet potato yield); SIG (yam area); RIG (yam yield); SAR (groundnut area); RAR (groundnut yield); AGE (age); NEA (years of farming experience); TAM (household size)

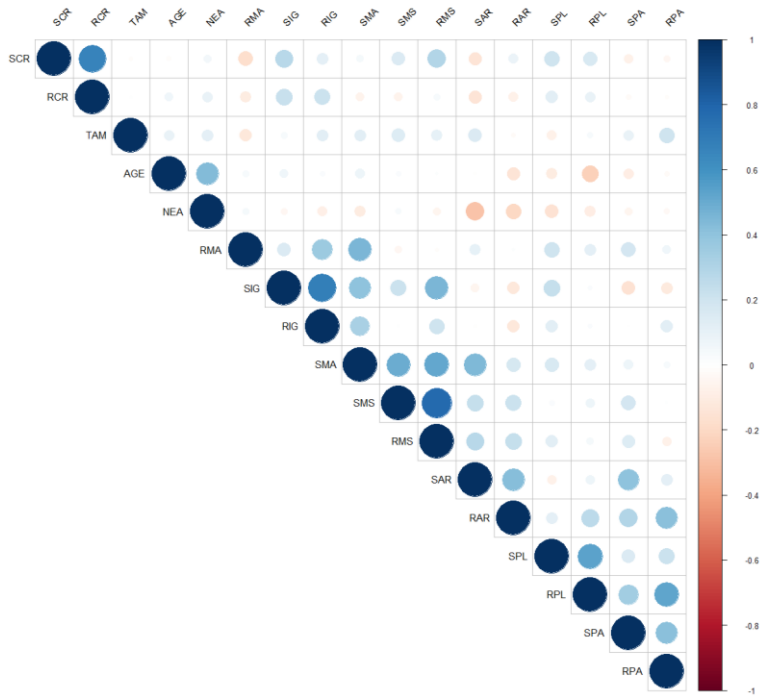


Figure 3. Image of the correlation matrix

There are a variety of used variants, based on the theory. 2.630.18 kinds of tubers/roots are the most prevalent. Given that the estimated p-value is less than the threshold of 5% for the Kruskal-Wallis's test, there is a relationship between the variety and localization of the variables. There are 2.52 varieties of cocoa, plus or minus 0.19. This variable and the various communes have a relationship (p-value=0.004). There is no discernible variation between places and this parameter for the major legume varieties, which are 1.980.18. Cereals have a reliance between the four boroughs and a record 2.220.18 variety (p-value).

There are a variety of used variants, based on the theory. 2.63±0.18 kinds of tubers/roots are the most prevalent. Given that the estimated p-value is less than the threshold of 5% for the Kruskal-Wallis's test, there is a relationship between the variety and localization of the variables. There are 2.52 varieties of cocoa, plus or minus 0.19. This variable and the various communes have a relationship (p-value=0.004). There is no discernible variation between places and this parameter for the major legume varieties, which are 1.98±0.18. With a reliance between the four boroughs, cereals have 2.22±0.18 varieties (p-value 0.0001). The average number of variations for the remaining secondary crops (sweet banana, squash, and sesame) is

1.67±0.21. However, the Kruskal Wallis test at the 5% level indicates that the districts are independent.

1.3.3. Livestock

40% of respondents did not engage in subsistence farming, compared to 60% who did. 49.07 percent practiced it for consumption, and 50.93 percent for sale. The chi-square test indicates a dependence between locales and this parameter at the 5% level (p-value = 0.0001). According to the studies, 50% of the farmers in the northern region of Central Cameroon who do not raise livestock think they are not proficient in the technical travel routes of cattle. However, 44.23 percent of respondents said they lacked the necessary resources. At the 5% cutoff, there is a large variation between localities.

According to the findings of the analysis of variance, there is a considerable discrepancy in the number of chickens owned between the districts. There were no differences noted in the ownership of goats, pigs, or sheep. The only group kept in greater numbers is fowl. Several farms breed pigs and poultry in Mbangassina in the Batchenga area. The Shapiro-Wills test indicates that the number of goats, sheep, pig, and poultry breeds is not homogeneous at the 5 percent level. On average, goats have 1, pigs 2, chickens 3, and sheep 1.

The study area contains several livestock farmers. Small ruminants and pigs are the most common types of livestock that are raised, along with poultry for special occasions like celebrations and urgent financial demands. Small-scale livestock is present in the markets because there is an immediate demand for money that cannot be satisfied by selling staple foods.

2. Access to factors of production

2.1. Land

The ability to access land is not a significant barrier to farming in the Mbangassina, Ntui, Batchenga, and Obala regions. Inheritance accounts for the majority of appropriations (58.33%), followed by rental income (14.43%) and short-term loans and assignments (1.43%). (10.56 percent). The methods used to acquire land and the regions have little bearing on one another. 45.55 percent of farmers grow perennial crops like cacao to protect their land. 25.55 % of the land is left fallow. The security depends on the research locations and has a p-value of 0.0001 for the chi^2.

50 percent of farmers use both food and cash crops as their primary land uses. 20% make use of savannahs. Old fallows make up 12.22% of the area, and forest galleries make up 17.78%. The four districts are dependent on the type of predominant land use. In fact, the chi2 test of independence has a p-value of 0.05 (p-value=0.0003). Additionally, the cash crop and food

crop modalities' Fisher-adjusted residual values are significant in Batchenga (-2.003 and 4.538, respectively) and Ntui (3.204 and -2.656). Batchenga (-2.152) and Mbangassina communes have substantial values for the savanna mode (2.152).

The field and the farm manager's home are separated by 3698.61161.65 meters. According to the Kruskal-Wallis's test, there is a significant difference between the several localities at the level of 5%. The analyses show that 70 percent of farmers believe the distance between their home and field is fair, 23.33 percent believe it to be far away, and 6.67 percent believe it to be far away. There is no correlation between location and distance assessment because the estimated p-value is greater than alpha=0.05, the threshold for significance. However, the p-value of Fisher's exact test at 0.05 indicates that the modality "far enough away" is significant in Batchenga.

2.2. Seeds, fertilizers, good agricultural practices, and pest management

In the region, there are no official seed vendors. The majority of the propagating material used is regional (80 percent). It is primarily derived from previous harvests (47.77%) but also from local market purchases (15.15%), GIC/Cooperative purchases (18.89%), agricultural institutions (10.56%), and contributions from other producers (7.77 percent). Some farmers do, however, employ modified seeds (20 percent). More people use these seeds in the communities of Batchenga and Obala.

According to 64.44 percent of farmers, soil fertility is unchanged. In Batchenga, it has marginally decreased. This variable and the various places show a significant difference at the 5% level (p-value = 0.0001). 52.78 percent left agricultural residues in place to allow the soil to recover naturally. The prevalence of this practice is high in Mbangassina (67%) and Ntui (64.44 percent). Districts do not relate to one another because the computed p-value is greater than 0.05. Organic amendments are used by 62.22 percent (chicken droppings, pig dung). There is a connection between the 4 municipalities and this parameter because the estimated p-value is less than the alpha=0.05 level of significance. In farms, chemical fertilizers are rarely used (74.78 percent). However, vegetable farmers employ them to increase crop production.

Crop rotation is used by 78.88% of the sample. There is a reliance between this practice and the various places because the determined p-value is less than alpha=0.05, which is considered to be the level of significance. Crop rotation is used by 92.22 percent of farmers. At the 5% level, there is a significant difference between this variable and the four districts according to the chi-square test of independence. 8.33 percent of people don't fallow.

These people fall under the non-native category. Chi2's p-value is more than 0.05, indicating that the study sites are independent. Farmers reported several issues with weeds, diseases, and pests in their crops. Plant wilt and scattered stand are therefore the most prevalent, as indicated by 47.78 percent of the sample. Severe defoliation (18.33%), shredded leaf edges (17.77%), and devoured/emptied seeds follow this (16.11 percent). There is a significant difference (p-value 0.0001) between the locales and this variable according to the Chi-square test of independence. In the locales of Batchenga (0.041 and 0.0001) and Ntui, the p-values (Fisher's exact test) of the modalities: shredded leaf edges and plant wilting is significant at the 5 percent threshold (0.025 and 0.020 respectively). In Batchenga, only the sparse stand modality (p-value = 0.005) was significant.

2.3 Workforce

At the arrondissement level, a considerable variation in household sizes was seen. The largest households are in Batchenga, which has 9 members, while the smallest are in Mbangassina, which has7 members. Family labor makes up the majority of the labor force on farms. With an average of 4 workers per farm, the family labor force on farms spans from 1 to 20 persons. There is a considerable difference between locality and family elaborate the 5 percent threshold. Family labor appears to be less prevalent in Mbangassina with 4 people. Between one and five people, external labor is found. There are typically two active people. Furthermore, according to 69.59 percent of respondents, this workforce is youthful. There is a dependency between the two variables because the calculated p-value of the chi-square test of independence of the locales and workforce constituents is below the significance level alpha=0.05 (p-value=0.002).

2.4. Relationship between household size and agricultural labor

More than 54.44 percent of the family farms surveyed admit that they only use family labor. There is a significant difference between the four districts because the estimated p-value is less than the threshold for significance, alpha=0.05. One-time, temporary, and permanent employees make up the external labor force the four localities do not significantly differ from one another (p-value = 0.91).

The following equations represent the relationship between household size and family labor: $y = 1.57x + 1.74$ and $R2 = 0.79^{***}$ where y is labor, x is household size, and R^2 is the coefficient of determination. For all the differences seen, household size determines 79 percent of the labor force. In addition, the explanatory variable accounts for 79 percent of the variation in the dependent variable, household size. The information offered by the explanatory factors is considerably better than what would be

explained by the mean of the dependent variable alone, given the F-statistic p-value associated with it (0.0001) and the significance level of 5 percent chosen (Figure 4).

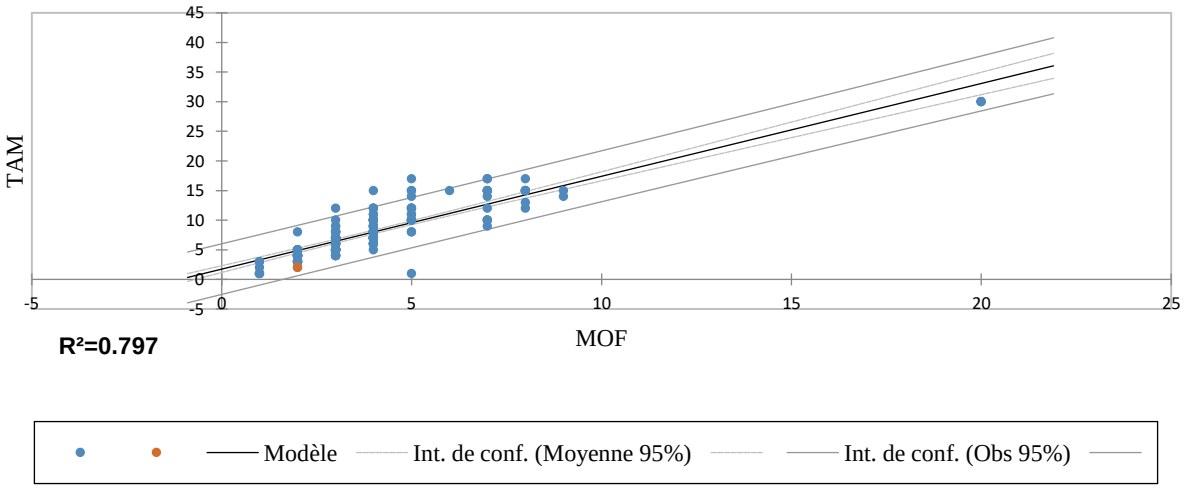


Figure 4. Simple regression curve of household size versus labor force

2.5. Production and transport equipment

Family farms employ a wide variety of machinery. The analysis of variance results revealed a substantial variation in the number of hoes, wheelbarrows, boots, sprayers, and seeders owned between the districts. Files, watering cans, gangs, sprayers, cocoa harvesting hoses, motorbikes, motorcycle pumps, motorcycle tricycles, pickaxes/planters, rakes, tractors, and chainsaws were all reported to be in the same amount of ownership. The hoe is the only piece of equipment that is retained in greater quantity, it is noted. As with chainsaws in Ntui, very few farmers in Batchenga own watering cans.

Analysis of the data reveals that 71.11 percent of respondents think it is difficult to get agricultural mechanization via tractors. 17.78 percent, on the other side, believe it to be simple. 11.11 percent of respondents claimed that mechanization was unavailable where they lived. There is a correlation between location and access to mechanization because the calculated p-value (p-value0.0001) is below the significance level alpha=0.05. The tough (0.0001), easy (0.001), and non-existent (0.002) modalities for the commune of Batchenga are significant, per the p-values (Fisher's exact test). The challenging modality for Ntui is significant (p-value = 0.023).

2.6. Market access and product orientation

The analyses show that 67.22 percent of respondents think it is tough to access the market. The isolation of the industrial locations can be used to explain this. The market access variable is correlated with the four study districts (p-value 0.0001). Fisher's exact test p-values for the districts of Mbangassina (p-value 0.0001), Ntui (p-value 0.0001), Batchenga (p-value 0.0001), and Obala (p-value = 0.01) are significant at the 5% level for both the easy and difficult modes. 96.77% of companies use motorcycles to transport their goods to customers. The consumers are varied. Re-sellers (bayam-sellam/coxeurs) make up 50%, followed by loan sharks (41.67%), and local purchasers (8.33%). Products are autonomous. Regarding the selling kind, 42.78 percent occur at the bayam-sellam/coxeurs field. In large towns like Yaoundé, 15.56 percent are sold in groups; 22.22 percent are sold at the district market; 15% are sold by the roadside, and 4% are sold at the weekly village market. There is a correlation between locality and type of sale because the estimated p-value is less than alpha=0.05, which is the level of significance.

86.11 percent of farm managers let 11-50 percent of customers know how their farms produce their products. The 4 research locations and the production process are interdependent (p-value 0.0001). When asked about the marketing of farm-produced goods, 60% of the farm managers who were questioned said that 11–30% of the goods from their farms are sold locally. There is a relationship between the various localities and the percentage of products marketed locally because the calculated p-value of the chi^2 test of independence of variables is below the significance level alpha=0.05 (p-value0.0001).

61.89% of farmers sell between 61 and 80 percent of their harvest to customers outside the area (bayam-sellam). 27.78% of the farmers sell between 21 and 60 percent of their harvest to the latter. There is no independence between the variables locale and percentage of goods sold to resellers because the estimated p-value is below the significance level alpha=0.05 (p-value0.0001). 85.56 percent of the farmers in the sample who live in the communities of Mbangassina, Ntui, Batchenga, and Obala said they only use 1 to 10 percent of the produce from their fields. 14.54% of the analyses eat between 11% and 20% of their harvest. Given that the estimated p-value is greater than alpha=0.05, there is an independent association between the relevant variables.

2.7. Sustainability of the farming activity

When asked if the farm will still be in operation in ten years, 49.44 percent responded that it is almost certain that it will. However, 50.56 percent mention the desired existence (if possible) and a probable existence

(27.22 percent) (23.33 percent). There is a correlation between the locales and this parameter because the estimated p-value is less than alpha=0.05, which is considered to be the level of significance. Additionally, the Obala locality (0.040) and Batchenga locality (nearly certain, 0.003) of the Fisher test are significant at the alpha=0.05 level for the desired existence.

3. Current challenges and nature of problems at the borough level

14.44 percent of respondents, as determined by the analysis, believe that infrastructure is lacking on three fronts. 13.88 percent report having restricted access to agricultural inputs, and 11.67 percent mention having trouble getting access to mechanization. Access to credit is a real issue, according to 11.11 percent of respondents. 8.89% of farmers think there is a shortage of rain, which is related to the rainfall deficit. 8.89% bring up a shoddy market structure. 7.78% of the sample cited the shoddy condition of the tracks and roadways. Integrating livestock and agriculture, not having enough money or other resources, and having unstable land tenure, respectively, account for 8.33 percent, 7.78 percent, and 7.22 percent of the farmers polled. There is a connection between the issues and the various localities because the estimated p-value is below the threshold of significance alpha=0.05. Both the absence of financial/material resources and access to credit have significant p-values (Fisher's exact test) at the alpha=0.05 level.

Discussion

Socio-economic situation and production system in the zone

This age (42.42 years) is seen as a vibrant and active one that probably displays inventions for financial gain. This result is essentially identical to earlier research by (Singh & Singh, 2017)), who noted that age significantly influences experience, income, and decision-making, which in turn affects how people work and, ultimately, individual productivity.

Understanding environmental phenomena and agricultural management depend heavily on the respondents' educational background. Farmers who have this education are better able to comprehend agricultural methods and devise plans for adapting to changing conditions and raising their level of life. We spoke with farmers with various levels of education. Small-scale farmers have the chance to impart agricultural knowledge and technologies to help the region address the difficulties of sustainable development with this level of schooling. Additionally, food insecurity is more prevalent in homes headed by FTs with lower levels of education. Another factor that helped to ensure the food security of the home was the household head's education level. The justification for this finding is intuitive: households with higher levels of literacy may choose more

logically and intelligently when it comes to the production and marketing of agricultural goods. There are 8 people in the typical home. This is roughly the size of Kindu's agricultural households, which have an average of 6 people (Masumbuko et al., 2012).

The primary characteristics of family farming are the existence of organic ties between the household economy of the family and the production unit as well as the mobilization of family labor (Fréguin-Gresh et al., 2015). As a result, a crucial element in the process of defining farms is the research on the socioeconomic circumstances of the farm household. Farm households are primarily headed by men in the Mbangassina, Ntui, Batchenga, and Obala areas (73.3 percent). In Central Kongo Province, the percentage of households with a male head of household is comparable to the national average (Mpanzu Balomba, 2014) (Kalambayi et al., 2019). This is because, unless they are widows or heirs, women are rarely EC in the study area. Additionally, this can be because households led by men have better access to social and physical resources that allow them to make, buy, and consume a variety of wholesome foods (Sani & Kemaw, 2019). Another explanation could be that households led by men are more likely to have access to labor and have more experience in farming than their female counterparts. Younger household heads are more likely to have access to food than other household heads, maybe because they often have the physical strength to run their farms and make money from other sources outside of farming.

The primary source of income for households in the study region, which has an average area of 4.56±0.21 ha, is agriculture. This region is larger than farming households in the Democratic Republic of the Congo's Kasai Central, South Kivu's Ruzizi plain, and Katanga province, according to data from (Furaha Mirindi et al., 2016), and Kasai Central in the Democratic Republic of Congo, respectively (Kalambayi et al., 2019). The petty trade sector (6%) and employment in public administration follow agriculture (4 percent). The sub-study area's average monthly household income is 777472 ± 67510.90 CFA. The primary source of income for households in Mbangassina, Ntui, Batchenga, and Obala continues to be agriculture. At the 5 percent level, there is a considerable local variation in annual income (p-value = 0.007).

Subsistence agriculture is practiced in the region of Central Cameroon's northern zone. This was brought up by (Chimi et al., 2022) in their research. There are three key qualities of it: small-scale farming, which consists primarily of manual labor using simple implements such as a daba, boot, wheelbarrow, machete, and sprayer. There is extremely little use of productive agricultural inputs like herbicides, chemical fertilizers, improved variety seeds or cuttings, etc. In Kasai Central, the same observation was

also made by (Kalambayi et al., 2019). Bushfires, deforestation, conventional farming methods, a lack of agricultural inputs, and a lack of farmer monitoring all contribute to low agricultural production.

Cocoa, maize, cassava, plantain, sweet potato, yam, and peanuts are the principal crops farmed in the region. Major crops include cocoa, maize, and cassava. This is so that cocoa speculation can profit from its potential to bring in money. Fufu and "cassava sticks," which are major meals in the region of interest, are made mostly from the cassava harvest. In addition to the seven main crops, households also raise a smaller number of other crops including cowpeas, sesame, pistachios, voandzou, tomatoes, etc. However, they enable households to diversify their sources of income and increase the variety of foods they consume.

According to survey findings, the zone's yields for cassava, maize, groundnuts, yams, sweet potatoes, plantains, and cocoa range from 92.2 to 15.5 for cassava, 324.6 to 71.6 for maize, 10.1 to 1.3 for groundnuts, and 45.4 to 4.6 for yams. The yield for cassava is lower than both the FAO's suggested average for Central Africa and the yields of Niger, which has the best yield in Africa and India, which has the best yield globally, as determined by (Furaha Mirindi et al., 2016). This poor performance would result from continued use of antiquated cultivation techniques (cultivation in primary forest and on slash and burn, crop association, etc.). This yield for maize is slightly lower than that seen in the Ruzizi plain but significantly greater than that shown in Central Kongo province (Mpanzu et al., 2011) but lower than that observed in the Ruzizi plain (Furaha Mirindi et al., 2016).

Overall, public policies should encourage the increase in these crops' yields and the productivity of the zone's production elements. Although these crops are grown in a range of environments, the seven major crops mentioned prefer the broad fields of the savanna. In the savannah, households plant maize, although very few do so in the forest. Cassava cultivation shows a similar pattern. These results go against those of (Kalambayi et al., 2019), who demonstrated that the forest is more frequently utilized for the production of these crops. Furthermore, they claim that the fertility of forest land and the higher harvests it produces are the key factors in choosing it. Even if the savannah is becoming more and more popular, cocoa is still growing more in the forest.

Given that this is slash-and-burn agriculture, this reality gives rise to concerns about the adverse consequences of agricultural practices on forest regions. This largely explains why farmers are traveling more and farther in quest of forest land that is thought to be more fertile. The majority of households in Mbangassina territory open up their fields in the forest, in contrast to Obala territory where households do not do so since forest areas

have all but vanished from the terrain. In the forest, households without fields cultivate crops near their houses and in the savanna.

40% of households in the study region unacceptably consume food. Their food intake is meager or restricted. Families do not eat enough wholesome food to support an active and healthy lifestyle. 18.5 percent of farm managers believe that their homes consume too little food. These households eat a lot of tubers, roots, and grains (such as cassava, sweet potatoes, and yams), along with some vegetables (voadzou, and various vegetables). Dairy and animal proteins are seldom ever found in their diet. 36.2 percent of people consume little food. Families often consume cereals, roots, and tubers together with a small amount of protein once a week.

The research area does not have a mixed agricultural system, or at least livestock is raised according to tradition. Therefore, livestock does not contribute much to household agricultural productivity and subsequently to food security. The majority of smallholder farmers in the northern area of Central Cameroon do not employ oxen for threshing and plowing work. The selling of cattle and livestock products is not a means of generating revenue, supplementing one's diet, or providing transportation. Additionally, cattle cannot be used as a coping strategy in the event of natural disasters such as crop loss. It should be mentioned that although there is a lot of livestock in this area, the owners are Bororo nomads. Farming households raise livestock for their own needs. This outcome differs from that of (Mohamed, 2021) who conducted research in Ethiopia.

Access to factors of production

According to several theses, there is a relationship between the amount of producible food and the contributions of a group of factors whose knowledge is of interest and that it is feasible to produce more with a certain quantity of factors (work, land, etc.). Some production factors merit in-depth examination to help classify farms in terms of their significance. Each socio-cultural group's evolution of the laws governing access to, purchase of, and use of land is reflected in these laws (Gislain et al., 2018). In the study territories, access to land does not present a significant obstacle to farming.
Inheritance accounts for 58.33% of all appropriations, and axe right is the mode that tends to diminish (8.5 percent). This runs counter to how Congolese land is accessed. In fact, in the Central Kongo province, where nearly 87.5% of agricultural households have direct ownership (Mpanzu Balomba, 2014). Similar to this, (Mulumeoderhwa Munyakazi et al., 2022) demonstrated in their research that tenancy dominates 66.7 percent of farmers. Customary rights holders who inherited the land from their ancestors are the main landowners and farmers in the area under evaluation. Land tenure is dualistic between the legal and the traditional, as

(Ngalamulume Tshiebue, 2010) emphasizes. There is often no issue with the area's access to fertile land. The availability of arable land for field extension is cited by 70% of agricultural farm managers. 8 percent of people even think that this land is bountiful. When the regions are looked at separately, it seems that Mbangassina and Ntui have equal access to arable land. In Batchenga and Obala, it is also challenging to find more arable land for field extension. According to perception, Ntui has more arable land than the other places. The same conclusions were reached by (Kalambayi et al., 2019).

The majority of farmers in the study area favor forest soils because of their fertility, however, these are spread out over large distances of up to 8 km. Due to the dearth of forested regions, the proximity of homes (3698.61±161.65 meters), and the convenience of evacuating the gathered goods, the majority of the harvested fields are situated in the savanna and on the periphery of the huts (52 percent). For 25% of farmers, a major challenge is the lack of rain during the planting season. The majority of farmers—30.4 percent—believe that the market is poorly organized.

Farmers start by cultivating areas near the villages using shifting cropping systems. They follow the declining fertility of the land as soon as it happens. In the savannahs, there is a need to support those who engage in agroforestry, i.e., to support food crops, cash crops, and trees, particularly fruit trees, melliferous tree species, and insect hosts, as well as species that can nourish the soil in the savannahs through improved fallows. This method might increase food security and bring in more money for farmers.

Although agricultural schools assert to be the best suppliers of certified seed in the region, there are no official suppliers of certified seed there. Almost always, local material is used as a spreading medium (80 percent). It is primarily derived from past harvests (47.77%), but it also comes from local market purchases (15.15%), contributions from other farmers, agricultural institutes (10.56%), and cooperatives (18.89%). (7.77 percent). More than half of the cassava, maize, plantain, bean, and peanut propagation material in Central Kongo Province, according to (Mpanzu Balomba, 2014), comes from past harvests or the local market. Similar findings were made by (Kalambayi et al., 2019), even though they did not discuss agricultural institutions and farmer organizations. The findings of this study also demonstrated that the use of agricultural technologies does not significantly and favorably affect the level of food security in households. According to the findings, households that used better seeds produced more and were consequently more likely to have access to food than their counterparts. The use of agricultural technologies, according to studies by (Kalambayi et al., 2019) (Mohamed, 2021), has a favorable impact on family food security. This conclusion is supported by this outcome.

The primary type of manure in the area is organic matter, especially litter. For 21% of farmers in the zone, getting access to these inputs is a severe challenge. Any increase in labor productivity, according to the OECD and FAO (2016), more than proportionally raises the availability of food. The household from which labor is provided is intimately related to that home. The majority of agricultural labor is non-wage in the research area. Family labor is used in 70% of fields, 25.3 % of households utilize temporary or permanent wage labor, and self-help group labor, or tontine labor, begins to decrease (4.7 percent). Even if there is a bigger percentage of non-wage labor in this circumstance than in (Kalambayi et al., 2019), who reached the same conclusions. However, these findings differ significantly from those made by (Gislain et al., 2018) in the Senegal River Valley, where non-household labor rates for conventional farms can reach as high as 62.5 percent. These findings concur with those from (Minani et al., 2013; Ndahama et al., 2014) , who reported that 73 percent of family farms in Burundi and Katana, respectively, rely only on family labor. The average age of individuals under 18 is merely 4 in various homes. Both agricultural and non-agricultural activities are included in this.

Most farmers in the study area cover significant distances on foot. The journey to the fields and the numerous markets each takes around an hour. 25 percent of people own motorcycles. These modes of transportation are heavily utilized in agricultural pursuits. The daba is the most widely-used farming instrument in farm households, followed by the boot, wheelbarrow, sprayer, and machete in terms of production equipment. The local market is where most of these tools are bought. This rural area is in a precarious state due to widespread poverty and a critical lack of support from the State and NGOs for grassroots development, which is explained by the absence of productive equipment alone.

The lines of supply for farming equipment are unofficial. This demonstrates the poor governance of the local agricultural sectors, where farmers' access to farming equipment is a significant barrier. All of these conclusions are in line with those of (Tshiebue & Tshiebue-G, 2011), who discovered that farming in the Kasai Occidental province is modest due to the primarily physical labor, crude tools, and extremely restricted access to effective agricultural inputs.

Agriculture experiences systemic issues. The outcomes from the application of subsequent agricultural policies are still not up to par. Crop production for food and export is still insufficient. Each hamlet has unique issues related to infrastructure. Farmers suffer as a result of the lack of conservation methods since they are forced to sell the majority of their crops at harvest and borrow money at exorbitant interest rates to make purchases during the lean season. A granary is only present in 24.5 percent of farmers.

Particularly during the lean season, these granaries enable the villages to conserve and better manage their inventories. The study area's agriculture industry struggles with a lack of funding. Only one-fourth (25%) of households have access to finance on a household level. The typical producer cannot afford the products offered by banks or microfinance. The family and the tontine are the two primary sources of credit. Rural producers continue to face severe supply issues concerning the availability and accessibility of agricultural inputs. Almost 81 percent of rural farming households don't use inputs. The vast majority of farmers and residents in the study area are small-scale producers. Their modest, family-run farms employ conventional techniques. Hand tools and/or a tractor are virtually the only production tools available. Only 10% of households rent tractors for plow work, while only 1.5% of households own chainsaws.

The main obstacle to the utilization of agricultural inputs and the improvement of farmers' living conditions is the lack of access to loans. Although the land may occasionally be accessible, they only farm limited sections since they lack the necessary funds. This is in line with the research of (Mpanzu Balomba, 2014), which found that credit is not a means of funding agricultural operations in Bas-rural Congo's districts. Ntumba et al. (2015), found that 86.9% of market gardeners self-finance their operations from money from other sources, as opposed to 13.1% who receive support from other household members, likewise hold the same opinion (Balasha et al., 2019). According to (Gislain et al., 2018), 16 percent of rice farmers in the Ruzizi plain receive formal credit, suggesting that the situation is different in other places. Additionally, finance is less accessible to the poorest households. These credits are mostly used to pay for food purchases, medical expenses, the purchase of agricultural supplies, ceremonial fees, and many other expenses in rural communities.

Another factor that has helped improve food security is access to financing, maybe by alleviating smallholders' liquidity issues. It is a regular occurrence for many smallholder farmers to be cash-strapped right before planting when they most need it. Farmers must regulate their consumption during the planting season due to liquidity restrictions that prevent them from purchasing agricultural inputs. The data also demonstrates that having access to finance has a favorable and considerable impact on the food security of households. This outcome is consistent with earlier discoveries (Fekede et al., 2016; Kassie et al., 2014).

Selling their goods on the markets is a great challenge for local farmers. They dislike unfair power relations caused by unregulated commodity chains, unstructured markets, and low prices. Because the production basins are located far from the consuming centers and are marked by impassable roads and a lack of suitable transportation, there are structural

and geographic obstacles to entry. Farmers travel to nearby marketplaces in an hour on average. Motorcycles are used to deliver the harvested goods. In addition to these challenges, the broad manufacturing system poses production risks, lacks economies of scale, and is characterized by price instability, opportunistic field sales, high transaction costs, limited bargaining power, and weak human capital. 80 percent of manufacturers make sales on their own.

The supply, demand, and price of the market are unknown to around 54% of producers before they enter it, while 35.5% learn about product availability, buyer presence, and pricing through unofficial methods, particularly other producers. The potential to satisfy a substantial demand to sell the harvested products in a short period plays a significant role in the decision of the sales location. These sales are not focused on added value; rather, they try to increase prices through geographical (price disparity between the village and the site of sale) and temporal (price differential between the harvest period and the lean period) differences. They are driven by a desire for a more lucrative price than what is offered in rural areas. There is never a shortage of storage space. In contrast to the central markets' booths, which are occasionally hygienic and constructed of sturdy materials, rural markets' stalls are frequently dirty and pose a health risk. There is frequently no electricity or water at markets. Family farming faces significant obstacles as a result of all of these concerns in the northern region of Central Cameroon.

Conclusion

If family farming is supported, it can serve as a foundation for growth and food security. One of the biggest issues preventing Cameroon's progress is still food insecurity. Therefore, the purpose of this study was to investigate the situation and key determinants of food security in the northern forest-savanna transition zone of the Central Cameroon Region. The tiny size of farmed plots, the poor usage of agricultural inputs, and the use of crude tools are all factors that contribute to food insecurity among rural communities in this region of the country. These households don't have a diverse enough diet or grow enough food to feed themselves all year long. Very modest holdings of no more than 17 hectares are what define the useful agricultural area. The daba, machete, boots, wheelbarrow, and sprayer are among the implements used by family farmers who are still struggling in the face of uncontrollable changes (climatic hazards, rural exodus, declining soil fertility). Poverty also restricts access to cutting-edge agricultural technologies that could increase crop yields in addition to the dwindling family labor force and unstable access to land. Due to its strong agricultural potential, this region can feed its population and satisfy domestic demand. The vast amount of available land

is one of its advantages. For family farming in the northern Central Cameroon Region to have an impact on food security and become competitive, it is necessary to take into account both upstream concrete incentive actions (financial means, incentives for the best food producers, ongoing monitoring, supervision, availability of inputs, land security), as well as the downstream commercial policy that is more conducive to a better connection of family farmers to the market (evacuation routes, remunerative prices, building local markets).

Credit authorship contribution statement

Chimi: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Writing-original draft. **Mala**: Methodology, Validation, Visualization, Writing–review & editing. **Manga**: Data curation, Formal analysis, Methodology, Validation, Visualization, Writing–review & editing. **Matick**, **Funwi, Kouoguem, Ngamsou, Feunang, Fobane & Bell**: Validation, Visualization, Writing-review & editing.

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The authors affirm that they have no known financial or interpersonal conflicts that would have appeared to have an impact on the research presented in this study.

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