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Maize Production and Food Security in Garu District of Upper East Region, Ghana

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Abstract: *Background and Objectives:* Agriculture, as the main economic activity in the Garu district, employs over 95 percent of households. Yields of maize in the district are however low, probably as a result of intermittent drought, low soil fertility, diseases and pests infestation, and the use of inappropriate agronomic practices. The objective of the study was to assess the impact of maize production on food security in Garu district of the Upper East region of Ghana. *Methodology:* The purposive sampling technique was used to select the Garu district out of the thirteen districts in the Upper East region of Ghana. The purposive sampling technique was also used to select 10 maize-farming communities within the Garu district. The stratified sampling technique was used to select respondents from the ten communities, while simple random sampling was used to select Agricultural Extension Agents for the study. A total of 124 respondents were selected for the study. *Results:* The study showed that over 50% of household members had enough maize to feed on throughout the 12-month period of the year. The research also established that most households made good use of maize as their main diet and nutrition throughout the year. *Conclusions:* Building the capacities of farmers on good agronomic practices and improved methods of farming should be intensified for increased maize productivity and improved food security. The Department of Agriculture should ensure effective extension services delivery to increase yields of maize from the average of 4-6 100kg bags per acre to 10 bags per acre.

Keywords: Food Security, Garu District, Household Members, Maize Farmers, Ghana

1. Introduction

In the Garu distrct, agriculture is the main occupation that employs over 95 percent of households [1]. Majority of the people of the Garu district are dependent on Agriculture for their livelihood. Maize is one of the main staple crops produced by majority of farmers in the area. However, maize yields have always been low. The perpetual low yields of maize recorded in Garu district could be due to drought, low soil fertility, invasion of diseases and pests, inadequate technical know-how, inadequate credit facilities to expand production and the use of inappropriate farming practices and techniques.

Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life [2]. Food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

According to MoFA [3], Ghana faces eminent food insecurity as the average yield has not been growing. In almost two decades the importation of commercial food, and food aid have reached about 4.7% of food needs. Food production and availability per year is dependent on rainfall during and between growing seasons, and the level of production. The adverse weather conditions (erratic nature of rainfall pattern), the problem of perennial bush fires, lack of improved production technologies and post-harvest losses have had severe impact on smallholder farm enterprises [3],

and this could be the cause of the food insecurity situation in the Garu district in particular and Northern Ghana in general. The introduction of improved production technologies, improved storage facilities, improved irrigation and water management systems, and improved post-harvest technology would probably be the panacea in improving food security in the Garu district of the Upper East region. The objective of the study was to assess the effect of maize production on food security in the Garu district.

2. Methodology

2.1. The Study Area

The Garu district was carved out of the Bawku-East District in 2004 and forms part of the thirteen (13) Districts in the Upper East Region of Ghana [1]. The district has its administrative capital at Garu. The Garu district Assembly was established in 2004 as defined by the Local Government Legislative Instrument (L. I. 1769). The District lies in the North-Eastern part of the Upper East region of Ghana. It covers an area of 1060.91 square km. It lies approximately on latitude 11° 38′ N and 11° N and longitude 0° 06′ E and 0° 23′ E. The district shares boundaries with Bawku Municipal to the North; Bunkpurugu-Yunyoo District to the south; Bawku West District to the West; and the Republic of Togo to the East.

The District forms an extension of the Gambaga scarp and is underlain mainly by birrimian and granite rock formations separated in parts by thinly to moderately bedded sandstones.

The White Volta and its tributaries are the most significant of which the Tamne drains is the district. The others are Pawnaba-Kiyinchongo streams. These rivers have strong irregular seasonal flow patterns. They flow from June to December with peaks in August and September. During the wet season, they flow excessively, followed by recession and low water levels during off seasons. The water from the rivers supports onion, water-melon and vegetable cultivation in the dry season. Except in a few areas around the river basins where the drainage becomes poor because of seasonal flooding, the area is generally well drained.

Agriculture is the main occupation in the District that employs about 95.4% of households. Rural households are engaged more in agriculture (97.2%) than their urban counterparts (68.3%). Crop farming is the most common type of agriculture activity (98.8%), livestock rearing (86.1%) and tree planting (0.4%). Fish farming is the least agricultural activity undertaken by agricultural households in the district (0.1%).

The vegetation of the district is mainly of the Sahel savannah type, consisting of fire swept grassland separating deciduous trees among which can be seen are a few broad-leaved species.

The most densely vegetated forest reserves include: Denugu, Siisi, Kpatua, Nakinting, Kariyata and Wakpesi. Other isolated places are Karateshie and Tarivargo forest reserves.

The predominant ethnic groups in the district are Kusasis, Busangas, Mosis, Bimobas and Mamprusis. Apart from that there are quite a number of migrants from other parts of the country, especially the south, and neighbouring countries of Togo and Burkina Faso.

The dominant religions are Islam, Christianity and Traditional African Religion. There are also some few nonbelievers.

2.2. Research Design

The research design is the overall plan for collecting data in order to answer the research questions. It also includes the specific data analysis technique or methods that the researcher intends to use. The research methodology used for the study was field survey. The instruments that were used for data collection were questionnaires, interview schedules and checklist for Focus Group Discussion (FGD).

2.3. Data Collection

Data was collected on the socio-economic characteristics of respondents, status of maize production as well as the level of food security among respondents in the district. Data collection was done using questionnaire, interview guide and checklist. Questionnaires and interview guides are basically the same kind of instrument, that is, a set of questions to be answered by the subjects of the study [4]. However, there are some differences in how they are administered. In a questionnaire the subject responds to questions by writing or more commonly, by marking an answer sheet. Items to be selected on questionnaires include multiple-choice, true or false, matching, or interpretive-exercise questions. Interview guide is conducted orally and the answers to the questions are recorded by the researcher or anyone trained by the researcher [5].

2.4. Population of the Study

Population of the study is the entire group or category of individuals selected for the research [6]. For this study, the population comprised of:

1) All maize farming households in the Garu district; and
2) All Agricultural Extension Agents of the Garu districts.

2.5. Sampling Technique and Sample Size

Sampling enables the researcher to study a relatively small number of units of the target population, and to obtain a data that is representative of the whole population. In most cases, however, the researchers opt for an incomplete coverage and study only a small proportion of the population – a sample. Sampling is thus, the process of choosing the research units of the target population, which are to be included in the study [7]. A sample is defined as a sub-set of or portion of the total population. It must always be viewed as an approximation of the whole rather than the whole itself [4]. There are different ways or techniques involved in the selection of a sample for any study. A sample technique therefore refers to the researcher's method of appropriately selecting the type, size

and representativeness of the sample.

The purposive sampling technique was used to select the Garu district out of the thirteen (13) administrative districts of the Upper East region of Ghana. The purposive sampling technique was again used to select 10 predominantly maize farming communities in the district. These included: Farfar, Kpatia, Meliga, Tambalalug, Kpatua, Yapala, Ziseri, Denugu, Salugu and Zaari. Purposive sampling is defined as a method of sampling where the investigator uses personal judgement to select a sample, which will provide the data needed, based on previous knowledge of the population [5]. The purposive sampling technique was used by the researcher to select the communities because those 10 communities were involved in maize cultivation. To ensure that all farmers were duly represented, farmers were stratified into male and female households. The stratified Sampling is a type of sampling where by the population is divided into a number of strata and a sample is drawn from each stratum. Sixty (60) respondents were selected from each stratum. Four (4) Agricultural Extension Agents were also randomly selected for the study. In all, 124 respondents were selected for the study.

2.6. Development of Research Instruments

The research instruments used during data collection were interview guide and questionnaire. The instruments comprised of a structure of open and closed-ended questions. Interview guide and questionnaires are a good way of collecting certain types of information (facts, views, opinions and perceptions) quickly and relatively cheaply as long as respondents are sufficiently disciplined to abandon questions that are superfluous to the main task [6]. The interview guide was employed for face-to-face interviewing of the farm families. The questionnaires were self-administered by the agricultural extension agents.

For the sake of reliability and validity, the questions were criticised, reviewed and revised many times by the researchers and their colleagues. The research instruments were pre-tested at Nakpanduri in the Bunkpurugu district of the North East region which was also a predominantly maize growing area. This process exposed all inconsistencies, wrong expressions and inappropriate words in the prepared questionnaires, which resulted in making of the necessary corrections before they were taken to the field of study.

2.7. Data Collection Procedure

The researchers supported by two undergraduate students administered the questionnaires. The students were trained over a two-day period to expose them to the import of the questionnaires with respect to the objectives of the research, and to teach them the skill of questionnaire administration. The interview guide for the farm family were interpreted into a local Ghanaian language (Kusasi) to enable respondents give appropriate answers. The questioning was done on a face-to-face interaction basis during the meeting with the farmers. The entire interview guide was read individually to ensure that the questions received the attention of respondents and was appropriately answered. The undergraduate students assisted in the recording of the responses from the respondents. This was necessary because the respondents were largely illiterates, and also to ensure that the responses came from the respondents themselves.

The questionnaire for the Agricultural Extension Agents was self-administered. According to Sarantakos [7], the self-administered questionnaire method of data collection allows respondents to consult their files at their own convenience, and help them avoid bias and errors by the presence or attitudes of the interviewer. This was the main reason why the questionnaire for the Agricultural Extension Agents was self-administered.

2.8. Data Analysis

The interview guide for the farmers were checked during and after each interview session to ensure that all the questions were answered. The self-administered questionnaires from Agricultural Extension Agents were also checked through to ensure that the data defined in the research instrument were actually collected and answers to all questions were properly recorded. Different coding manuals were developed for the different research instruments of the study. All responses were coded, and fed into a computer for statistical analysis using the Statistical Package for Social Sciences (SPSS). All the data from the farmers were analysed together. The analysis produced descriptive statistics of frequencies, counts and percentages. The data from the focus group discussion was also organized into thematic areas. For visual impression and ease of understanding, summaries of findings were presented in graphs/tables.

3. Results

3.1. Social Characteristics of the Study Population

3.1.1. Age of Respondents

The study revealed that 18.5% of the respondents were above 60 years while 5.6% were between the ages of 21-30 (Table 1).

Table 1. *Age of respondents.*

Age of Respondents	Number of Respondents	Percentage
21 – 30	7	5.6
31 – 40	31	25.0
41 – 50	35	28.2
51 – 60	28	22.6
Above 60	23	18.5
Total	124	100

Source: Field survey, 2020.

3.1.2. Sex of Respondents

The study showed that 18.5% of the respondents were females while 81.5% of the respondents were males (Table 2).

Table 2. Sex of respondents.

Sex of Respondents	Number of Respondents	Percentage
Male	101	81.5
Female	23	18.5
Total	124	100.0

Source: Field survey, 2020.

3.1.3. Respondents' Level of Education

Majority of the respondents (76.6%) had no formal education, while 5.6% of the respondents had tertiary education (Table 3).

Table 3. Respondents' level of education.

Level of education	Number of Respondents	Percentage
No formal education	95	76.6
Basic education	17	13.7
Secondary education	5	4.0
Tertiary education	7	5.6
Total	124	100

Source: Field survey, 2020/

3.2. Total Cultivable Farmland

The study revealed that the respondents' farmlands ranged from 1-15 acres. From the study, 50% of respondents cultivated between 4-6 acres of farmland. However, only 4.8% of the farmers cultivated between 13-15 acres (Table 4).

Table 4. Total land area cultivated by farmers.

Total Cultivable Farmland (acres)	Number of Respondents	Percentage
1 – 3	26	21
4 – 6	62	50
7 – 9	21	16.9
10 – 12	9	7.3
13 – 15	6	4.8
Total	124	100

Source: Field survey, 2020.

3.3. Average Yield of Maize

The study revealed that farmers recorded yields varying from 1-15 100 kg bags per acre. From the study, 57.3% of respondents harvested 4-6 bags per acre, 23.4% recorded 1-3 bags per acre, while 8.9% recorded 10 or more bags per acre (Table 5).

Table 5. Average yield of maize.

Yields per acre (100 kg bag)	Number of Respondents	Percentage
1 – 3	29	23.4
4 – 6	71	57.3
7 – 9	13	10.5
≥ 10	11	8.9
Total	124	100

Source: Field survey, 2020.

3.4. Sufficiency of Maize as a Staple Food

The study established that majority of respondents (69.4%) agreed that the maize produced was sufficient for them throughout the year (Table 6). 28.2% of respondents disagreed and said that the food produced only last for about 7-11 months of the year, whilst 2.4% of respondents were undecided.

Table 6. Sufficiency of maize as a staple food throughout the year.

Response	Number of Respondents	Percentage
Yes	86	69.4
No	35	28.2
Undecided	3	2.4
Total	124	100

Source: Field survey, 2020.

3.5. Yield Improvement Potential

On the question of the potentials of improving their maize yield, 96.8% of the respondents believe that they have the potentials of improving maize yields and 3.2% said they could not improve maize yields (Table 7).

Table 7. Potentials of yield improvement.

Responses	Number of Respondents	Percentage
Yes	120	96.8
No	4	3.2
Total	124	100

Source: Field survey, 2020.

3.6. Factors of Improved Maize Production

On ranking the factors of improved maize production in order of importance, fertilizers application scored 2.4%, improved technologies scored 12.1%, improved seeds scored 35.5%, extension services scored 37.1%, access to land recorded 11.3%, and labour availability recorded 1.6% of the total responses (Table 8).

Table 8. Ranking the factors of improved maize production.

Factor	Number of Respondents	Percentage
Fertilizer application	3	2.4
Improved technologies	15	12.1
Improved seeds	44	35.5
Extension services	46	37.1
Access to land	14	11.3
Availability of labour	2	1.6
Total	124	100

Source: Field survey, 2020.

3.7. Accessibility of Maize as Staple Food

On the question of whether for the last 12 months, households had access to enough maize to feed, 41.9% answered 'No', while 58.1% of the respondents answered 'Yes' (Table 9).

Table 9. *All year-round accessibility of maize as staple food.*

Responses	Number of Respondents	Percentage
Yes	72	58.1
No	52	41.9
Total	124	100

Source: Field survey, 2020.

3.8. Availability of Maize as a Staple Food

3.8.1. Households Eat Preferred Meals

Majority of respondents (58.1%) agreed that they eat their preferred choice of meals, prepared from maize, throughout the year. However, 41.9% did not agree that they eat their preferred choice of meals prepared from maize throughout the 12 month-period of the year (Table 10).

Table 10. *Households eat preferred meals.*

Household Responses	Number of Respondents	Percentage
Yes	72	58.1
No	52	41.9
Total	124	100

Source: Field survey, 2020.

3.8.2. Households Sleep Hungry Due to Maize Shortage

(i). Households Sleeping Hungry at Night

Majority of the respondents (62.9%) disagreed that their households ever slept hungry in the night because of unavailability of maize in the household, while 37.1% agreed that their households sometimes, within the year, sleep hungry due to unavailability of maize (Table 11).

Table 11. *Households hungry at night.*

Household Responses	Number of Respondents	Percentage
Yes	42	37.1
No	78	62.9
Total	124	100

Source: Field survey, 2020.

(ii). Households Go Hungry All Day and Night

Majority of the respondents (66.1%) disagreed that their household have ever gone hungry all day and night because of unavailability of maize. However, 33.9% of the respondents agreed that their household sometimes, within the year, go without food all day and night (Table 12).

Table 12. *Households go hungry all day and night.*

Household Responses	Number of Respondents	Percentage
Yes	42	33.9
No	82	66.1
Total	124	100

Source: Field survey, 2020.

3.9. Utilization of Maize as a Staple Food

3.9.1. Quality of Maize Produced

On whether the maize produced was wholesome for their household consumption, 94.4% of the respondents answered 'Yes', while 5.6% of the respondents answered 'No' (Table 13).

Table 13. *Quality of maize produced.*

Household Responses	Number of Respondents	Percentage
Yes	117	94.4
No	7	5.6
Total	124	100

Source: Field survey, 2020.

3.9.2. Food Prepared from Unclean Water, and Disease and Pest Infested Maize

Majority of the respondents (93.6%) agreed that when they eat food prepared from uncleaned, and disease and pest infested maize, they will fall sick. However, 6.5% of the respondents hold a contrary view (Table 14).

Table 14. *Food prepared from unclean water, and disease and pest infested maize.*

Household Responses	Number of Respondents	Percentage
Yes	116	93.6
No	8	6.5
Total	124	100

Source: Field survey, 2020.

3.9.3. Farm Families Fall Sick Due to Water or Food Taken from the Maize Products

Majority of the respondents (93.6%) disagreed that household members fall sick because of the water and/or food taken from maize products. However, 38.7% of the respondents agreed that household members fall sick as a result of the water and food taken (Table 15).

Table 15. *Farm families fall sick due to water or food taken from the maize products.*

Household Responses	Number of Respondents	Percentage
Yes	48	38.7
No	76	61.3
Total	124	100

Source: Field survey, 2020.

3.9.4. Food Prepared from Household Maize Is Nutritious and Healthy

On whether the food prepared from respondents' household maize is nutritious and healthy, 96.8% of them agreed, while 3.2% disagreed (Table 16).

Table 16. *Food Prepared from Household maize is nutritious and healthy.*

Household Responses	Number of Respondents	Percentage
Yes	120	96.8
No	4	3.2
Total	124	100

Source: Field survey, 2020.

3.10. Stability of Maize as a Staple Food and Price Fluctuations

In a Focus group discussion with maize farmers in the Garu district, Majority of them agreed that food insecurity is a threat to human life and need to be addressed:

We mostly experienced maize shortages in the months of

January, February, March, April, May and June. During this period many of us, as household heads, do not have enough maize to meet our household nutritional needs. During this period, price of maize is very high in our markets and many of us cannot afford to buy the foodstuff. During this critical period, household heads depend on the local markets, food aid, neighbouring households and family remittances to meet our foodstuff needs. In order to improve food availability, accessibility and stability, majority of the household members agreed that maize production/cultivation should be increased throughout the Garu district. They implore Government, stakeholders and NGOs to make available farm machineries such as tractors and their accessories, and combine harvesters for farmers use. They also admonish Government to provide guaranteed prices for farm produce, seed and fertilizer subsidies, and affordable loan schemes to encourage farmers to boost agricultural production.

4. Discussion

4.1. Social Characteristics of the Study Population

The study revealed that over 76% of respondents had no formal education. However, training and development of human capital plays a major role in accelerating agricultural productivity. It is possibly that the lack of formal education among majority of the farmers probably contributed to the low yields of the maize crop. Romer [8] and Lucas [9] also reported that human capital plays a crucial role in accelerating agricultural productivity by learning, applying and disseminating technical knowledge. The authors also observed that capacity building also influences a farmer's capability to adjust new technology in particular circumstances as a changing demand. Jamison and Lau [10] also observed that farmer's education and extension services have enhanced the production of Korean, Thai and Malaysian farms.

The study also revealed that age and sex of respondents also varied. It is possible that the age and sex variation among farmers caused a great deal of variability in terms of getting access to production factors such as land, labour and capital. Women and younger male farmers generally find it difficult to access land and capital for production purposes, mainly because they cannot provide collateral for credit since they may not have legal ownership of tangible assets.

Ogwumike [11] in a study observed that discrimination, a situation where unequal opportunities are given to some people to participate in the production process based on gender, age and ethnic considerations has impeded livelihood activities, particularly among women. Quisumbing *et al*. [12] also reported that cultural and institutional factors often limit women's access to land, labour and capital, and that access to land is often restricted to usufruct rights (that is, women cannot provide collateral for credit because they may not have legal ownership of tangible assets).

4.2. Maize Production

There were variations in the amount of yield (100 kg bags) of maize harvested by farmers, and that yield were generally low. This was probably because most of the farmers were small holder farmers who generally employ the traditional methods of farming. Majority of the farmers had no access to improved technologies, improved seeds, improved agronomic practices and mechanization services. Bawa [13] reported that Ghana still experiences food insecurity lasting from 3-6 months per annum, and that the Upper East region has been the worst affected region.

The study revealed that total number of acreages cropped by the farmers were generally low; ranging from 1-10 acres. This is possibly attributed to the problems of land acquisition as a result of the land tenure system practiced in the Garu district. Ownership of lands is vested in the hands of specific group of people known as 'Tindaannima' meaning traditional land owners, and farmers who wish to go into farming would have to request the farmland from these land owners.

4.3. Maize Production and Food Security

According to the Food and Agriculture Organization [2], Food security is a situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life. The World Food Summit also states that food security, at the individual, household, national, regional and global levels is achieved when all people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life. Both definitions provide the basic understanding of food security and it is necessary so that anything short of that will lead to food insecurity.

The study revealed that the farm produce does not suffice the farm families throughout the year, and many households resort to borrowing and family/neighbour remittances as copping strategies to feed their household members. The use of modern methods of farming such as improved seeds, improved technologies and improved agronomic practices, coupled with the adoption of irrigable agriculture and improved extension services is likely to increase yield and improve food security. Bawa [13] also reported that in order to reduce food insecurity in northern Ghana, the following measures should strictly be adhered to: modernization of agriculture, reduction in post-harvest losses and improved storage and distribution systems through capacity building, and promotion of macro and micro-nutrients fortification as an essential aspect of food processing. Abu and Soom [14] also reported that higher food production increases the probability of a household being food secure. They further observed that due to rising food prices, households with less income have difficulties to purchase enough food, hence they tend to rely more on own food production in order to reduce their vulnerability to food insecurity.

The study also showed that the quality of maize products was good and safe for consumption.

The households did not fall sick for the consumption of the maize products, and that the household members were, very

much, aware of the nutritional value of maize. According to Hauck and Youkhana [15], food utilization is a measure of the peoples' ability to obtain sufficient nutritional intake and nutrition absorption during a given period.

5. Conclusion and Recommendation

The study revealed that over 50% of household members had enough maize to feed on throughout the 12-months period of the year. The study further established that most household made good use of maize as their main diet and nutrition throughout the year.

It is recommended that capacity building of farmers on agronomic practices and improved modern methods of farming should be intensified to sharping the skills of farmers for increased productivity and hence, improved food security. It is also recommended that the Department of Agriculture of Ghana's Ministry of Food and Agriculture should ensure effective extension services delivery to increase yields of maize from the average of 4-6 100kg bags per acre to 10 bags per acre.

Ethics Approval and Consent to Participate

There are no actual or potential conflicts of interest including financial, personal or other relationships with other people or organizations that could inappropriately influence, or be perceived to influence this work. Therefore, no ethical issue may arise after the publication of this article.

Consent for Publication

Both authors have consented to the publication.

Competing Interest

Authors have declared that no competing interests exist.

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Authors' Contributions

Author 'A' designed the research, prepared questionnaire, analyzed data and prepared the first draft. Author 'B' collected and analyzed data, and proof-read the manuscript.

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