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Sorghum Production Practices: A Case Study of Four Districts in Navrongo, Ghana

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ABSTRACT

A study was conducted in Biu, Pungu, Gia and Kologo in the Navrongo Municipality of the Upper East Region of Ghana, to examine the extent to which farmers' knowledge, perception and management practices influenced the cultivation of grain sorghum. This survey was undertaken to provide background information regarding the crop to aid in future improvement and marketing efforts in the Navrongo Municipality. A total of hundred farmers were sampled from these areas with twenty farmers from each district, using a simple random sampling technique. In the survey, both open and close-ended questionnaires as well as interviews were adopted. Data collected included, demographics of respondents, general production and utilization, number of acreages cultivated, yield levels, marketing and constraints to the production of sorghum. Data gathered was analyzed using the Statistical Package for Social Scientist (SPSS version 16.0). Frequencies, percentages, bar and pie charts were used to present the results of the various variables analyzed. The findings from the study showed that farmers in these four communities cultivated sorghum but intercropped with other crops and vegetables; sorghum was cultivated by the people as a main crop (65.00%). Males formed the majority (61.00%) of people involved in the cultivation of sorghum. Active working age of people who engaged in sorghum production was between 20 and 29 years. Majority (37.00%) in these communities were Christians, even though sorghum is said to be a traditional crop. Most of the farmers in the four communities used the red sorghum landrace or variety (61.00%). From the results, smaller families (1-4, 34.00%) were more involved in sorghum production either for sale or consumption, and the number of acres most farmers cultivated was 1-2 acre (32.00%). Sixty-four percent (64.00%) of the farmers inherited their farm lands, 72.00% of the respondents sold their products in the market and also had ready market for their sorghum produce. Results from this baseline survey could be useful to the Ministry of Food and Agriculture, the District Assemblies and Non-Governmental Organizations in their poverty reduction strategies, ultimately contributing to food security.

KEYWORDS: Constraints, farmers, improvement, market, poverty, questionnaires, Sorghum

1.0 INTRODUCTION

Sorghum (*Sorghum bicolor* L. Moench), a popularly cultivated cereal grass crop in the tropical regions, is a largely self-pollinated crop, and cultivated on more than 40 million hectares of land worldwide, across both tropical and temperate regions (Vanderlip, 1993; ICRISAT, 2014).

Sorghum is commonly a crop that is believed to have undergone domestication first and probably in the Nile or Ethiopian (Valley) regions of North Africa, around 1000 BC (Kimber, 2000) before been taken to India and China (Jordan and Sullivan, 1982), then to Europe. According to Vanderlip, (1993), sorghum was introduced to USA in the middle of the last century.

The dispersal of the Bantu (black) sect of individuals through sub-Saharan Africa was not complete without the growing and marketing (production) of sorghum (Vanderlip, 1993).

Currently, the cultivation of sorghum spans the world over, and commonly in the warmer, temperate regions, standing quantitatively as the 5th largest and most essential grain (cereal) coming after wheat, maize, rice and barley (Vanderlip, 1993; ICRISAT, 1994; FAO, 2003). It is grown on subsistence basis principally as a rain-fed crop in the arid and semi-arid tropical regions of Africa and Asia. The crop is also produced by commercial farmers in the USA, Australia and Latin America (ICRISAT, 1994). According to the Food and Agricultural Organisation, the world yearly production volume of sorghum stands at over 60 million tons, out of which Africa alone crops greater than 20 million tons (FAO, 2003). This therefore quantitatively puts grain sorghum as the number two most significant cereal grain crop produce in the African sub-region after maize. Close to seventy percent (70%) of Africa's production of sorghum is accounted for by the following countries alone; Nigeria, Sudan, Ethiopia and Burkina Faso, found at the Northern part of Africa (FAO, 2003).

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The potential yield of sorghum grain is reported to be as high as 15 t/ha and above (ICRISAT, 1994; FAO, 2003). However, majority of farmers, especially in the Sub-Saharan Africa who cultivate the crop under subsistence farming have little or no options to finance the addition of inputs in its cultivation. This makes yields on sorghum grain fields of farmers in Asia and Africa in particular largely low (500 - 800 kg/ha). This is primarily as a result of biotic and abiotic factors including diseases (grain mold, anthracnose, ergot, root and stalk rots, and sorghum downy mildew) insect pests, parasitic weeds, low soil fertility or nutrient deficiencies, grain-feeding birds and various wild mammals, drought, aluminum toxicity and salinity in some regions (ICRISAT, 1994).

Cultivars of sorghum that are genetically resistant to diseases, insect pests and weeds such as Striga, and also tolerant to abiotic stresses, coupled with grains and stover that are quality and market-desired, would present economically relevant options for integrated crop management and production systems capable of enhancing incomes or livelihoods of producers of sorghum (ICRISAT, 1994).

Sorghum is significantly important to food security in Africa because, it is generally and uniquely drought tolerant as compared to other cereals and can survive periods of high temperature and can also withstand periods of water-logging (Doggetts, 1988; Osmanzai, 1992). Even though sorghum is still generally subsistent in Africa, it is progressively developing the base of successful food and beverage production industries. Sorghum in Africa is processed into a very wide variety of attractive and nutritious traditional foods, such as semi-leavened bread, couscous, dumplings and fermented as well as non-fermented porridges. Sorghum is the cereal grain of choice for the brewing of traditional African beers (Taylor and Robbins, 1993). Certain sorghum varieties or types are also used in making cakes, unleavened bread, wallboard, starch, dextrose, syrup, brooms, ethanol, high quality wax and even vodka and other alcoholic beverage (Taylor and Taylor, 2000).

Nonetheless, upsurge in production of sorghum has only been due to an increase in cultivated land area under production and not necessarily and significantly the total enhancement in general crop yields. Reported average grain sorghum crop yields stay under one ton/ha. This is possibly due to the fact that, sorghum cropped in Africa and Ghana, is to date primarily characterized by traditional, out-moded farming and management activities; characterized by low or no farm inputs and absence of improved planting varieties (Taylor and Dewar, 2000). The characteristic low yields of sorghum indicate farmers are unable to maintain any surplus sorghum for use by processing industries (Olatunji, 1993). It is against this background that the current study proposes to obtain general information about production and management practices of the crop in Navrongo, Ghana; assess the general production challenges and to find out the extent to which farmers' knowledge, perception and management practices influence the cultivation of sorghum.

This study would therefore provide an important first step at improving the crop, particularly in the Northern parts of Ghana, with majority producers, and provide a foundation to enhance increased cultivation, marketing and use in future, in order to ultimately contribute to food security.

MATERIALS AND METHODS

Physical Geography of Navrongo Municipality

According to the Navrongo Demographic Survey System (GSS, 2014; www.statsghana.gov.gh), Navrongo is sited in the Kassena-Nankana District of the Upper East region of Ghana. The district lies between latitudes 10 to 30' and 11 to 00' North of the equator and between longitudes 1 to 00' and 1 to 30' West of the zero meridian and covers an area of 1,675 square kilometers along the Ghana-Burkina Faso border. It measures roughly 50 km long and 55 km wide and has an altitude of 200m - 400m above sea level. The land is relatively flat and passing through it from Burkina Faso is the White Volta River, which feeds Lake Volta (the world's largest artificial lake) in the Volta region, south of Ghana (Binka *et al.,* 1994).

Located in the Guinea Savannah belt, the district's ecology is typically Sahelian (hot and dry), with the vegetation consisting mostly of semi-arid grassland interspersed with short trees. There are two main climatic seasons, the wet and dry seasons. The wet season extends from April to October, with the heaviest rainfall mainly occurring between June and October (Debpuur *et al*., 2000). The mean annual rainfall is 1,365 mm but the highest level is recorded in August. Similarly, the dry season is subdivided into the *Harmattan* (November to mid-February) and the dry hot (mid-February to April) seasons. Monthly temperatures range from 20^{o}C to 40^{o}C, with the mean minimum and maximum temperatures estimated at 22.8^{o}C and 34.4^{o}C respectively (Debpuur *et al*., 2000).

Population Characteristics of Navrongo Municipality

The population of the Kassena-Nankana district (Ghana Statistical Service, GSS, 2014; www.statsghana.gov.gh) as at October, 2014 was 109,944, a figure slightly below 1% of Ghana's population and around 10.5% of the total population of the Upper East region. The population density is 84 persons per sq. km. The district is generally rural (with about 72.2% of the population living in rural communities), whereas small 9.5% living in urban quarters (GSS, 2014).

Of the population 11 years and above, 56.3% are literate and 43.7% are non-literate (GSS, 2014). About 82.7% of households engage in agriculture. In the rural localities, 93.1% of households are agricultural households while in the urban localities, 56.8% are households are into agriculture. Most households (96.1%) in the Municipality are involved in crop farming, with Poultry (chicken; guinea fowls) as the dominant animal reared among others such as cattle, goats, sheep, pigs (GSS, 2014). The chief crop products under the agricultural sub-sector in the Municipality include groundnuts, sorghum, rice, guinea corn, millet, sweet potatoes, beans and tomatoes. Unfortunately, the rainfall pattern limits food cultivation to a single growing season and even though the Tono irrigation dam and a few dugout wells supply water for dry season farming, the major crop grown during this time is tomato. Weather conditions in the district can be very severe, resulting in either occasional floods or droughts and, therefore, poor crop harvests. This situation, among others, has resulted in the gross annual out-migration of the population over some years now (Binka *et al*., 1999; GSS, 2014).

Sampling Technique and Sample Size

A survey was carried out involving the use of questionnaires and interviews as well as focus group discussions. The study was undertaken in four (4), districts (Pungu, Gia, Biu and Kologo), selected by a simple random sampling selection technique and based on predominance in terms of sorghum production in the Navrongo Municipality. A total of hundred farmers were sampled from these areas with twenty farmers from each district.

Data Collection

Although both secondary and primary data were used, the study focused more on primary data. Data collection adopted the use of questionnaires and key informant interview with some key farmers and opinion leaders. Questionnaires composed of open-ended and close-ended questions.

Data Analysis and Presentation of Findings

Quantitative data collected was analyzed based on data or information gathered from general sorghum crop production, farmer management of the crop, constraints to the production of the crop, postharvest handling, uses and marketing among others. The analysis was based on descriptive statistics. Results from the data analysis were analyzed with SPSS (Version 16.0) and Microsoft Excel and findings presented in tables, graphs, pie charts and bar charts.

RESULTS AND DISCUSSION

DEMOGRAPHY OF RESPONDENTS

Gender

Table 1: Gender distribution of respondents

Gender	Number of responses	Percentage (%)
Male	61	61.00
Female	39	39.00
Total	100	100.00

According to the results of the study (Table 1), more than half (61.00%) of the sorghum farmers were males whilst the females constituted 39%.

Sorghum is a traditional crop that is cultivated by both males and females in communities. Women's participation in farm activities has always been dominant. From the current study, women were equally engaged in agriculture in these communities as their male counterparts. It was gathered from the interviews that although women assisted on family farms, they were actively involved in the production of other crops such as cowpea, groundnut, Bambara groundnut and soybeans, apart from sorghum (Kimber, 2000; Akpalu *et al*, 2013).

Age Distribution

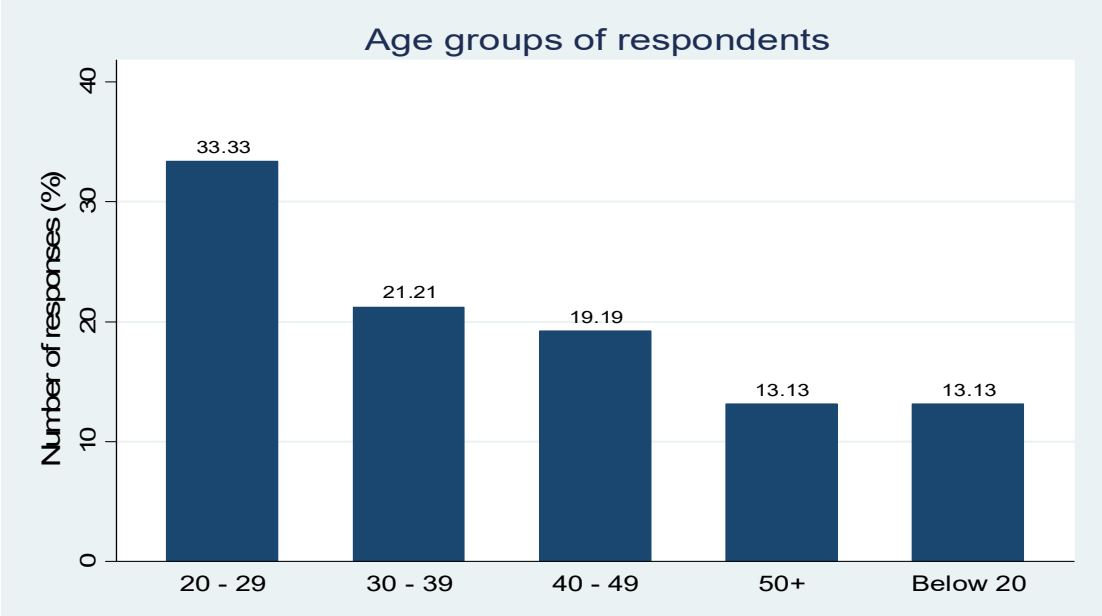

Figure 1: Age distribution of respondents

From Figure 1, the study observed that a majority 33.33% of the sorghum farmers were between the ages of 20 – 29; 21.21% were between 30 – 39 while 19.19% constituted the 40 – 49 age group. The aged (50+) and the teenagers (below 20 years) constituted 13.13% of the total sample size respectively. Though sorghum is generally cultivated by the elderly, results from the current study gave an indication that the youth have in recent times developed interest in its production; perhaps due to the ready market and comparatively high market price the crop commands. A research in Bambara groundnuts (Akpalu *et al.*, 2013) and groundnuts (Oppong-Sekyere *et al.*, 2015) corroborates the results found in the present study.

Marital Status

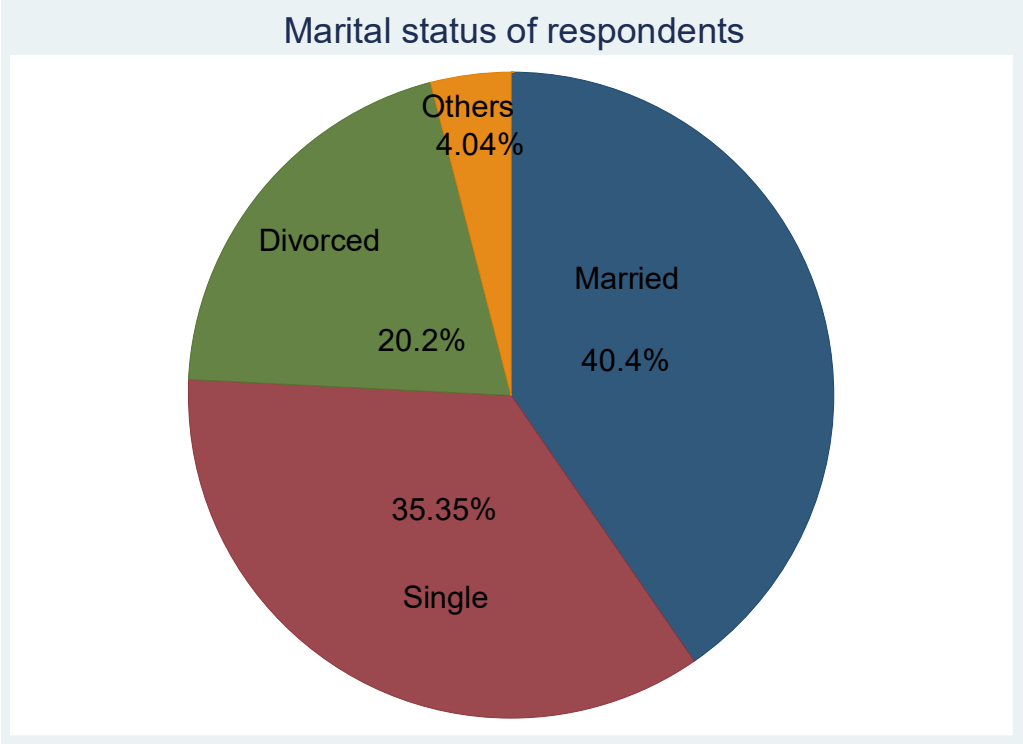

Figure 2: Marital status of respondents

Results from the study in Figure 2, indicate that, close to fifty percent majority (40.4%) of the sorghum farmers were married, 35.35% were single while 20.2% of them were divorced.
Sorghum is a traditional crop normally cropped by both sexes in the household. In the study districts, and indeed most parts of the Northern Regions of Ghana, women do not culturally owe lands. The lands are either for their husbands (who are the household heads) or the property of the entire family. Therefore, cultivation of traditional crops including sorghum by females or women would mean that the farm traditionally belongs to the husband. Thus, the results obtained in the present survey where married people were found to be more interested or involved in sorghum production. This brings to light the link and significance of such crops to the family or household needs and the fact that its production has remained under subsistence over the years. Many dishes are prepared from sorghum which generally is handled by women who take care of the family's nourishment and sustenance needs. This may also partially account for the more married women in sorghum production in the Municipality (Akpalu *et al*., 2013; Oppong-Sekyere *et al*., 2015).

Household Size

Table 2: Household size of respondents

Household size	Number of responses	Percentage (%)
1 – 4	34	34.00
5 – 9	38	38.00
10 – 14	15	15.00
15+	13	13.00
Total	100	100.00

According to the current study (Table 2), 38.0% of the respondents had a household size between five (5) and nine (9) individuals; 34.0% had between one and four whereas 15.0% of the farmers indicated that they had a household size between ten (10) and fourteen (14). However, 13.0% of the households had at least fifteen (15) members living together. The cultivation of sorghum, a traditional crop has remained largely under subsistence, therefore larger family sizes are required to supplement the production labour (Akpalu *et al*., 2013).

Educational Level

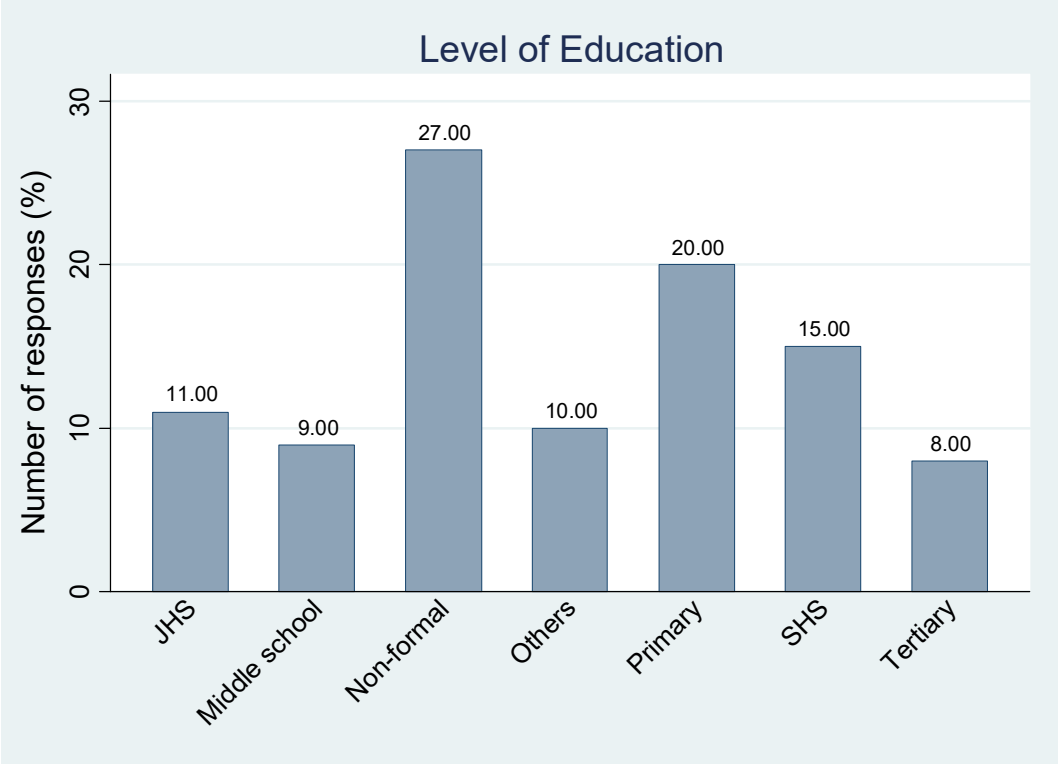

Figure 3: Level of education

The study revealed in Figure 3 that 27.0% of the farmers in the study communities had non-formal education while 20.0% had basic education. The Junior High School and Senior High School graduates who were farmers were a small 11.0% and 15. 0% respectively. Also, 9.0% and 8.0% of the respondents had obtained middle

school and tertiary education respectively. According to the Navrongo DSS basic output, educational attainment in the district is quite low. Education has both direct and indirect influence on crop production, attitude towards adoption of new production technologies etc. that results in yield improvement and a subsequent food security (Oppong-Sekyere *et al*., 2018). Low educational backgrounds could perhaps be a factor to low yields normally recorded by farmers (of Sorghum crop), which is generally a traditional crop in the Northern Ghana (Akpalu *et al*., 2014).

Religious Affiliation

Table 3: Religious affiliation of farmers

Religious affiliation	Number of responses	Percentage (%)
Islam	35	35.00
Christianity	37	37.00
Traditional worship	28	28.00
Total	100	100.00

From Table 3, a majority 37.00% of farmers indicated they were Christians, 35.00% were under Islamic religion whereas 28.00% of the respondents were affiliated to the traditional worship or religion. Even though Sorghum is a traditional crop, the cultivation of same over the years has been mixed across the religion. This is because, sorghum has proved not only as a traditional crop but also an economically marketable and viable crop produce that can generate sustainable income and thus ensure the family and the household's survival. Therefore, religion does not have significant influence on sorghum production in these communities (Debpuur *et al*., 2000). Sorghum is a crop that is very significant in the economy of Ghana. It can be traded both locally and on international markets (Oppong-Sekyere *et al*., 2018).

CROP MANAGEMENT AND PRODUCTION ACTIVITIES

Site Selection

The study revealed that, grain produces greatest yields on deep fertile well-drained loamy soils. Grain sorghum has an extensive root system and may be more tolerant than maize of soils with a shallow hardpan. According to Kimber, (2000), the best soils for other crops will also likely produce the highest grain sorghum yields.

Grain sorghum does best on deep fertile soils; however, it grows satisfactorily on most soil types as long as there is sufficient fertility and moisture. The month of May, according to the survey, is normally the optimum time to plant to get good seedling emergence and expected yields. A corn planter or grain drill is normally used for seeding or sorghum in the study areas. Manual seeding is also very common. Grain sorghum is normally cultivated in 15 or 30 Inch rows, even though it can perform in varied planting distances or width (FAO, 2003).

Because the study areas within the Navrongo Municipality of the Northern Savanna is generally dry, hot and humid, particularly during the planting and growing season, where other crops do not survive due to the drought or water stress, sorghum can tolerate the hot, dry conditions better, therefore sorghum comes across as the crop of choice, against other legumes such as soybeans, groundnut and cereals such as maize.

The study revealed that, grain sorghum grown under rotation generally results in increased grain yields than when cultivated year after year. The crop rotation plan needs to be measured carefully because, because sorghum may trail other crops readily, but not all crops trail it successfully and productively (FAO, 2003).

Planting Date

Farmers planted their sorghum over a varied and extensive collection of planting periods. Planting of sorghum was done normally in the morning but not until the soil temperature about 2 inches below the soil surface had warmed (65°F) slightly (Gomez, 1993).

Sorghum that is planted early takes benefit of sufficient rainfall that characteristically falls during the months of May and June and evades extreme heat and drought (Murty and Kumar, 1995).

Farmers also planting sorghum early to avoid some insect (sorghum midge, corn earworm and head webworms) stress.

Planting Depth

Farmers interviewed revealed that, sorghum seeds were planted as shallow as possible but careful enough to still obtain good soil-to-seed contact.

Farmers planted at a planting depth of 0.75 to 1 inch, early in the season (where possible) when the soil temperature is low and rainfall is likely to follow shortly after planting.

Farmers increased the planting depth of sorghum to about 1.5 inches later in the season when soil temperature is high (Murty and Kumar, 1995).

According to Murty and Kumar, (1995), sorghum seedlings can emerge when the seed is planted deeper than 1.5 inches, but the emergence is slow and final stand numbers may be reduced; before emergence, the plant is fully reliant on upon the food reserves in the seed from the endosperm for existence. Slow emerging plants risk depleting these reserves, which are essential to early plant growth immediately following emergence (Murty and Kumar, 1995). Planting into soils that are too dry for seed germination or are too wet for good seed furrow closure is not recommended and planting should be delayed until soil conditions improve (Murty and Kumar, 1995).

Total Land Size under Cultivation

Table 4: Number of acres of land cultivated

Number of acres of land	Number of responses	Percentage (%)
0 – 1	27	27.00
1 – 2	32	32.00
3 – 4	16	16.00
5+	16	16.00
None	9	9.00
Total	100	100.00

Thirty-two (32.0%) of the sorghum farmers indicated that they cultivated farm lands between one and two acres; 27.0% had at most one acre while 16.0% maintained up to four acres of farm land (Table 4). However, only 16.0% of the farmers actually had farm lands that were five acres or more. Agriculture is the main economic activity of the population of the Navrongo Municipality (GSS, 2014). According to the 2014 Ghana Statistical Service report, about 82.7% of households in the Municipality engaged in agriculture.

In the rural localities alone, 93.1% of households are agricultural households as against 56.8% in the urban localities who are into agriculture. Majority 96.1% households in the Municipality were involved in crop farming, with chicken, guinea fowls as the dominant animal reared among others such as cattle, goats, sheep, pigs (GSS, 2014). Moreover, the major agricultural crop products produced in the Municipality were groundnuts, sorghum, millet, guinea corn, rice, sweet potatoes, beans and tomatoes.

In general terms, agriculture in Ghana contributed over 40% of Gross Domestic Product (GDP) and employed about half of Ghana's labour force (Codjoe, 2006). This makes agriculture very significant to the economy of Ghana.

Varieties of Sorghum Cultivated

Table 5: Type (s) Sorghum landrace grown by farmer

Landraces	Number of responses	Percentage (%)
White	39	39.00
Red	61	61.00
Total	100	100.00

It is indicated in table 5 that majority of the sorghum farmers cultivated the red type of landraces (61.00%) whilst 39.00% of the respondents cultivated the white type of sorghum landrace.

Description of sorghum varieties or landraces grown by farmers

Sweet sorghum (*Saccharatun*): This variety of sorghum is tall and leafy with a richness of sweet juice in pith (Taylor and Taylor, 2002). Because of this, the stem is often chewed as sugarcane. It can be used as a source of syrup. It has also been used as silage for stock (Hugo *et al*., 2003).

Broom sorghum (*Techaicum*): These sorghum plants have very dry stem and has long and open inflorescence. Inflorescence is used as broom (Hugo *et al*., 2003).

Fodder sorghum: These are usually grown for forage or for silage, for feeding farm animals (Taylor and Robbins, 1993).

***Grain sorghum*:** Grain sorghum differs from sweet sorghum because they tend to be stocky and have dried piths which may be slightly juicy. Grain sorghum is mainly grown for grain (Gerik *et al*., 2003).

Sowing Period of Sorghum

Table 6: Best sowing period for sorghum farmers

Sowing period	Number of responses	Percentage (%)
April – May	20	20.00
May – June	56	56.00
June – July	20	20.00
July – August	4	4.00
Total	100	100.00

According to result of the current study shown in Table 6, more than half (56%) of the farmers sowed their seeds between May-June (best sowing period), 20% sowed between April-May and Jun–July respectively. Only 4% sowed their seeds between July-august due to climate change.

Cultivation of Sorghum as a main crop

Table 7: Sorghum cultivated as the main crop

Sorghum as main crop	Number of responses	Percentage (%)
YES	65	65.00
NO	35	35.00
Total	100	100.00

It was discovered from the current study in table 7 that, majority (65.00%) of the farmers cultivated sorghum as a main crop, while 35.00% of the respondents did not. This was because, according to the farmers, sorghum was their stable crop and could sustain the family for a longer period. Farmers indicated that they only cultivated the crop for consumption. A research study by Alhassan and Egbe, (2013) corroborates the findings in the present study.

Weed Control

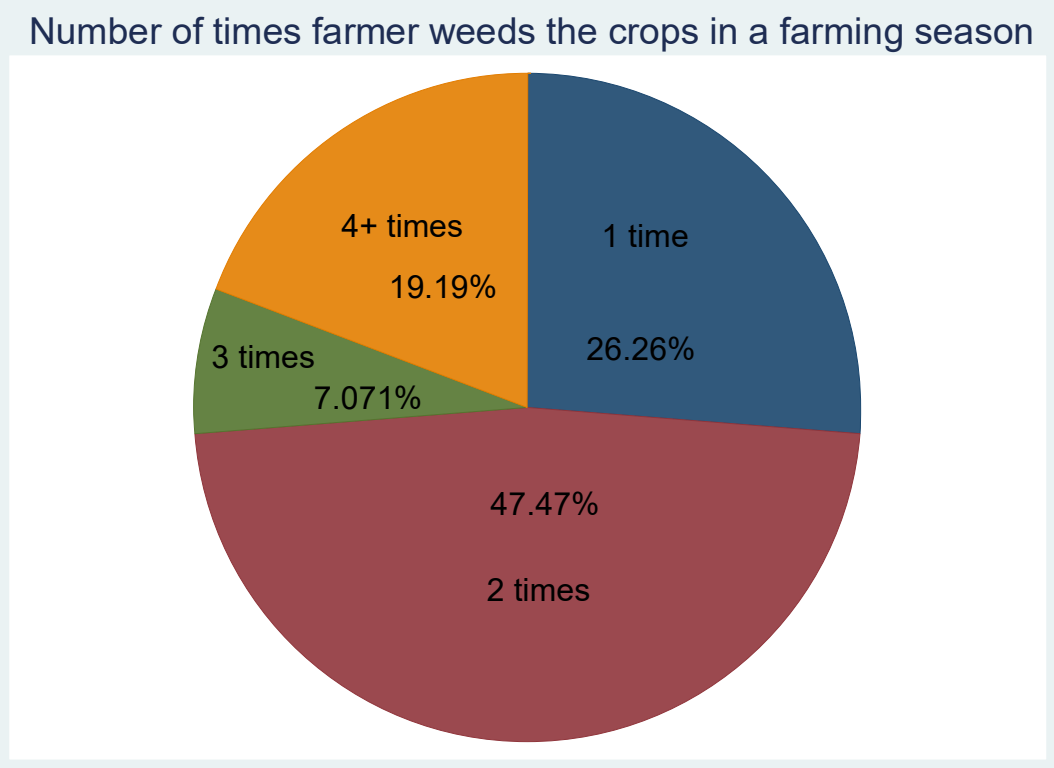

Figure 4: Number of times farmers weeded their farms in a farming season

Whilst, 47.47% of the farmers in the study weeded their farm lands two times before the end of the farming season, 26.26% only attended to their farms once. Also, 19.19% of them had their farm lands weeded about four times or more whereas a small 7.07% of the respondents did weed three times before the end of the farming season (Figure 4).

Disease and Pest Control

Table 8: Disease and pest attack on crops

Pest and disease attack on crops	Number of responses	Percentage (%)
YES	84	84.00
NO	16	16.00
Total	100	100.00

It was discovered from results of the study in table 8 that the destruction of sorghum crops by pests and diseases was the main concern by farmers as indicated by 84.0% of the respondents. The remaining16.00% of the farmers did not encounter any pest attacks. Pest and disease attack is one of the major drawbacks in the sorghum, grain legume production business, affecting yield on seasonal and annual basis. Until a serious attention is given it, yield would continue to dwindle (CGIAR, 2012; MOFA, 2007).

Pest management

Insects of potential importance include sorghum midge, corn earworm, fall army worm, sorghum webworm, European corn borer, and aphids. Several types of diseases attack grain sorghum, including seed rots and seedling blights, leaf diseases, smuts and root and stalk rots (Gerik *et al*., 2003)

Farmers indicate that, early weed control is important since sorghum seedlings are slow in growing and poor competitors with weeds. The tool box of herbicides labeled for grain sorghum is very small and pre-plant or pre-emergence herbicides are a necessary component of the weed control program. In addition, grain sorghum seed may need to be treated to provide safety to some herbicides. When this crop is planted in small fields, near trees or buildings, it may be vulnerable to bird damage. Bird-resistant varieties are available and these should be planted if a bird problem is expected (Gomez, 1993).

Fertilizer Application

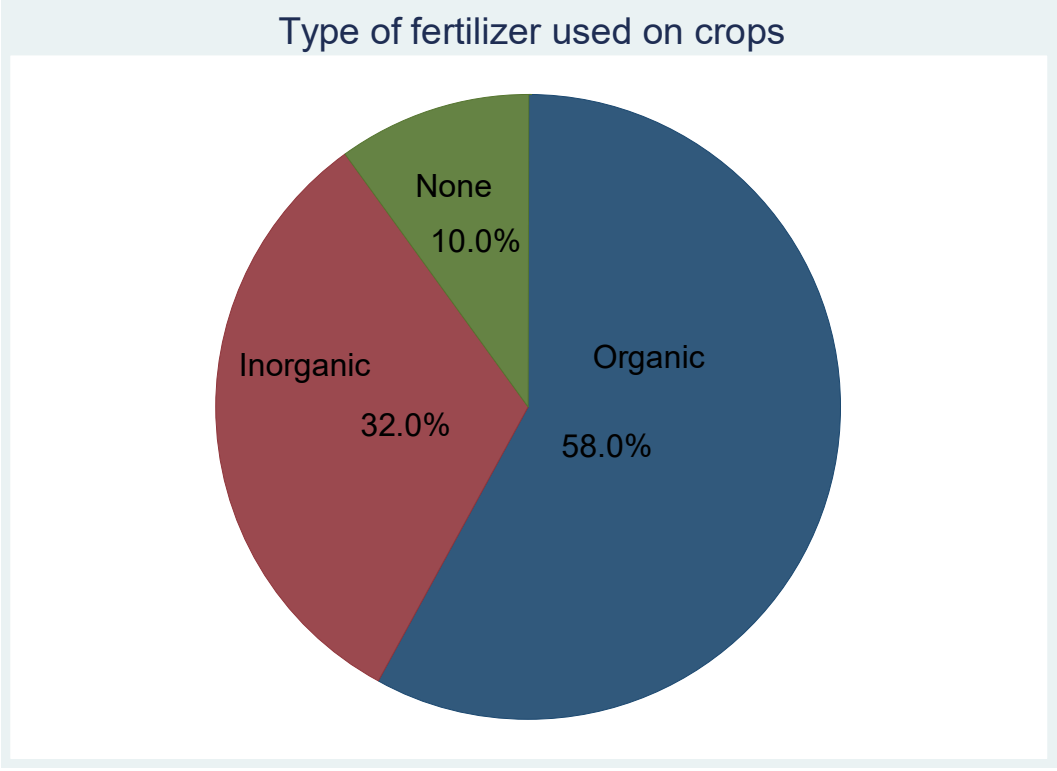

Figure 5: Type of fertilizer used on crops

Out of the hundred (100) respondents interviewed, regarding the use of fertilizer in the cultivation of sorghum, less than half (32.0%) preferred the use of inorganic fertilizer. A little above fifty percent (58.0%) used organic manure while 10.0% of the respondents used no fertilizer at all on their farms (Figure 5). Inorganic fertilizer is the most common fertilizer used by farmers, perhaps due to ease of handling and application. According to MacCarthy *et al*. (2009), 'fertilized systems were not visible in grain yield. The magnitude of grain losses were, however, higher with the climate change scenarios in both the no input system as well as when 40 kg N ha-1

was used'. 'This is probably due to the differences in temperature and in rainfall distribution and amount'. Comparing average grain yield between historical and climate change data indicates an average loss in grain yield of 22% for no fertilizer application and yield increase of 4% when fertilizer was applied over the simulation period (MacCarthy *et al*., 2009).

Access to Land for Sorghum Production

Table 5: Mode of access to land for sorghum cultivation

Access to land	Number of responses	Percentage (%)
Inheritance	64	64.00
Land lease	15	15.00
Purchase	9	9.00
Kinship	12	12.00
Total	100	100.00

The current study revealed that more than half of the sorghum farmers (64.00%) inherited their lands they used for sorghum production whereas 15.00% of the acquired their lands through lease. Twelve percent (12.00%) of the farmers acquired land through kinship. However, 9.00% purchased their own land for crop production (Table 9). The results confirm those of Akpalu *et al*. (2014) in a cowpea study in the Upper East Region of Ghana. This result has a great implication for large scale production of the crop, since land is becoming very difficult to acquire for agricultural use as opposed to industrial or building purposes.

Yield of Sorghum

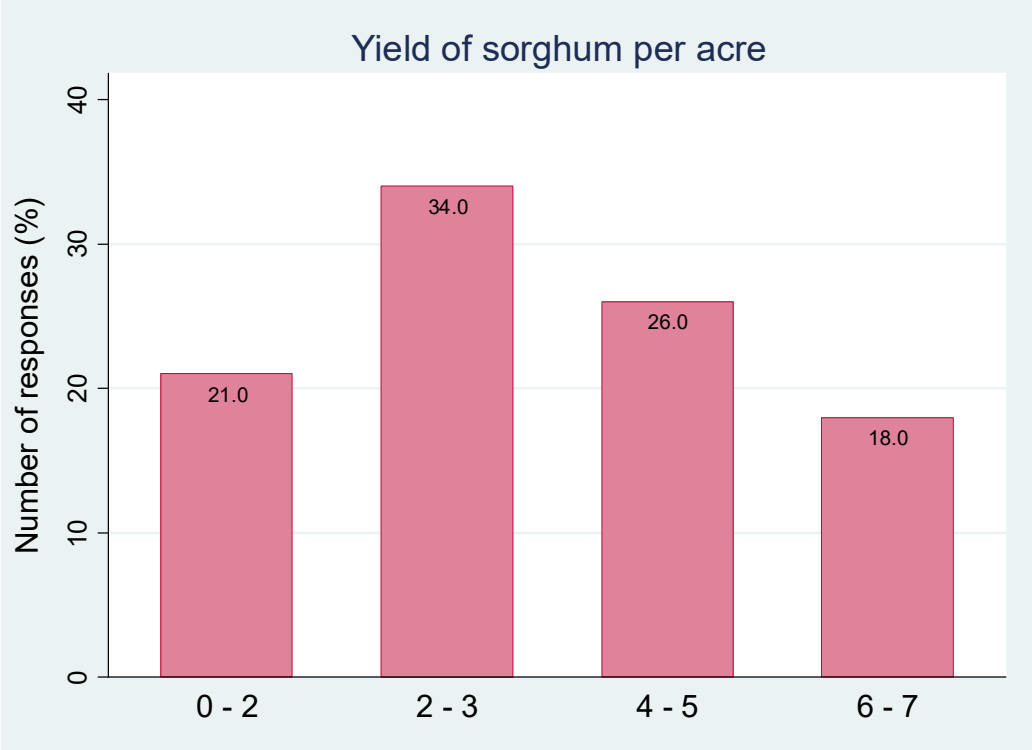

Figure 6: Yield of sorghum per acre

From the study in Figure 6, Less than half (34.00%) obtained yields of 2-3 bags per acre; 26.0% of the farmers recorded 4-5 bags; 0-2 bags where obtained by 21.0% of the farmers and 18.0% had 6-7 bags at the time of the study. Yield of sorghum and other grain legumes are always low due to poor farming practices adopted by farmers during production and in postharvest and storage activities (CGIAR, 2012; Akpalu *et al*., 2013). This has an implication for food security in the Region and the nation as a whole.

HARVEST AND STORAGE

According to the farmers, grain sorghum is harvested as early as possible after maturity. Harvest-aid treatments may also be used to hasten grain drying in the field. Prior to storage, the grain is dried by using either a heated or natural air drying system. Farmers indicated that, sorghum requires more drying time than corn (Gerik, *et al*., 2003). In addition, because sorghum packs more tightly than corn, farmers familiar with drying corn often

overburden artificial driers when attempting to condition sorghum. Excellent grain bin management is needed to condition and store grain sorghum.

USES OF SORGHUM

Table 10: Dishes of sorghum

Dishes	Number of responses	Percentage (%)
Raw	11	11.00
Boiled	88	88.00
Fried	1	1.00
Total	100	100.00

Results in Table 10 indicate that, a whopping 88% use sorghum as food (cooked), 11% consumed it raw whilst 1% fried it before eating. Other uses such as brewing of traditional beer called 'pito', dumplings, couscous, breads, pancakes, porridges, gruels as well as fermented, alcoholic products such as beers (opaque and cloudy) and fermented and non-alcoholic beverage products were also noted during the face-to-face interview.

Traditional Foods, Beverages and Uses of Grain Sorghum

The popularity and significance of grain sorghum across Africa may be evident from the idea that there exists confusing diversity of African traditional grain sorghum food and beverage products. Included in this are products and beverages of whole grain rice-type products, dumplings and couscous, breads and pancakes, porridges, gruels, opaque and cloudy beers, fermented beverages as well as non-alcoholic beverage products (Serna-Saldivar and Rooney, 1995; Murty and Kumar, 1995; WHO, 1996; Rooney and Waniska, 2000 and Taylor and Dewar, 2000).

MARKETING OF SORGHUM

Sales Point

Table 11: Sales point for the produce of sorghum

Sales point	Number of responses	Percentage (%)
Market	72	72.00
Home	28	28.00
Total	100	100.00

From the current study in Table 11, majority, representing about two-thirds (72.00%) of the sorghum farmers sold their products in the markets. The remaining 28.00% sold their produce at home. Sorghum is a commodity with high market demand. Farmers stored a percentage of their sorghum produce after harvest for home or family consumption while the remaining is sold in the market for extra income (Oppong-Sekyere *et al*., 2015).

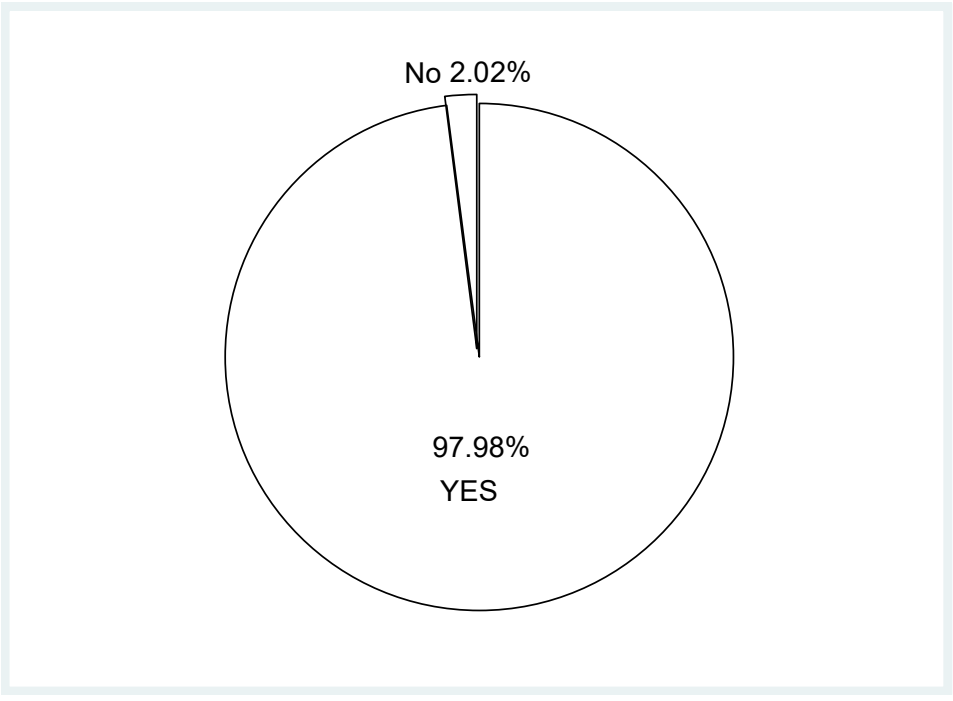

Figure 7: Ready market for sorghum

Results in Figure 7 regarding marketing of sorghum, indicates that there is ready market for sorghum, according to the farmers, because it has many uses; food and beverages. These include: 'pito', whole grain rice-type products, breads and pancakes, dumplings and couscous, porridges, gruels, opaque and cloudy beers, and non-alcoholic fermented beverages (ICRISAT, 1996).

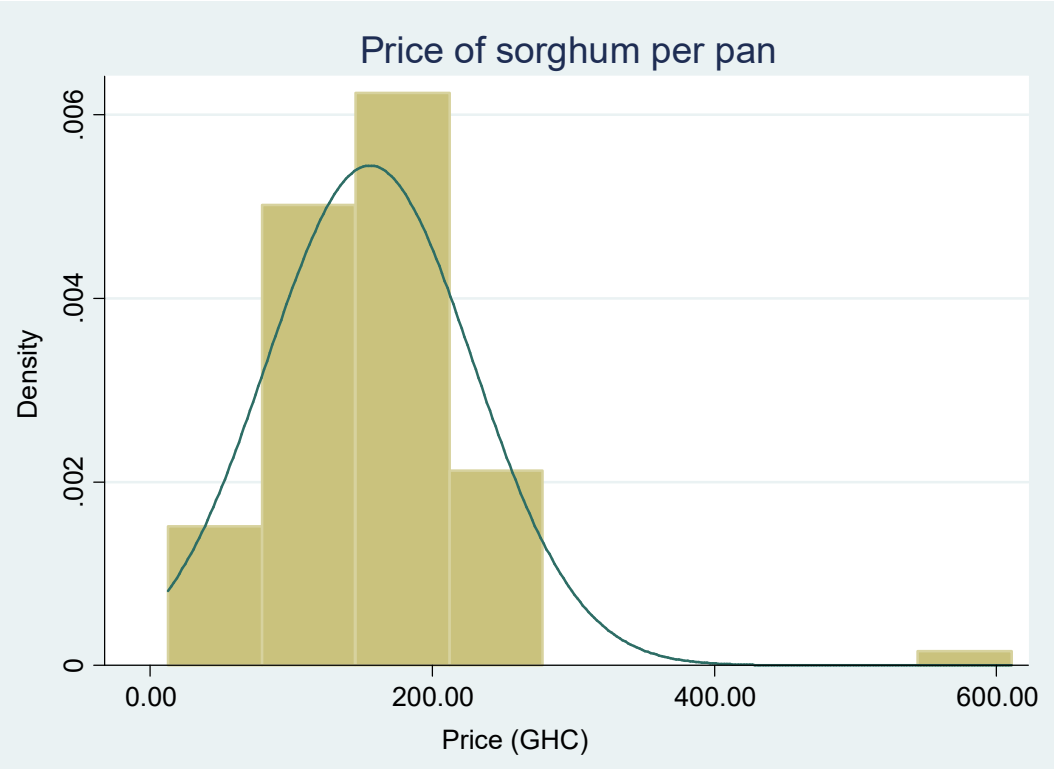

Figure 8: Price of sorghum per bag (100kg)

It was discovered from the study that majority of farmers sold their sorghum produce at GH₵155.86 per a 100kg bag, on the average (equivalent to $33). However, the price of sorghum per bag, as indicated by the farmers is skewed to the right. Meaning the price of a bag could be as high as Ghs600 ($125) depending on the year, type of market and the demand for the produce. The farmers indicated that, the price of sorghum fluctuates per a season and upon availability and demand, but price has always tilted to the higher side (ICRISAT, 1996; MOFA, 2014).

CONCLUSION

Sorghum production has the potential to empower the people economically and therefore should be well structured into a small or micro scale and ultimately into large scale enterprises to supply industries with grain sorghum seeds for processing it into food and other food products in order to contribute to achieving the targets set by the Sustainable Development Goals (SDG goals 2, 6, 12, 13). There should be a back-up service for sorghum produces not only to assess the output per acre but the viability of sorghum to improve likelihoods and technical support from project planning through monitoring and evaluation to its implementation to ensure the success of sorghum production in the Municipality, Region and the country as a whole.

Since the Navrongo Municipality has comparative advantage in agriculture (grain sorghum and other grain and legume crops) as a result of good geographical condition, it is expedient that District and Municipal Assemblies further develop and expand their policies to assist private individuals and groups to go into and or expand their agriculture ventures. The role of agriculture as basis for economic growth has been re-emphasized in the GPRS II document of the Ministry of Food and Agriculture (GPRS II, 2005) and in other technical documents, therefore the Municipality needs to take advantage of this to encourage people in sorghum production to help reduce poverty in the area. In addition, since there are several interventions that seek to make the individual acquire the necessary skills to become self-reliant; sorghum production should be re-examined, since they have the potential to reduce poverty through the acquisition of skills that can put one in a sustainable employment. It should also be noted that sorghum production should aim at promoting the development and growth of micro and small enterprises with the objective of adoption the cultural practices involves in sorghum production and equipping an individual with productive skills. Government agencies such as the National Board for Small Scale

Industries (NBSSI) and Rural Enterprise Project which aim at offering skill training and supporting farmers' with capital to undertake micro or small scale enterprises are encouraged to expand, enhance and further promote their efforts as per their mandates especially in the agro-based small-scale industries into the Navrongo Municipality.

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