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An assessment of the competitiveness of cassava production in the Birim south district of Ghana.

MASTER'S THESIS

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Declaration

I hereby declare that this master's thesis titled "**Assessment of Competitiveness of Cassava production in the Birim South District of Ghana"** is my own work and all other sources have been duly acknowledged by means of a thorough reference and according to the Citation rules of the FTA.

In Prague date

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Abstract

Transformation of the cassava sector for improved incomes for farmers, efficient supply and utilisation, very much depends on deliberate efforts by government to coordinate and support the activities of major actors within the cassava value chain. The studies aimed at assessing the competitiveness of cassava production in the Birim South District of Ghana and evaluate options for production expansion. Survey research methodology using questionnaires and guided interviews were used in collecting data. A farm-level data size of 239 cassava farmers was obtained using simple random sampling techniques for community selection and snowball method to select respondents. Data analysis was performed using the Statistical Package for the Social Sciences (SPSS) and Microsoft Excel. Results indicate that cassava densities per acre, a routine weeding, planting pattern and method of planting statistically influenced yields. The study further found that expansion of local cassava production in the area is possible given the availability of market opportunities and farmers willingness to expand. Other Findings from the research showed that the local cassava production in the study area was profitable earning a gross margin per farmer of ¢867 and a Cost Benefit Ratio (BCR) of 2.6 averagely, making it competitive. Findings on opportunities for industrial food and non-food uses of cassava indicate high awareness on these new cassava products by farmers but modest demand. High cassava beer consumption was evident. A trend analysis of Policies implemented to transform the sector had seen improvements in raising yields and land area under cultivation but limited impact on mechanisation and processing (10%), as coverage had been relatively low. Farmer's preference for sales at the farm gate was found (78%). The share of the marketing margin along the cassava supply chain was 11.29% for intermediaries and some farmers. Improving post-harvest infrastructure to enhance transportation, processing marketing is needed. Increases incomes for farmers, and ensure food security. Developing food and new cassava derivatives with specific focus on urban and export market for key food products such as fufu flour, High Quality Cassava flour and cassava chips for poultry feed is imperative. Quality and accessible extension to promote appropriate agronomic practices must be prioritised. Improvements in input support to farmers and extension workers were recommended. Farmers organising themselves into cooperatives and utilising extension messages were suggested.
Keywords: *Manihot esculenta Crantz,* government policy, value addition, profitability, marketing channels.

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List of abbreviations

CRI	Crops Research Institute
CSIR	Council for Scientific and Industrial Research
DFID	Department for International Development
ECOWAS	Economic Community of West African States
FAO	Food and Agriculture Organisation
FASDEP	Food and Agriculture Sector Development Policy
GDP	Gross Domestic Product
GSS	Ghana Statistical Service
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
ISSER	Institute of Statistical Social and Economic Research
JHS	Junior High School
MOFA	Ministry of Food and Agriculture
SHS	Senior High School
SRID	Statistics Research and Information Directorate
USAID	United States Agency for International Development
AEA	Agricultural Extension Agents
DAES	Department of Agricultural Extension
FBG	Farmer Based Groups
CRT	Cassava Root Tubers
AGDP	Agricultural Gross Domestic Product
AGSSIP	Agricultural Services Sub-Sector Investment Programme

BCR	Benefit Cost Ratio
MFIS	Microfinance Institutions
CIAT	International Centre for Tropical Agriculture
COSCA	Collaborative Study of Cassava in Africa
CPHP	Crop Post-Harvest Programme
IITA	International Institute of Tropical Agriculture
NARP	National Agricultural Research Project
NAEP	National Agricultural Extension Project
RTIP	Roots and Tubers Improvement Programme
RTIMP	Roots and Tubers Improvement and Marketing Programme
MDG	Millennium Development Goal
SRDP	Smallholder Rehabilitation and Development Programme
TGD	Technology Generation and Development
WAAPP	West Africa Agriculture Productivity Programme
FF	Farmer Fields School
PSI	Presidential Special Initiatives
CIRDAP	Center on Integrated Rural Development for Asia and the Pacific
CMVD	Cassava Mosaic Virus Disease
CBB	Cassava Bacterial Blight
FMCG	Fast Moving Consume Goods
T&V	Training and Visit
SWOT	Strengths Weaknesses Opportunities and Threats

LDC	Least Developed Countries
ICT	Information Communication Technology
MEAS	Modernising Extension and Advisory Services
GGBL	Guinness Ghana Breweries Limited
ABL	Accra Breweries Limited
UES	Unified Extension System
HCN	Hydrogen Cyanide
NBSSI	National Board for Small Scale Industries
NRTCIP	National Root and Tuber Crops Improvements Projects
SADEP	Small Holder Agricultural Development Programme
R&T	Root and Tubers
IPM	Integrated Pest Management
AMSEC	Agricultural Mechanisation Service Centers
GPC	Good Practices Center
MEF	Micro Enterprise Fund
DSF	District Stakeholder Fora

1. Introduction and Literature Review

1.1 Introduction

Cassava (*Manihot Esculenta Crantz*) is a root tuber plant indigenous to the South American continent. From Brazil, it spread to most part of the world and for that matter, Ghana (Ewusie, 2008). It is known by other names such as Brazilian arrowroot, Mondioca, Manioc, Yucca and Tapioca. The most economic part of the plant is the tuberous root which grows between 15 - 100cm and ranges in mass between 0.5 -2.0kg (Hillocks et al. 2002).

Cassava is the fourth most important staple in the world after rice, wheat and maize as over 600 million people are estimated to depend on it for their daily supply of calories (FAO 2007a). Nweke (2004) cites that 40% of Africa's population also rely on it for the supply of calories and its ranked second to maize for the supply of calories (Sayre et al. 2011), which makes it indispensable in Africa (Phillips et al. 2004). Relevance of the crop in Africa is also evident in the increasing levels of annual per capita consumption of over 80 kg/capita compared to a worldwide average of 17 kg/capita (Nweke 2004). Almost 95% of the total cassava production, after accounting for waste, is used as food in Africa.

In Ghana, the per capita consumption of cassava according to the 2013 MOFA statistics indicates a rising trend from 151.4 kg/head/year in 2000 to 154 kg/head/year in 2010. During the same period, per capita consumption of yam increased from 42.3 kg/head/year to 50 kg/head/year. Per capita consumptions of plantain, maize and rice in 2010 were 85 kg/head/year, 45 kg/head/year and 24 kg/head/year respectively in 2010 (MOFA 2013).

Cassava is an important staple in Africa because of its drought and disease resistant attributes, efficiency in producing carbohydrates and its good performance in marginal soils. It is also highly flexible in relation to the timing of planting and harvesting (Plucknett et al. 2000). Consequently, it is referred to as a famine reserve crop, which can be exploited to reduce food insecurity and speed up poverty eradication (Guy et al. 1998). In Ghana its importance somewhat is ascribed to a long held tradition among Ghanaians for eating cassava (Al-Hassan & Daio 2007; Nweke 2004).

The volumes of cassava produced worldwide in 2013 was approximately 277 million tonnes (FAO 2013), Africa produced nearly 91 million tonnes, representing 51% whilst Asia and

America contributed 32% and 17% respectively. Ghana however, contributed nearly 16,115,600M/T in the same year (MOFA 2014). Other top producers are Brazil, Thailand, Indonesia, and Congo Democratic Republic. Ghana remains the 6th producer in the world and third in Africa with a total annual production of 16, 523,661mt in 2008 and 17,212,756 in 2015 (MOFA 2016). The world's Production potential of cassava is estimated at 80 MT ha-1 as compared to world average of 12.8 t ha-1 (FAO 2013). The global trade in cassava products has been growing rapidly in recently, largely driven by imports by China and supply from Thailand and Vietnam. China imports million tonnes of cassava chips to make ethanol. (Naoko et al. 2015). African countries, In spite of accounting for majority of the production volumes, are practically insignificant in its trade. This is mainly attributed to the fact that most of their produce is consumed locally as food (Prakash 2015). This however, is in contrast to Thailand, the world's largest exporter whose local consumption is under 20% of its total production. The remaining 80% are exports as nearly 2.8 billion dollars were realised from its trade in 2013 (Naoko et al. 2015).

Cassava accounted for the highest share of the Agricultural Gross Domestic Product in Ghana, amounting to 22% out of a total of 34.5% AGDP share of the national GDP in 2009 (MOFA 2010). It is used mainly in food preparation although an allowance is made for some industrial uses on a small scale. Cassava is consumed as food in the form of cooked fresh roots (pounded fresh cassava, (fufu), cassava flour (fermented and unfermented), granulated roasted cassava (gari), granulated cooked cassava (attieke, kwosai), fermented pastes (agbelima), leaves (vegetables and animal feed). The Industrial uses are mainly in the production of starches (domestic and industrial uses), drinks with cassava components, ethno-medicine, biofuel and animal feed (Meridian Institute 2013).

1.1.1 Problem Statement

Cassava is an important crop in the farming systems of Ghana and contributes nearly 22 % to the annual GDP. In terms of calories consumed in Ghana, it is the highest with a per capita consumption of 154 kg/head (MOFA 2013). Despite these crucial contributions towards food security and the economy of Ghana, Sam and Dapaah (2009), emphasised that focus on developing cassava as an important crop both for food and as a cash crop by the government and its bilateral donors have been limited. Angelucci, (2013) indicated that no crop specific policy has been implemented apart from the presidential special initiatives in cassava in 2001, which sort to commercialise the sector. Preference for investments by governments and its

development partners are on other crops such as cocoa and cereals. Cassava is perceived as an inferior crop hence a preference for investment in the former (Sam & Dapaah 2009). Moreover, decades of agricultural policies by successive governments in Ghana have focused extensively on increasing crop production through the introduction of modern and best agronomic practices. Surprisingly, the observed crop increases over the years have been attributed to land expansion rather than improvements in yields (Breisinger et al. 2010). Less efforts have been made to develop an effective value or marketing chain that will ensure proper market coordination among farmers and other actors which Sam and Dapaah cites as crucial in stimulating demand and increased incomes for farmers.

Average yields of cassava in Ghana are low due to farmer's use of crude methods such as traditional cassava varieties, traditional agronomic practices, and overdependence on rainfall (MOFA 2010). The yields are way below the countries achievable level of 28 metric tonnes per hectare as well as the world's potential of 80 tonnes per hectare (FAO 2013). The average yields in Ghana hovers around 16 tonnes per hectare as against 12 MT/HA worldwide. Industrial uses of cassava in Ghana is still low and, in some parts, virtually non-existent (Gibson 2005). The largest market for cassava in Ghana however, is in food, while industrial utilisation is still limited (Sam & Dapaah 2009). This affects the drive towards industrialisation and improved income for farmers. Post-harvest losses persist among smallholder farmers due to its high perishability nature, substantially impairing growth in their incomes and standard of living. Less efforts are made at utilising additional markets for the product apart from food (Kleih et al. 2013). Ghana records yearly surplus of 8,132,372 M/T, which are not utilised (MOFA 2016). This result in loses for farmers.

In Ghana, it is popularly known that cassava farmers are those who feature in the lowest echelon when the hierarchy of farming is discussed Returns from cassava production according to Sam and Dapaah (2009), ranges from 1% to 50% for over 70% of farmers while others hardly recoup their investments due to rising cost of inputs especially labour. This affects access to capital for initial farming or expansion as access to financial assistance is difficult to come by, the few that have access are faced with high interest rate. As at 2008, of all cassava farmers, only 14 % had access to loans from banks and microfinance institutions. (Sam & Dapaah 2009). This threatens continuous production which eventually affect food security. Efforts of government and its donor agencies at eradicating some of these problems have barely

yielded results. The study therefore wishes to assess the competitiveness of cassava production in the Birim south district of the Eastern region of Ghana and assess options for expansion.

1.2 LITERATURE REVIEW

1.2.1 Economies of Cassava Production

Cassava is an important root crop in Sub-Saharan Africa. It best suited in regions with average temperatures between 25-29°C and a soil temperature of approximately 30°C. It is best fit in areas with an annual rainfall distribution 1000-1500 mm, although it can survive minimum conditions of rainfall distribution as low as 500 mm. This gives it an urge over other crops under similar conditions (Howeler et al 2018). Average annual rainfall distribution and temperatures in Ghana hovers around 1100 -2100 and 26°C respectively. Additionally, its survival in marginal environments makes it preferred by most farmers (Kleih 2013).

In Ghana, cassava is grown on different types of soils, but is best suited to soils which are deep to very deep and well to moderately drained. It tolerates soils with pH values ranging from 4.5 – 8, thereby enhancing its survival even in acid soils. Its survival in periodic and extended droughts and defoliation by pests makes it a significant force for sustaining the poor in the tropics (El-Sharkawy 2012). It is also very much compatible when intercrop with other crops and has a flexible time of harvest. Africa's contribution towards cassava total production from 1960 to 1990 rose from 40% to around 50% with Nigeria overtaking Brazil as the highest producer (Nweke 2002). Two forces according to Nweke explain this dramatic growth. First, demand expanded because of rapid population growth and second, due to improved genetic research and better agronomic practices.

Cassava is grown in abundance across Ghana except for the Upper East and Upper West regions, where production volumes are low. Cassava production levels from 2007 increased from 10,217929 MT on a 640,000 ha to 16, 523,661 MT (886,000 HA) in 2014. This represents nearly 45.6 % increase in output over the period (MOFA 2015). These increases in production volumes within the period are linked increases in average yields per hectare of nearly 26% from 14.64 MT/HA in 2011 to 17.37MT/HA in 2014 resulting from the introduction of high yielding, early maturing and disease resistant varieties. It is worth noting that the amount of land under cultivation also increased by 11% in the period. (Kleih et al 2013). Average yields in Ghana ranged from as low as 7.6 MT/HA in the Western to a high of 23.52 MT/HA in the Eastern Region between 2011 and 2014. (MOFA 2015) These values are far below the potential

of 26-38 tonnes/ha for improved varieties (RTIP 2002), but are above local varieties which yields up to 10 tonnes/ha (Graham et. al. 1999). In terms of area harvested, cassava is now the second largest crop as it has been recently superseded by maize (MOFA 2015).

1.2.2: Cassava farming systems in Ghana (Agronomic Practices)

Cassava is grown in almost all the agro ecological zones in Ghana with the exception of the Sudan Savannah, with the Bulk of production nearly 50 percent occurring in the Semi-Deciduous Rain Forest (Gerken et al. 2001). Nearly 75% of farmers are engaged in its production on subsistence levels (MOFA 2006).

Site selection for cultivation plays an important role in plant survival and yields. Flat or gently sloping lands which are deep (30cm) with well-drained loamy soils are ideal for optimum plant yields. (Agbabiaka 2017). The choice of method of planting which according to Nweke et al (2002) affects cassava yields is also influence by the nature of the available land. Land acquired for cultivation therefore must be well drained and not prone to waterlogging. A proper land preparation method according to Agbabiaka (2017**)** is very crucial towards cassava yields as it complement the output and adds further that it forms the foundation of any cultivation. By ploughing using either a tractor, hand-held hoe or using an ox-drawn plough, pulverize or turn and mix the soil which exposes the lower region of the soil and subjects pests to unfavourable condition, thus, reducing their population or eradicating them completely as well as ensuring good root and tuber formation of the cassava plant. Slashed weeds spread on the farm help to trap soil moisture, manage soil erosion and to help control weeds as well add nutrients (green manure) which improves soil fertility.

In Ghana and most parts of Africa, several forms of land acquisition exist. A study by Samuel Adjei-Nsiah on Cropping Systems, land tenure and social diversity in Wenchi Ghana, revealed four forms by which lands are acquired for farming. According to him, the main means of accessing land in most part of Ghana especially the Akan speaking communities where cassava is grown extensively are either by outright purchases, rented (paid or share cropping), inherited(gifts) or obtained from government forest lands with its accompanying terms for usage. Government also gives farmers lands in return for replanting of trees.

Pests and diseases are common threats to the productivity of any crop. Pest and diseases is estimated to cause approximately 50% loses in crops (Oerke 2006). Pest such as rats, termites, grasshoppers, mealy bugs, grass cutters among others, attacks cassava plants and is also

affected by the cassava mosaic disease, bacterial blight disease, anthracnose disease, root rot, bud necrosis and the brown and white leaf spot disease. This causes a reduction in plants performance due to damage to the plant and its roots. The most effective measure to control pest and disease according to Ezulike et al (2006) is the use of resistant cassava stems for planting and removal of infected plant from the field immediately the disease is noticed. The cassava plants can also be sprayed with chemicals like insecticides, fungicides, bactericides; depending on the causal organism of the disease. Good weed control, either manually or chemically, is probably the most important factor in obtaining high cassava yields. Weeds compete with plants for space, light, water and nutrients. This affects yields (nearly 40%) by reducing canopy development and root bulking. Required routine weeding for optimum yields is a minimum of three times specifically at the 4,8,12 weeks after planting (Ezulike et al 2006).

Generally, two varieties of cassava are of economic value: the bitter, or poisonous; and the sweet, or non-poisonous, distinguished based on their levels of cyanide concentration. More than 5000 known cassava cultivars according to Chavarriaga-Aguirre et al (2016) have been developed from them, with all contain varying levels of cyanogenic glucosides: *linamarin* (85%) and *lotaustralin*, (15%). HCN content less than 50mg/kg of freshly peeled and grated roots, is harmless and thus a sweet variety while HCN content between 50-80mg/kg, are considered toxic and needs further processing before been eaten (Adaklu et al. 2010). Soil, climatic conditions, cultural practices and plant age have been attributed to cause this phenomenon. (McMahon et al. 1995) Stephens, (1994) thus, concluded that a sweeter cultivar in one locality might be bitter in another area considering the aforementioned reasons. Both varieties yield a wholesome food because the volatile poison can be destroyed by heat during processing (International Starch Institute 2018**).** Adaklu et al therefore, stress that varietal preference or selection by farmers should consider access to processing methods and warned that cassava with higher levels of cyanogen should not be patronized in areas with limited processing methods.

However, farmer's varietal selection in Ghana is based exclusively on those that are liked by consumers, grow fast, give good yields and are tolerant to major pest and diseases. (Nweke 2004, Smale et al. 2001). These very factors have also influence plant breeders who also design their objectives to meet farmer's demands and solve constraints faced by simply making changes to the genetic makeup of a plant population. (Bentley et al. 2017). Several varieties

that respond to farmer selection decisions have been developed and recommended to farmers (RTIMP &MOFA 2009).

These cultivars are early maturing, high yielding and tolerate various biotic and abiotic stresses. All the varieties are tolerant to the Cassava Mosaic Virus and have moderate resistance to the cassava Mealybug Pests and yields 40% higher than local varieties without fertiliser application. This study wishes to assess the availability and adoption of these improved varieties and explore the reasons for the use of a particular variety in the Birim South District. Some cassava varieties developed in Ghana and their distinctive attributes are summarised below.

Improved cassava varieties released by the National Agricultural Research Systems since 1993 and their characteristics.

Table 1: Improved cassava varieties in Ghana and its and characteristics

Variety	Maturity period (Months)	Mean root yield (T/ha)	Uses	CMD resistance
Afisiafi	12-15	28	Starch, Flour, gari	Tolerant
Abasafitaa	12-15	29	Starch, Flour, gari	Tolerant
Tekbankye	12-15	28	Poundable	Tolerant
Dokuduade	12	35	Starch, gari	Resistant
Agbelifia	12	40	Starch, gari	Resistant
Essam bankye	12	42	Flour, gari	Resistant
Bankyehemaa	12	40	Flour, gari, poundable	Resistant
Eskamaye	12-15	20	Poundable	Tolerant
Nyerikogba	12-15	25	Poundable	Tolerant
Filindiakong	12-15	17	Poundable	Tolerant
Nkabom	12-15	30	Poundable	Tolerant
IFAD	12-15	33	Poundable	Tolerant
Capevars bankye	12	54	Poundable	Tolerant
Bankye botan	12	64	gari, flour, agbelima	Tolerant
Ampong	12	45	Flour, starch, Poundable	Resistant
Broni bankye	12	40	Flour and bakery products	Resistant
Sika bankye	12	40	Starch, flour	Tolerant
Otuhia	12	35	Starch and flour	Resistant

Source: Acheampong & Owusu (2015).

In Africa, cassava planting materials are usually, sourced from the farmers' fields, neighbours and sometimes from cassava marketing middleperson. In Ghana, there is abundant supply of cassava cuttings in the forest zone than the savannah zone, which experience short supply of cassava cuttings (FAO 2012). As a result, farmers in the savannah zone discontinue the use of varieties, which produce low yields of the planting material (IFAD &FAO 2005). Some farmers do not dispose of stems affected by pests or diseases, which are responsible for the spread of pests and diseases (IFAD &FAO 2005: Rossel et al. 1994). Farmers who produce cassava on large scale, normally plant healthy-looking cuttings from plants that are more than a year.

Quality of the cassava stem cutting according to Nweke et al. (2002) plays an important role in crop productivity. It is recommended that the length and thickness of cassava stalks be 20-30 cm long and 2 m thick for optimal production. This however should have approximately 5-8 buds on the plant. There is no strict way of planting the cassava stalks, as the choice is very much dependent on the nature of land available. Direct planting of stalks in to the ground is recommended for those with flat lands where soils are well drained whilst in waterlogged areas, planting in moulds and ridges are recommended. Storage of cassava cuttings should not be more than 3 weeks and it must be stored under a shade since storage in the sun affects plant germination. Use of appropriate tool in cutting stems is recommended to avoid stem splintering which also affects germination of plants. (Adebayo et al. 2014).

The cassava plant density is an important agronomic consideration as it positively and strongly correlates to cassava yields. The most commonly recommended spacing for cassava is 1 m x 1 m which is equal to a plant density of 10 000 stands per ha (Nweke 2004: Onwueme 1978). The average farm-level plant density in Ghana according to the Collaborative Study of Cassava in Africa was 8 000 plants per ha. The cassava stand density in the farmers' fields varies widely from 500 plants per ha to 40 000 plants per ha depending on climatic zone. Farmers who cultivate cassava as a cash crop usually plant at higher densities as when compared with others who plant it as a famine-reserve crop or as a rural food staple (Nweke 2004).

Cassava does not have a critical planting date as long as there is enough moisture at planting for rooting to commence. The actual date of planting is determined by the arrival of the rainy season. In West Africa, cassava is planted from the beginning of the rainy season (February–March) to the end of the rainy season (October-November) (Nweke 2004). However, in Ghana, cassava is usually planted from May to September which is the main rainy season. It is harvested approximately 12 months after planting. This is done usually from March to October

(in an average year). The highest supply of cassava roots are usually in the early part of the wet season (May to July) just before planting begins. Harvesting during the dry season (November to March) is not common as only small quantities. (Kleih et al 2013).

In Africa, cassava is frequently grown as an intercrop with other crops (Dahmardeh et al. 2010). Farmers in Ghana apart from the selection of suitable varieties have also developed cassava-cropping systems in the form of rotations and crop mixtures that are adapted to the various agro-ecological zones in the country (FAO 2002). In the COSCA study countries, 60 percent of the cassava fields were intercropped and 40 percent mono-cropped. Cassava/maize intercrop is the most common, constituting about 50 percent of all cassava-based intercropped fields (Nweke 2004). According to FAO (2002), apart from combination with maize is also intercropped with yam or beans. Other combinations are cassava/pea, cassava/banana (or plantain), cassava/rice, cassava/millet (or sorghum), cassava/yam and cassava/sweet potato. (Kleih et al. 2013). Cassava's flexible planting schedule, wide interspacing and slow rate of growth relative to maize, for example, make it suitable for intercropping. Intercropping system merely refers to the cultivation of two or more crops in the same space during the same season. This aims to improve soil fertility (Dahmardeh et al. 2010), maintain high yields, reduce risk of crop failure, controlling weed pressure (Dapaah *et al.*, 2003), decrease disease severity (Zinsou et al. 2005) and achieve more efficient utilization of environmental resources. Three forms of fallow have evolved in the cassava cropping systems, which are the long, short and continuous cultivation. Population growth in Africa has contributed to the decline of production under the long fallow system. The COSGA study summarized the distribution of cassava fields in its study area as follows: long fallow, 5%; short fallow, 75 %; and continuous cultivation, 20%. Most farmers now produce cassava under the production under the short fallow system is now preferred due to cassava's long growth period, pests and disease problems and compatibility with crops such as yam and maize. However, production under the continuous cultivation is increasing in many African countries including Ghana in response to the increasing population pressure on farmlands. This point to the need for early bulking and pests and diseases-resistant cassava varieties (IFAD &FAO 2005).

Farmers generally do not apply fertilisers owing to its high cost. This consequently affects soil fertility maintenance and crop yields. MOFA 2013 estimates Cassava yields from 5 tonnes/ha to 25 tonnes/ha. Serious agronomic investigations are urgently needed to develop appropriate systems of soil fertility maintenance and yield according to the IFAD.

Knowing when the roots are ready for harvest is a key step in ensuring good eating quality roots. If harvesting is delayed, the roots will become brittle when cooked, a condition often described by consumers as “past”. While there is a debate on what happens, it is believed that after the accumulation of maximum starch in the roots, the plant tends to remobilize the starch into sugars to facilitate new shoots growth and, therefore, the roots loose its mealiness. However, some varieties do not succumb to this condition (Mohammed 2009).

Time after planting is the commonly used index for determining when to harvest cassava roots. Roots are typically and sufficiently well-developed beginning 6-7 months after planting up to 18 months and over, depending on the variety. Early maturing varieties are ready for harvest between 9-12 months and late maturing 12-18 months after planting (RTIMP & MOFA 2009). Harvest maturity is also based on the root size desired by the market determined by random selection of plants as a representative of the entire field, Foliage senescence and lower leaf yellowing (Kitinoja & Kader 2003). Harvest may be delayed until market, processing or weather conditions are favourable, however, as the roots age beyond a year, it becomes woody, lignified and fibrous. Harvesting before maturity results in low quality produce whiles over matured roots are low in dry matter and starch content. (Ministry of Fisheries, Crops and Livestock 2004). Research conducted by Institute of Social, Statistical and Economic Research (ISSER) and cited by Dapaah and Sam (2009), revealed that yield of cassava is highly influenced by its maturity.

Postharvest system or handling according to the Centre on Integrated Rural Development for Asia and the Pacific (CIRDAP) (2010), is series of interconnected practices covering the delivery of a crop from the time and place of harvest, to the time and place of consumption, with minimum loss, maximum efficiency and maximum return for all involved'. Cassava is very bulky and contains 60-70% moisture rendering it the most highly perishable among all the root tubers with about 30-45% of roots loss occurring after harvest and the roots begins to perish after 48hours when harvested. Some of the worst losses of cassava often occur after harvest due to misunderstanding or ignorance on the postharvest handling procedures of the produce. Post-harvest treatment of cassava therefore is crucial towards curbing loses. The post-harvest treatment of cassava includes precooling, curing, transportation, cleaning/washing, grading/sorting, waxing storage and processing (MOFA & CSIR 2010).

1.2.3 Profitability of cassava production

The term ‘Profit’ and ‘Profitability’ are two different words although they are used interchangeably. They are rather closely related and mutually interdependent, having different roles in business. Profit is an absolute term and the same as income, margin, earnings, whereas, profitability is a relative concept (Gnanasooriyar 2014). Profit according to Gnanasooriyar (2014) is the total income earned by the enterprise during the specified period, while profitability on the other hand refers to the operating efficiency of the enterprise thus, its ability to get enough return on the capital and employees used in the production process, as it shows how efficiently the management can make profit by utilising all the available resources since profit is the engine that drives any enterprise. The term ‘Profitability’ is not synonymous to Efficiency but rather an index of efficiency as it is used as a measure of efficiency and serves as a management guide to greater efficiency. Profitability, although, an important yardstick for measuring efficiency, cannot be taken as a final proof of efficiency. Sometimes satisfactory profits can mark inefficiency whereas; a high degree of efficiency may be accompanied by an absence of profit. (Gnanasooriyar 2014).

Gross margin (GM) and profitability ratio (using Benefit Cost Ratio) analysis are the most critical analytical tools used to assess the profitability or otherwise of a business. GM is one measure of profitability, useful for cash flow planning and determining the relative profitability of farm enterprises (Rural Solutions 2012). GM refers to the difference between the annual Gross Income (GI) for an enterprise and the variable costs directly associated with the enterprise. GM analysis according to Odoemenem and Otanwa (2011), is ideal where fixed capital is a negligible portion of the farming enterprise. Rural solutions agree with these statements and advocate that fixed costs be ignored, as it will be incurred regardless of the level of the enterprise undertaken.

Furthermore, GM is defined as the difference between the Gross Farm Income (GI) and the Total Variable Cost. (Odoemenem & Otanwa 2011;Olukosi & Erhabor 2005), In contributing to the assessment of profitability of farm enterprises, Nandin et al., (2011) postulate that the difference between Total Revenue (TR) and Total Variable Cost (TVC) makes up the GM and it evaluates the gross profitability of a given enterprise. A gross margin for farming enterprise merely is its financial output minus its variable costs. Generally, farmers want optimum return over variable cost of production and using gross margin analysis this can be achieved. It collects

Information on total cost (TC) (comprising total fixed cost (TFC) and total variable cost (TVC)), and total revenue (TR) (product of quantity of cassava produced (kg) and unit price.

1.2.3.1 Benefit Cost Ratio

The profitability ratio, benefit-cost ratio (BCR) is also given as Gross Benefit/Total Cost (Nandi et al. 2011). This is the average return to each Ghana cedi spent on the cultivation of cassava and is an important criterion for measuring profitability. It is estimated as ratio of gross return or total revenue to total cost per hectare. According to Olagunju et al. (2007), as a rule of thumb, any enterprise with benefit cost ratios greater than one, equal to one or less than one indicates profit, break-even or loss respectively. According to Adegeye and Dittoh (1982), this ratio is one of the concepts of discount method of project evaluation

1.2.4 Processing

Cassava has the potential to be processed into a range of sub-products from food products to industrial sub- products to add value to it and mitigate against post-harvest challenges. This is an important way to promote agricultural growth and increase profits. Expanding cassava production without adequate storage facilities and access to market may discourage investments in cassava.

Studies done by Folayan and Bifarin 2011, Quaye2009 and Mafimisebi 2007, concludes that value addition through processing improves returns on investments by farmers. Kleih et al., (2013) agrees there are options to earn improved incomes from processed cassava products. Consequently, Chukwuji et al. (2007) and Farinde et al. (2007) adds that the solution to spoilage of CRT is by processing. Furthermore, Kaine (2011), concludes that processing increases CRT shelf-life in storage, leads to rise in marketing margins for processors but however, states that realising the full potential was greatly affected by low levels of technical efficiency. Olaleye et al. (2007) supports this assertion and states that returns on gari processing do not satisfy the profit maximization objective of firms. Chiefly because of the usage of traditional approach of processing resulting in increased expenses and decreased profit. In a similar vein, Ayoade and Adeola (2009), Knipscheer et al. (2007) and Liverpool et al. (2010), argued that CRT production, processing and marketing were constrained by government agricultural policies and the poor state of infrastructural provisions. Processing simply implies the treatment of food substances in such a manner as to change its properties with a view of preserving it, improving its quality or making it functionally more useful (Levenstein 2003).

1.2.4.1 Importance of Processing Cassava

Processing of cassava roots is crucial due its high perishability rate resulting from its high moisture content (approximately 70 %). Cassava roots have high cyanide contents and processing decrease its toxicity. (Kleih et al 2013). Generally, processing cassava roots helps:

- Reduce water content in the roots to convert them into products that are more stable, easier to transport, and more marketable.
- Eliminate or reduce cyanogenic glucoside contents.
- Improve the flavour of cassava products.
- Create an opportunity for farm surpluses to receive aggregate value and thus enter alternative markets.
- Prepare a varied range of products to supply consumers' food needs
- Helps promote cassava production
- Substantial foreign exchange
- Creates job opportunities for youth and women
- Income generating activity for farmers (RTIP &MOFA 2004).

1.2.5 Existing and Traditional Forms of Processed Cassava

In Africa, and for that matter Ghana, mainly five major groups of common cassava-processed products are found. These are the fresh root, dried roots, pasty products, granulated products and cassava leaves. (Nweke 2004).

1.2.5.1 Fresh root

The roots of sweet cassava cultivars are either eaten raw, roasted, or boiled in water and oil. Cyanogen in the roots are destroyed by slowly cooking the roots. Starting with cold water, gradual heating promotes the hydrolysis of the cyanogen (Nweke 2004: Grace 1977). In Ghana the most common food under this category is the pounded cooked cassava root known as fufu which a delicacy for people in the south although it has spread to almost every part of the country.

1.2.5.2 Dried roots

Dried cassava roots are stored or marketed as dried chips or milled into flour and used subsequently as food. It is preserved by either sun drying or smoked. (Sam &Dappah 2009).

1.2.5.3 Pasty products

Two forms of pasty cassava products exist: uncooked and steamed pastes. The most popular is the uncooked paste since it is stored or marketed without cooking hence requires less effort. In Ghana the uncooked paste locally known as agbelima constitute nearly 18% of total production uses. This is a fermented product from cassava and has major dietary importance in Ghana especially in the Greater Accra and the Volta region. It is used as an immediate product for the preparation of akple, banku, yakeyake and most Ghanaian dishes. The quality of Agbelima can be judged by its colour, smoothness, cohesiveness, aroma and sourness. Good quality Agbelima should be smooth and creamy. It can be dried into flour to prolong its shelf life. The dried form although more stable with better shelf life are only available in few supermarkets in the country. The dried product according to RTIMP and MOFA (2009) has a potential for the export market.

1.2.5.4 Granulated products

In Africa, there are three common types of granulated cassava products: gari, attieke and tapioca. The methods for making granulated cassava products originated in Brazil. (Nweke 2004).

1.2.5.5 Gari

Gari is the most commercialised of all cassava products. In recent times, it has been increasing in production due to increasing urban demand and export market potential (Addy et. al. 2004; Oduro et. al. 2000). It is a major staple food in Ghana and 25% of total cassava produced in Ghana is used to produce gari. It is fermented partially gelatinized granule product, which is free flowing. The particle size varies from one locality to another depending on consumer preferences. Fermentation greatly affects the taste and colour of product. It is best stored at 8-10% moisture level and it can be stored up to 12 months. Its popularity is attributed to the fact that it is pre-cooked and takes shorter time to prepare into a main dish or snack. Apart from it being a staple food, a large market exists for in it the West Africa sub-region (RTIMP& MOFA 2009).

ISSER (2006) observed that given improved technology, the yield rate of gari from cassava could be improved and the problem of post-harvest losses through lack of ready markets could be reduced. Since 1997, the price per kg of gari has generally been increasing at a faster rate

annually than that of the price of maize. In 2008, the price of gari increased 8.5 times while that of maize rose by nearly 7.3 times. However, in 1997 the price per/kg of gari was similar to that for maize (Oduro et al. 2000).

1.2.5.6 Attieke (Cassava Couscous)

This is a type of steamed cassava that is found mostly in the Côte d'lvoire but with migration of Ghanaians in the 80s and 90s it has also gain grounds in Ghana and its one of the expensive food products from cassava. However, its consumption is still low and popular mostly in the Volta and western region as well as some cities like Accra and Kumasi. Attieke is made almost in a similar way as gari, however, instead of toasting, attieke is steamed and available in a wet form. This gives it a shorter shelf life than gari. (Nweke 2004).

1.2.5.7 Tapioca

This is primarily consumed in Benin and Togo. It is prepared by putting grated cassava in water. It is pressed and kneaded to release the starch. The starch is permitted to settle at the bottom of the container and the water is drained off. The operation is repeated several times to prepare a high-quality product. The damp starch is spread on a pan and toasted in the same way as gari to form a coarse product. Its consumption in Ghana is very low and quite unpopular. (Nweke 2004).

1.2.5.8 Cassava leaves

Cassava leaves are edible and more convenient than the fresh roots. It could be stored in dried form and relatively inexpensive to dry due to its low water content. If leaf harvesting is done properly, it does not affect the root yield of the crop (Gbasouzor et al 2015; Dahniya 1983). Cassavas leaves is nutritious just like other green leaves. It serves as a source of vitamins A (carotene) and C, iron, calcium and protein (Gbasouzor et al 2015; Latham 1979). Its consumption helps many people in Africa make up for the lack of protein and some vitamins and minerals in the cassava roots. Cassava leaves are consumed mainly in the northern part of Ghana, while minimal consumption exist throughout the country. (Gbasouzor et al 2015). This may be attributed to the presence of several indigenous plants in Africa which provides vegetables, usually consumed with yam (Okigbo 1980). Most of these vegetables are however, available seasonal (during the rainy season), Cassava leaves therefore could fill the gaps in the

availability of vegetables in West Africa. The cassava leaves in combination with the peeled skin serves as a major source of feed for livestock in Ghana.

1.2.6 Current commercial and potential scope of Cassava

The largest market for cassava in Ghana is in food, while industrial utilisation is still limited but with potential for expansion. It has a potential to be used as a raw material for several agro-industrial products. Globally, there has been an increase in the transformation of cassava raw tubers in to several forms to meet rising demand as an industrial raw material. This according to Manprasert (2014), is due to its low prices compared with other starchy vegetables and its relatively high calorific content which gives it an urge over the other alternatives.

In Ghana, Kleih et al, (2013), puts industrial uses of cassava at 1% of Ghana's total cassava production although a recent study by Dalberg in 2015 contrast this and pegs it at 0.5% of total production. Utilization of processed and semi-processed cassava derivatives can broadly be categorized into four product areas: livestock feed (in the form of peels, fresh and dry root, chips, pellets and sometimes flour), food for people (high quality cassava flour HQCF), industrial non-food uses (Starch, HQCF) and biofuels (Meridian Institute 2013, Gibson 2005).

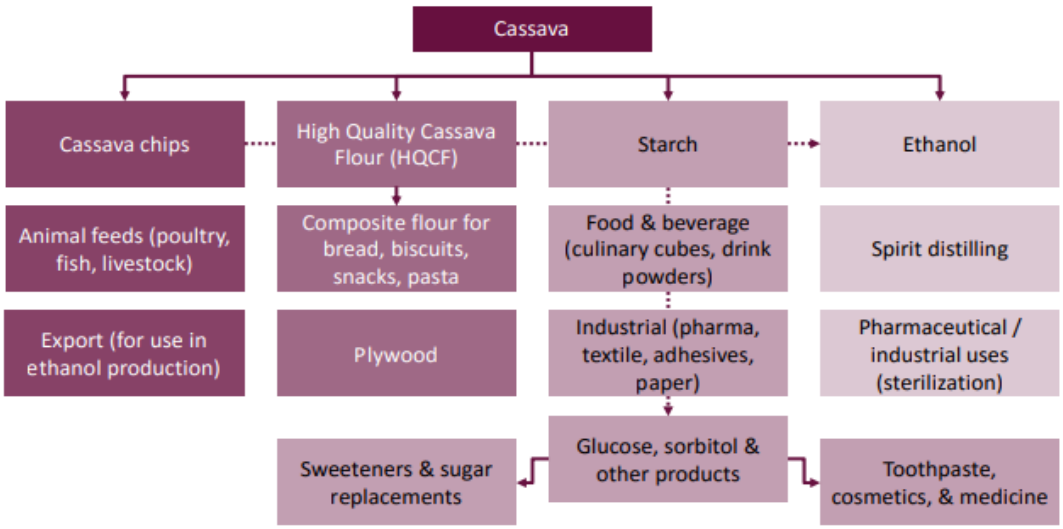

Figure 1: Summary of Cassava Derivatives.
Source: Naoko et al. (2015).

1.2.6.1 High Quality Cassava Flour (HQCF).

Ghana statistical service in 2015 reported Ghana's annual wheat flour imports at approximately 446,000 MT in 2014. These are mainly used in the production of bread (70%). An estimated

12% is used for biscuits, 10% for pasta and noodles, 6% for snacks, and 2% for the plywood industry. Due to an increase in the prices of wheat in the international market coupled with an unfavourable exchange rates in Ghana, high quality cassava flour is gradually gaining popularity as a substitute or complimentary to wheat in the preparation of bakery products such as cakes, biscuits, cookies, doughnuts and bread. HQCF is unfermented smooth, odourless, very light cream flour with no gluten. Currently, HQCF accounts for about 0.7% of all flour consumed and has a market estimate of 66,000 MT.

In industries, HQCF is also used in the production of adhesives by the paper and wood industries, a base for pharmaceutical drugs and in making cosmetics. The production process of HQCF from harvesting to drying must be completed in a day to ensure that cassava flour produced is near white and odourless (RTIMP &MOFA 2009). In 2014, Bread and other baking industries utilized about 70% of all demand, which is equivalent to nearly 2,100 MT of HQCF. Between 2011 and 2012 a total of 800-1000MT of HQCF per year was produced by cassava processors in Ghana. There is however, a potential for producing larger quantities but there exists a financial constraint. Of the 800-1000 MT produced, some were produced as non-food grade industrial-grade flour. (Kleih et al. 2013)

1.2.6.2 Plywood

Ghanaian plywood industry is well established in spite of reported declines in employment in the sector. Majority of its production is destined for the West African Sub-regional market. It is projected that the industry utilised nearly 4,000 MT of various types of flours as glue extender. The bulk of these flours are cassava flours, both industrial grade flour and traditional Kokonte flour. The industry recognises that quality cassava flour results in better bonding of the glue and a high-quality end product. A constraint faced by the sector however is the seasonal scarcity of cassava flour during parts of the year (Assuming et al. 2009).

Table 2: Industrial options for HQCF and its market potentials in Ghana

Industry	Current Product	Locally produced cassava-based alternative	Quality requirements	Market potential (Tonnes of fresh cassava)
Plywood	Imported wheat flour	High-grade cassava flour	High-Finely milled (0.25mm), white flour, low fibre, not fermented, with high paste viscosity and stability	17, 000-34,000 Tonnes
Paperboard	Imported glue, based on maize starch	Adhesive made from high-grade cassava flour	High-As for Plywood	21,000 Tonnes
Textiles	Imported and locally produced maize starch Imported cassava starch	High-grade cassava flour	High-Finely milled (0.25mm), white flour, low fibre, no odour or taints and not fermented, with high paste viscosity and stability	17,000 Tonnes
Sugar Syrups	Mostly Imported Sugars	High-grade cassava flour converted into sugar syrup using plant enzymes	High-As for textiles, but paste viscosity and stability are not important	251,000Tonnes
Industrial Alcohol	Mostly imported sugars	High-grade cassava flour converted into sugar syrup, then fermented and distilled to produce 96% industrial ethyl alcohol	High-As for sugar syrups	56,000Tonnes
Bakery products	Imported wheat flour	High-grade cassava flour	High-Similar to textiles	90,000 Tonnes*
Total market requirement (Tonnes fresh cassavas) Tonnes				**452,000-469,000**

*Assuming a 10% replacement of imported wheat flour with high-grade cassava flour

1.2.6.3 Animal feed

Kleih et al. (2013) projects cassava use as livestock feed as a potential driver for future cassava markets. In 1994, nearly a quarter of the global cassava production was consumed as feed by the pig, poultry, cattle and fish industry (Gibson 2005: IFAD&FAO 2000). Peels, fresh and dry root, chips, pellets and at times flour are used as livestock feed. Conventionally, cassava is fed to sheep and goats in Ghana, constituting up to 20% of compound livestock feeds especially in poultry and pigs. Majority of the livestock reared in Ghana rely on open grazing, however, the poultry and pig industry have been identified as a potential entry markets for the use of dried cassava chips as feed. (Kleih et al 2013). Gibson (2005) believes the amount of cassava and its bye-products fed to animals must be big, since no data for approximating exist and adds that a true livestock feeding industry based on cassava was yet to develop.

A study by Rhule et.al. In 1998 revealed the possibility of cassava to replace maize in pig diets at nearly 20% inclusion level. In addition, the Crop-Post Harvest Programme (CPHP) report on a field trial on broilers, pigs and laying hens, using cassava as partial replacement for maize, showed that diets reformulated to make up for low levels of protein in cassava resulted in pigs attaining market weight (60kg) in seven months compared to a year or more when fed by conventional ones. There were no significant fall in the performance of poultry placed on a 20% cassava diets. Consequently, a prominent pig industry concentrated around Kumasi, uses different forms of cassava products such as dried chips /flour, peels, and cooked roots as feed, even though the quantities used are relatively not high, it is viewed as an easy entry point for dried cassava in feed. It is assumed that in the long run, the livestock sector in Ghana could absorb nearly 80,000 MT (i.e. 75,000 MT for layers, 2,000 MT for broilers, and 3,000 MT for pigs) of dried cassava chips as feed. However, the study raised issues with the presence of Coliform bacteria (high microbial levels) in dried cassava chips due to improper drying and unhygienic conditions of local processing of cassava chips. This constitute a major constraint in its use in the poultry feed industry. The CPHP report, however, stated that cassava chips obtained through a mini-chip technology meets specifications required by the poultry industry.

1.2.6.4 Starch

Ghana in 2014 imported starch equivalent to 7,100 MT to supplements its domestic native starch production by the sole producer, Ayensu Starch Company which has an installed capacity of 22000MT per year (Dalberg 2015). The demand for cassava starch is expected to

grow to 28,000 MT by 2020 representing the need for early 138,000 MT of fresh cassava per year to be sourced from 16,000 farmers. Starch from cassava has both industrial and domestic uses.it is used in the brewery industries and the fast-moving consumer goods (FMCG) sectors, including the food & beverage and personal care product companies, though none of these companies are currently sourcing locally made cassava starch. Starch also has a large export market and provides job opportunities. The technology for its production is industrial as well as traditional (RTIMP &MOFA 2009).

1.2.6.5 Brewery

Cassava starch has also been shown to be used as adjuncts in brewing beer. Agbale et.al. (2008) report that three improved varieties of cassava: Afisiafi, Gbemoduade and Tekbankye had reasonably high extract content and fermentability and can be used as brewing adjuncts. Earlier on, Ayernor and Ocloo (2003), revealed that starch from Cassava and sweet potato can be used by the fermentation industries in the preparation syrups and alcohol. According to BMI research, Ghana's consumption of beer has increased and is regarded one of the largest beer consuming countries in the African beer market albeit low per capita consumption rates per regional standards. The volumes of beer consumed in Ghana is projected to grow by nearly 14.5% from 2015-2020. According to the Ghana's mergers and acquisition report in 2017, the total volumes of beer consumed is expected to rise from 280.9 million litres in 2017 to 368.5 million litres by 2019.There has been a general rising trend in the growth of per capita consumption from 7million litres in 2013 to 16 million in 2017forcasted to increase further to 20 million litres by 2019, reflecting the fastest growth rate in the Sub-Saharan region. (Kleith et al. 2013, Mergers and Acquisition Report 2017). This creates a huge market opportunity for the cassava sector as it is now used as an ingredient in the preparation of alcoholic beer in Ghana and sells 35% cheaper than mainstream beers made from malt and hops (BMI Research 2017) This is mainly due to the use of local materials and enjoyment of tax holidays, which substantially reduces cost of production for these companies.

This sector is dominated by two major companies, Guinness Ghana brewery limited (GGBL) and Accra brewery limited (ABL) a subsidiary of the SABMiller group to provide a market for CRT, put its surpluses into use to limit post-harvest loses and provide cheap and affordable beers for the low-income earners in the country (Kleith et al 2013). Their products are the Ruut Extra Premium and Eagle Lager Beer respectively, which are produced from locally sourced cassava roots. The potential needs of the sector are currently not being estimated but between

2013 and 2015, GBL alone sourced 13,778.02MT worth of cassava roots, which amounted to 2,258,995 Cedis for their production (AESD 2016). It is worth nothing that the industries is in its infant state and are faced with inadequate access to raw materials in spite of modest market demand.

1.2.6.6 Ethanol industry (biofuel)

All of Ghana's ethanol is currently imported. Ghana imports a total of 60 million litres of ethanol yearly. Nearly 97% of this is used in the potable ethanol (spirits) sub-sector by spirits producing companies who blend potable ethanol with water and flavours to produce alcoholic spirit beverages. Kasapreko Company limited, which is the market leader with nearly 40% market share imports over 23 million litres of ethanol per anum. The pharmaceutical industries absorb a small portion of the ethanol market, with the use of ethyl alcohol as a solvent in the manufacture of medicines. Other industrial uses of ethanol include its use as a sterilizer and fuel for cook-stoves or vehicles (blended with gasoline). Ghana's first ethanol plant at Hodzo, in the Ho Municipality produced 150,000 litres of ethanol from cassava between June and December 2016, way below its initial take off projection of 30000 litre per day. (Kafui 2017). There is a gap in Ghana's local demand and production. There is a sub-regional (Ecowas) demand of 16 million litres which Ghana can tap into to enhance the cassava sector. The ethanol industry is seen as the main driver for cassava industrialisation, projected to absorb nearly 50% of the total latent demand by 2020 (Naoko et al. 2015). Current industrial uses and potential needs of cassava by industries in Ghana is summarised in the table below.

Table 3: Market requirements and potentials for cassava derivatives

Sector		Cassava-based product and of cassava-based product (MT/Year)					Long-term potential	Conditions
			Current use	Short-term	Medium- Term	Long-term		
a	Wheat Total	HQCF	0	0	30,000	24,000	136,000	Currently no legislation for composite flour, large mills against legislation. Some potential for replacement possible in medium term. Here assumed maximum of 10% replacement long-term based on current volumes.
b	Bakeries	HQCF	Limited	1,000	5,000	17,000	68,000	Medium-term projections based on at least 25% of small (rural) bakeries replacing average of 10% with HQCF for bread and doughnuts, etc
c	Institutions (e.g schools)	HQCF	Limited	1,000	5,000	17,000	68,000	Known use of HQCF by some institutions such as schools and demand exist for higher quantities (market demand to be explored).
d	Composite Flour	HQCF	0	0	0	0	0	Assume some potential volumes from a and b would incorporate composite flours
e	Biscuit manufacturers	HQCF	Limited	200-300	1000-2000	3,000	12,000	Subject to trials and slowly increasing the percentage of HQCF towards a maximum of 10% replacement in the long-term. Price is significant barrier in current market due to cheap Turkish soft wheat flour imports

f	Paperboard	HQCF (Starch)	0	500	2,000	3,000	12000	Trials need to be conducted, particularly large-scale users of starch. Medium to long-term potential to replace current sources 100% with cassava starch for SBAs
g	Plywood	Industrial grade flour	2,000	2,000	4,000	6,000	24,000	Some already using cassava. Trails and logistic issues to be considered before potential to increase volumes.
h	Animal Feed	Improved chips	Limited	2,000	10,000	80,000	240,000	Layers represent the bulk of this potential demand based on 16.6% inclusion in poultry feed rations Pig rations can also provide an entry point, albeit at a small scale
i	Breweries	HQCF/Improved Chips	0	?	?	?	?	Guinness Breweries Ghana already use cassava in beer making according to Dec 2012 press release. Quantities to be verified.
j	Distilling	Cassava Starch	0	0	0	Tbc	0	Currently alcohol mainly imported for mixing into potable alcoholic beverages and other uses.
k	Soft drinks	Liquid glucose	0	0	0	0	0	Currently no plants exist in Ghana so would require large small investment from private sector. Likes of Coca Cola not interested.
l	Textiles	Cassava Starch	0	0	0	0	0	Unlikely to be an option for technical reasons, mainly weaving factor currently uses modified starch.

m	Pharmaceuti cal	Cassava Starch	0	0	0	0	0	Nothing
n	Other Starch uses	Cassava Starch	0	0	0	1000-5000	12,500	Subject to production re-commencing at Asco starch factory which ceased production since 2011. Long-term potential based on assuming average TL requirement 2500Tcassava starch.
	Total (without mandatory 10% HQCF inclusion in wheat flour for industrial use) (b+c+d+……n)						436,500	
	Total (with mandatory 10% HQCF inclusion in wheat flour for industrial use) (b+c+d+……n)						436,500	

Source: Kleih et al (2013).

1.3 Policy Framework on Cassava Production in Ghana

The significance of agricultural policy in increasing food production and speeding up agricultural development cannot be overlooked (Akpan 2012). Several studies have shown the excellent attributes of cassava such as tolerance to drought and poor soils, easy-to-grow, food security crop, poverty alleviation in rural communities among others, yet government and its partner's commitments to guide the development of the cassava crop until recently have been inadequate.

The superiority of cassava during the 1982/83 severe drought in Ghana prompted government to pay serious attention to its development. Series of local initiatives and bilateral agreements in development as a vehicle for economic growth efforts has been implemented although, it has been described as discriminatory as it favours the cereals - maize and rice productions, in the form of guaranteed minimum prices, subsides on fertilisers and agro-chemicals. (Nweke et al. 2002).

The Ministry of Food and Agriculture (MOFA) in Ghana is the principal agency of the Government of Ghana in charge of the developing and execution of policies and strategies under the agricultural sector (Kleih et al 2013). Its supervised research in cassava between 1928 and 1962 before take over by various research institutions under the CSIR and universities in Ghana. MOFA develop or implement programmes independently or in collaboration with its external partners (Research institutions, universities, NGOs and other developmental agencies).

Since independence various programmes by government and non-state actors have been implemented to develop the cassava sector by the provision of support services in a number of areas including research, extension, credit, rural infrastructure, marketing, input delivery among others. These interventions primarily targets crop expansion, mechanisation and developing post-harvest (Marketing structures and relationships, Processing, storage).

1.4 Crop expansion

1.4.1 Introduction of improved varieties

The first of such interventions was the introduction of other varieties from other West African countries, East Africa, the Caribbean and the Far East to tackle the issue of yields and pest and diseases infestation in the 1930s as the existing local varieties were affected. To avert the effects, several crosses between the local varities and the foreign ones were made leading to the introduction of four exceptional varieties namely: Queen, *Gari,* Williams and Ankrah in 1935. These were high yielding (7–10 tonnes/ha), of good taste and highly resistant to CMVD.it was also adaptable to all the agro-ecological zones in Ghana. However, by the end of the 1950's, all the newly released varieties apart from Ankrah became highly prone to the CMVD due mainly to either an increased impacts of the virus or a collapse in varietal resistance, which called for a second breeding intervention. (FAO&IFAD 2005).

1.4.2 Crossing of Local and Improved Varieties

The second intervention in the mid-50s and 60s involved crosses between the local varieties and four other species closely related to *M. Esculenta,* owing to the fact that no lack of resistance was found in any of the M. esculenta varieties. This drive produced four varieties to farmers namely: K357, K162, K680 and K491. The best, K680, produced nearly 19 tonnes/ha, had reasonable resistance to CMVD, good palatability and cooking quality. They retained their good characteristics until the early 80s when these varieties were attacked by the two new cassava Pest; Cassava Mealybug and Green Spider Mite and the Cassava Bacterial Blight (CBB) disease, compelling an urgent response (FAO&IFAD 2005).

1.4.3 Biological Control of Pests and Introduction of Improved Varieties

In response to the effects of these new pests and disease coupled with the devastating impacts of the 1983 droughts, FAO mandated IITA to offer consultations to Ghana (FAO&IFAD 2005). This led to the introduction of the Biological control programme with specific objectives to: "Release available beneficial agents from IITA to evaluate their effectiveness under Ghanaian conditions" and perform an Assessment of IITA and

Ghana's native cassava varieties for improved yields and resistance to the pests and disease (Korang-Amoakoh et al. 1989).

"The programme officially started in March 1984 with the introduction of a parasitoid wasp (*Epidinocarsis lopezi*) and predatory insects (*Diomus sp. and two Hyperdspis spp*) and a second batch of the natural enemies together with one more predatory lacewing insect (*Sympherobius sp*) and predatory mites *Neoseiulus idaeus* and *N. anonymus* were introduced." (Nweke et al 2004).

1.4.4 National Root and Tuber Crops Improvement Project (NRTCIP)

The NRTCIP programe, an element of the Ghana Smallholder Rehabilitation and Development Programme (SRDP) was consequently introduced from 1988-1995. This was in partnership with IFAD. The programme had the sole purpose of ensuring food security and as such had dual objectives to expand the productivity and consider favourably conditions for its marketing (Kissiedu & Okoli 1988). To this end the policy supported root crop adaptive trials and root crop based farming systems research, introduce pest and disease resistant varieties of cassava from IITA and evaluation for adaptability and acceptability, initiated a biological programme to control cassava mealybug and green mite. It also conducted a survey of root crop processing technologies at the village level and supported human resources development for the root and tuber crops research and biological control of pests.

Under the NRTCIP, activities carried out on cassava included the continuance of the biological control programme for the mealybug and green spider mite. This carried out by the Plant Protection and Regulatory Services Department of MOFA, in partnership with IITA and later from 1989, a cooperation with Benin, Cameroon and Nigeria. Gathering and testing of local germplasm alongside the enhanced IITA varieties was done by the Crop Research Institute. These new varieties namely; Afisiafi, Gblemo Duade and Abasa Fitaa, were introduced in 1993 with good attributes such as high yielding, pest and disease resistant. These varieties produced nearly 200% compared with the prevailing native varieties.

The SRDP project however ended in 1995 but the NRTCIP received continuous funding under the succeeding project, the Smallholder Agricultural Development Project (SADEP) which was also born out of the SRDP.

1.4.5 The National Agricultural Research Project (NARP)

The Government of Ghana with support from the World Bank launched a National Agricultural Research Project (NARP) in 1991, to strengthen its agricultural research system. It targeted partnerships with. It concentrated on developing processes, institutional arrangements and partnerships with various research institutions in the country to plan and develop technologies, which respond to farmer needs and are consistent with the agricultural sectorial research priorities of the country.

The overall objective was to ensure a sustainable use of its scarce resources. The programme performed well in enhancing crop improvement by the acquisition, characterization and preservation of germplasm in partnership with IITA, evaluation of both local and introduced germplasm for desirable agronomic and end-user qualities and Planned to embark on a hybridization programme.

On agronomic practices, studies on the use of N, P, K and Bo and its effects on the yield and quality of cassava was undertaken. Additionally, plant population and intercropping studies were carried out (1FAD&FAO 2005). Other efforts by the programme on integrated pest management resulted in the production of healthy planting material using tissue culture, evaluation of cassava germplasm for tolerance to ACMD and CBB, Control of spear grass, a chief cassava weed, survey of storage pest in dried cassava, studies on cassava anthracnose disease and general Post-harvest Management.

The programme further developed pasta and other food products and conducted a baseline studies on cassava production, marketing, adoption and impact of using improved varieties and technologies (IFAD&FAO 2005).

1.4.6 Decentralized extension service (NAEP).

Agricultural extension in Ghana has gone through phases of political shift from 1957 till date. These changes in emphasis targeted improvements in traditional farming practices,

diffuse resources and technology as well as train workers to respond to the extension constraints faced by peasant farmers.

Extension approaches such as the colonial export commodity approach, the government's policy of modernizing 'peasant' agriculture (1960s to the 80s,) the World Bank assisted unified extension system (UES-T&V approach from 1991 to 2000) have been implemented over the years. Inefficiencies in these prior approaches such as its top-down and pro-urban feature, rigid and unresponsive to farmer's needs, lack of harmonisation amongst various departments within the Ministry of Food and Agriculture (MOFA) as well as weak interconnections between MOFA and other research institutions, Lack of well-trained extension workers who are faced with logistic challenges, according to Okorley (2007).

The decentralised extension approach which is demand driven and aimed at increasing farmers' productivity and income was introduced in 1997 and have being in place up until now. Under this current approach Ghana government through MOFA offers extension services to all farmers including cassava farmers throughout the country at no cost. This is financed by the government and its bilateral donors such as the World Bank, GIZ and others. Under this approach, Mofa transfer powers to the district level offices, to design and implement their own agricultural extension activities and manage their resources within the framework of a national policy. MOFA also transferred resources including staff to the district offices. Previously, the Ministry of Agriculture used its staff from the national level down to the field level to implement extension programs. This transfer of powers and resources to the district reduced the level of participation of the ministries and the number of technical staff for coordination activities while the regional and national level administration focused on policy planning, coordination, technical support, monitoring and evaluation (Okorley 2007, IFPRI et al 2011; MOFA 1997). The various extension service providers, including government (MOFA, the main actors in extension), efforts of MOFA in offering extension services are complemented by other providers such as non-governmental organisations (NGOs), producer organisations and other farmer organisations.

This current extension system has promoted approaches from the top-down commodity-based approaches to more a participatory approach like the World Bank's Training and

Visit (T&V), commodity participatory approaches, the farmer field schools (FFSs), the innovative ICT based approaches which provide advisory support to farmers on-line through mobile phones and community radio stations. Its market-oriented approach and introduction of ICT innovation is hailed.

However this current pluralistic approach of extension delivery in Ghana according to the 2012 McNamara et al 2014 has some inherent weaknesses in terms of maximum concentration on increasing production as against attention to farm profitability, inadequate training and capacity building workshops for MOFA staffs, lack of access due to logistical challenges, staff motivation and high ratio of farmers to AEA approximately 1:3000 farmers. Lack of coordination among other actors such as NGOs and private providers, source of funding by projects, which makes extension provision time bound, and shaping of agendas to themes of projects and not to the needs of farmers.

1.4.7 Root and Tuber Improvement Programme (RTIP)

The greatest support for the development of roots and tubers was provided under the Root and Tuber Improvement Programme (RTIP) funded by IFAD from January 1999 to December 2005 (Sam & Dapaah 2009). It targeted some 720 000 resource poor farmers, prioritizing women. The overall objective of RTIP was to enhance food security and improve incomes of resource poor farmers through five basic components: Multiplication and distribution of improved materials, integrated pest management, Adaptive research, Community support and mobilisation, Programme management and coordination and a component for post-production and marketing. The period of RTIP implementation met with an important government policy, the presidential initiatives on cassava, which provided a space for its success (Mensah-Bonsu et al. 2012) although a subsequent evaluation of the program by IFAD in 2004 identified this collaboration to be the reason for its inability to achieve some other important objectives. An agreement with psi culminated in the supply of planting materials to framers to supply cassava for the impending export-oriented starch production under the PSI.

The gains included the development of a nationwide system for multiplication and dissemination of planting materials and transmission of knowledge of improved practices. Approximately 9800 community mobilisation groups were formed for this purpose. Four improved cassava varieties were introduced in 50 districts between 1999 and 2002. The

component for adaptive research served as a vehicle for undertaking more than 60 research projects submitted by Ghanaian researchers in more than a dozen different government and academic institutions on agronomic areas as captured in the RTIP appraisal report. Training in integrated pest management and control practices by the establishment of seventeen farmer field schools in 15 districts. Predators furnished by the RTIP led to the successful control of the *Green Mite, Mononychelus tanajoa* in seven of the ten regions of Ghana. Improved cassava graters, stoves for roasting and screw presses were developed. Training modules were developed in cassava processing which were delivered to more than 1500 people including MOFA staff, small-scale processors, bakers, and farmers.

However, according to the IFAD interim report, the project attention on poverty alleviation was limited as well as the vigour to address the wide range of issues that relate to the post-harvest phase of root and tuber crop. For instance, under the postproduction and marketing component, RTIP collected information related to storage, processing and utilisation of roots and tubers, but stopped short of fully exploiting that information production.

This is however attributed to the initial omission of the component on post product and marketing and that the component added was not well developed and as such inadequate. The multiplication and dissemination drive according to the report was done without recourse to the socioeconomic status of the farmers and that the 80 percent of the groups formed for the distribution and knowledge sharing was defunct.

The FFSs had weak links with the adaptive research component resulting in missed opportunities to the detriment of both researchers and beneficiaries. It was also inadequate in number and too resource intensive, reaching a total of only about 600-700 farmers in 20% of the 76 districts currently in RTIP. The IPM component results were below target due to delays in the construction of two of the three planned insectaries. Efforts to control Larger Grain Borer were made on a limited scale, with correspondingly limited results. The RTIP was later renewed in 2006 as the Root and Tuber Improvement and Marketing Programme (RTIMP).

1.4.8 West Africa Agricultural Productivity Programme (WAAPP)

WAAPP was triggered by the need to meet the goals of the African Action Plan designed by the World Bank to achieve Africa's resolution of a 3% increase in annual agricultural total factor productivity growth and a 6% growth in agricultural GDP to reach the MDGs by 2015.

Consequently, a two-phase, 10-year Adaptable Programme of five years duration each, was initiated by ECOWAS with support from the World Bank. The project aimed at ensuring a successful execution of agricultural policies in west by overcoming agricultural challenges in the West African Sub-region.

The overall objective of the programme was to contribute to increase in agricultural productivity in targeted commodities in accordance with regional priorities. More specifically, to generate and disseminate improved technologies in 4 target countries' priority areas. Under the first stage of the WAAPP, country specific commodities were assigned. Improvements in the roots and tubers were assigned to Ghana, rice to Mali and drought-tolerant cereals to Senegal. These priority areas were derived from a study by the International Food Policy Research Institute (IFPRI) and the West and Central African Council for Agricultural Research and Development (WECARD/CORAF) (IFPRI 2006). The second phase of the project, which commenced in 2013 aimed at building upon the gains of the phase 1 and upscale proven technologies generated by research to farmers and other value actors. Collectively the two phase of the programme resulted in the introduction of four main cassava cultivars: CSIR-CRI Ampong, CSIR-CRI Buroni Bankye, CSIR-CRI Sika Bankye, and CSIR-CRI Otuhia, which are superior to the existing improved varieties such as Afisiafi, Dokuduade, Essam bankye, Agbelifia and Bankyehemaa in terms of yield, dry matter, and resistance to African Cassava Mosaic Disease (CMD), weed control, cyanogen concentrations as well as adaptability to wider ecological environments. The WAAPP programme saw the establishment of 34 community demonstration/multiplication sites in 23 districts to supply planting materials to 2,720 farmers for production. Moreover, the WAAPP established a secretariat for the National Variety Release and Registration center for the classification and registering of newly released and existing genetic materials.

On discovery and Upscaling new technologies, the programme It Collaborated with MOFA to establish an e-extension to enhance qualitative extension service delivery to farmers and other stakeholders promoted the cassava legume intercropping/rotation technology and the use of solar drying in cassava for the production of gari (use in Techiman and Wenchi) (MOFA &WAPP 2013).

1.5 Promotion of Agricultural Mechanisation

1.5.1 Agricultural mechanisation trials

For large-scale farms, mechanisation of planting and harvesting are very necessary but there have not been any major interventions in this field. The first of its kind was an on field mechanisation trial at Agricultural Station in Pokuase in 1960, which sort to test the viability of a tractor for planting, and harvesting on a semi mechanized farm. A field trial of a semi-mechanized planting (persons sitting on low platform behind a tractor doing the planting) was done (FAO&IFAD 2005). The trial was successful since results showed that the planter could ridge and plant six rows at a time and only needed 2 hours 10 minutes to ridge and plant. A mid-mounted disc terrace could also harvest an acre (0.4ha) in two and a half hours which would have required five person-days (Doku 1969). Adoption however has been zero mainly due to the presence of smallholder framers active in the cultivation of cassava in Ghana coupled with the high cost of such innovations.

1.5.2 Establishment of Agricultural Mechanisation Centres

To facilitate the transformation from the use of rudimentary tools to mechanisation, the ministry initiated the establishment of Agricultural Mechanisation Services Centres (AMSECs) in5all ten (10) regions in collaboration with the private sector to subsidized (60% subsidy) the machinery to enable more farmers and other interested Ghanaians afford it. However, the number of operational AMSECs has reduced from 82 in 2014 to 48 in 2015. This was mainly because of lack of spare parts to fix the broken machinery and inadequate managerial skills. In an attempt to revamp this initiative, agricultural machinery/equipment worth USD 32,366,200 under the 1st tranche of Brazil More Food International Programme was imported to establish more AMSECs. It is worth noting that, equipment was gender friendly and are easily operated by women farmers.

Table 4: Equipment's under the Amsec programme.

Item	Total Quantity Imported
New Holland tractor	111
Massey Ferguson tractor	150
Valtra tractor	288
Maize shellers	224
Multi crop thresher	112
Cereal Harvester	21
Cassava harvester	50
Cassava planter	25
Mechanical planter	60
Pneumatic planter	15
Seed drill	36
Boom sprayer	20
Mobile mechanical workshop	12
Trailer only	102
Plough only	**102**
Harrow only(18 discs)	**102**

Source: MOFA (2016)

1.6 Interventions to Post-Harvest Challenges

1.6.1 Introduction of Medium-Scale Motorized Cassava Grater

The major intervention of farm cassava activities was the introduction of a medium-scale motorized cassava grater by the Agricultural Engineers Ltd in 1966. The cassava grater presented a great innovation in cassava processing since grating is central to traditional processing of cassava in Ghana. Since then, several equipment manufacturers including engineering firms, research institutes, university departments, small-scale artisanal shops, blacksmiths and mechanics have developed and produce various types of cassava processing equipment. A key company spearheading cassava processing equipment's in Ghana is the gratis foundation. Cassava processing machinery manufactured locally are drum graters, horizontal disc graters, cassava chippers, screw presses, hydraulic presses,

cassava dough disintegrates, sieving machines, grading machines, plate mills, hammer mills and mechanical dryers.

Over the past three decades, there has been a steady rise in the rate of adoption of cassava processing equipment in the cassava processing industry. In the last few years, the export of cassava chips has been introduced into the country through the activities of a private company, the Transport and Commodity General Ltd. Several potential exporters are exploring this activity, which is promoted by the Government. It is envisaged in the near future that cassava may be considered as a cash crop rather than as a food crop. (IFAD&FAO 2005)

1.6.2 The Food and Agriculture Sector Development Policy (FASDEP)

One of the key initiatives driving government efforts has been The Food and Agriculture Sector Development Policy (FASDEP). The first phase was developed in 2002 and the second revised phase in 2007. The policy outlines agricultural development strategies that prioritize staple foods such as cassava along four focus areas: Income growth for sector players, increased competitiveness and market integration, Sustainable management of land and environment and the application of science and technology with improved institutional coordination.

The policy increased focus on research and development, consequently leading to the release of more than 40 new varieties of cassava cuttings through the Food Research Institute and its partners. Sustained focus on agricultural development has also contributed to creating awareness and business development opportunities for small and medium enterprises involved in cassava processing and trade (Naoko et al.2015).

1.6.3 Agricultural Sub-Sector Services Improvement Programme (AgSSIP)

The agricultural sub-sector services improvement programme (AgSSIP) initiated from 2001-2007 was funded by the World Bank and the DFID CPHP to develop industrial uses for cassava, Technology generation and Dissemination. A mechanical harvester for harvesting cassava on large scale farms was developed under the project (Noako et al. 2015).

1.6.4 Presidential Special Initiative (PSI) on Cassava

Introduced in 2001, the PSI on cassava grew out of an African Union summit and was supported by the NEPAD's Pan-African Cassava Initiative (NPACI), which aimed to improve production in Africa's cassava belt countries. The psi was as a strategic measure not only to improve production of fresh cassava roots and increased incomes for farmers but also a means to diversifying the economy of Ghana by introducing new pillars of growth for the economy. The export market of Ghana has been dominated by exports of cocoa, gold and timber.

This was to be achieved through the transformation of production and processing of cassava products for export. Specifically, the PSI sought to establish 10 starch-processing facilities and generate $100 million in export revenue by the end of 2006. The flagship output of this initiative was the establishment of the government-owned Ayensu Starch Company. It also aimed at serving as a major vehicle for job creation for about 50,000 rural farmers in rural communities. It also targets fifty per cent (50%) female participation (Tonah 2014).Preliminary assessment of the programme looked promising as within a short time it was able to introduce new crop varieties in collaboration with the RTIP program, organise smallholder farmers into farmer-based groups (FBG) to deliver raw materials. Provision of extension service to farmers, guaranteed market for cassava roots, building of a processing plant to prevent food loses and reduce farmers work load of processing the cassava with low technique, provision of loans and other input subsidies for farmers.

The policy however suffered some challenges and died off naturally mainly due to shortage of raw materials leading to the close down of the Ayensu starch factory and the subsequent collapse of the programme by 2007. This was mainly attributed to the non-provision of guaranteed fair prices for farmers coupled with delays in payments and haulage of produced from farm sites resulted in spoilage. The shortage of local fufu (poundable) variety pushing up price of cassava led farmers to shift to produce local varieties that were not suitable for the starch production but had high demand and prices. The programme impoverished most farmers as they lost their investment (Tonah 2006).

1.6.5 Root and Tuber Improvement and Marketing Programme (RTIMP)

It was implemented over a period of eight years from 2007 to 2014 by the government of Ghana and IFAD to build on the successes of the RTIP and respond to the weakness of the RTIP. The assumption was that MOFA and its partnering agencies in the country had strong technical fields (e.g. selection/multiplication of planting material), but lacked expertise in policy, economic and marketing issues, paid partial attention to post-harvest stages (processing and marketing), and lacked experience in working with the private sector. The programme aimed at enhancing food security and incomes of poor rural households in Ghana, particularly, women and other vulnerable groups. Its specifically targeted to build up a competitive market-based and a comprehensive product chains for R&T, which is assisted by the relevant, effective and sustainable services that are available to the rural poor. The major programme highlights were to: support increased commodity chain linkages, Root and Tuber Production, upgrading of small-scale R&T Processing, business and marketing skills programme increased productivity of R&T-based cropping system coordination as well as monitoring and evaluation.

The programme according to its completion report in 2015, supported the development of several commodity value chains in the country by focusing on 4 key chains namely; Gari, High Quality Cassava Flour, Bonding cassava flour for plywood industry, and fresh Yam (IFAD 2015) Key among them is the cassava flour as glue extender for the manufacture of plywood (i.e Cassava plywood chain) (kleih et al 2013).

The project collaborated with the National Board for Small Scale Industries (NBSSI) to develop the enterprise record for all actors especially farmers and processors in other to streamline financial analysis and record keeping in the value chain business. The traders and farmers involved in the chain were trained on business and technical support so as to improve profitability and general trading conditions as well as provided with a platform to build relationships and even make trade deals at the various DSFs (115) which brought together nearly 3928 participants. It also promoted technologies for processing & storage through Prototype testing, manufacturing and facilitating acquisition of equipment and training towards the production of high quality products. Seventeen new, more efficient, cost-effective equipment (prototype) for the processing of R & T crops are made available, which is being promoted. These include cassava Harvester, Washing bay,

Self-feeding stainless steel Grater, Fermentation bay, Effluent management, systems, robust single/double-screw Press, Stainless steel roasting pan and Smoke Free-Roasting kilns.

RTIMP in partnership with the GRATIS foundation and REP II, trained a group of 124 (122 males and 2 females) fabricators and repairers to offer after sales serves and repairs of these equipment's. Nineteen processing centers have been upgraded to Good Practices Centers (GPCs) and 1,503 (374 males and 1,129 female small-scale processors have been exposed to good manufacturing practices by visiting the GPCs.

The creation of the GPC additionally serves as a focal point for linkages activities as some farmers sell their cassava root directly as well as small processors utilizing the facilities in the communities. 1,294 processors have been trained in Quality Management systems (including packaging and labelling). This has enhanced quality of their product hence gaining access to external markets in the supply of gari from to Niger, Burkina Faso, Nigeria, USA and UK among others .Nearly 2,319 (928 males and 1,391 females) entrepreneurs have been trained on business development and marketing skills whist a total of 541 beneficiaries (216 males and 325 females) have accessed Micro-Enterprise Fund (MEF) facilitated by the Programme to upgrade their processing operations profitably.

However, operations of the MEF was hampered by the unwillingness of most of the accredited PFIs to commit from their own resources short-term funds for the 50% investment cost under MEF. The programme however recommended the scaling of efforts in the area of Planting material multiplication and distribution, Business development training, linking up small-scale producers and processors with larger-scale users of R&T products, District Stakeholder Fora (DSF), Farmer Field Fora and Good Practices Centres (GPCs) (IFAD 2015, MOFA undated).

1.6.6 Excise break for local content beers

A recent policy initiative to promote the use of cassava root tubers as raw materials by key agro based industries is the introduction of excise break for local content in beers in 2013. There is a tax break for beers that uses greater than 30% local content up to as low as 10%, depending on the percentage of locally sourced contents. This is in comparison

to excise tax of 47.5% on mainstream beers. This tax incentive policy has promoted the introduction of local raw materials in the preparation of beer. In responds to this tax cuts, Guinness Ghana limited and Accra Brewery limited have consequently introduced 2 beers made from cassava (Naoko et al. 2015 2015).

Table 5: Summary of investments by GGBL and ABL (2013-2016).

Year	**Accra Breweries Limited**			**Guinness Ghana Breweries Limited**	
	Commodity	Quantity(Mt)	Value (GHC	Quantity (Mt)	Value (GHC)
2013	Cassava	1,214	N/A	3,527.00	N/A
2014	Cassava	794.6	488,431.77	7,368.32	1,105,248.00
	Red Sorghum	161.1	233,196.40	N/A	N/A
	Maize Grits	2,994.5	4,299,936.10	N/A	N/A
	Whole Grain	270.35	279348.96	N/A	N/A
2015	Cassava Flour	85	192,256.00	6,409.70	1,153,747.00
	Red Sorghum	584	884,400.00	4,885.00	N/A
	Paddy Rice	825	1,155,000.00	N/A	N/A
	Whole Grain	25,900.00	36,460,000.00	N/A	N/A
	Maize	N/A	N/A	4,813.00	N/A
2016	Maize Grits	7,204.95	20,332,263.28	N/A	N/A
	Whole Maize	171.60	292,462.01	N/A	N/A
	Red Sorghum	93.45	185,427.32	2,014.00	N/A
	Cassava Flour	107.60	243,581.02	N/A	N/A
TOTALS		39,192.15	65,046302.86	29017.02	2,258,995.00

(Source MOFA 2016)

1.6.7 Export Trade, Agricultural & Industrial Development Fund (EDAIF)

The Cassava Integrated Enterprise Development project, spearheaded by the Export Trade, Agricultural & Industrial Development Fund (EDAIF), was launched in 2015 to increase production, improve marketing, and develop agro-enterprises in the cassava sector. The project at aimed at large scale production and processing of cassava for industrial use and export by proposing the establishment of three cassava factories in the Ashanti, Brong-Ahafo and Northern regions. This is to be achieved through three phases of funding to innovative agro-enterprises. The project intends to promote promising

entrepreneurs in the HQCF, ethanol, and starch sectors as well as the production of high quality cassava flours as substitute for wheat between 2015 and 2017. For a project take off, it will identify and support 1200 out growers from the three areas where the factories are to be established. It will also collaborate with implementation agencies to offer technical support in best agronomic practices to the out-growers (Kleih 2013, Naoko et al. 2015).

1.7 Marketing organisation of cassava

A market according Adekanye, 1988 simply refers to "the interaction of the forces of demand and supply, irrespective of the physical location, or means of information that link buyers and sellers". Additionally, Emam and Malik, 2011 describes it as "a series of services involved in moving a product or a commodity from the point of production to the point of consumption". Kohls and Uhls (1990) however, provides a precise definition, which is more related to agricultural marketing. They explain it as the "performance of all business activities involved in the flow of goods and services from the farm gate where they are produced until they are in the hands of the final consumer". The need for marketing arises with increased productivity, where the surplus can be traded for a nominal income. The major activities performed in the marketing function involves many aspects of business, including buying, selling, processing, storage, transportation, standardisation, financing risk-bearing and provision of market information. Cassava travels over long distances because of regional or seasonal deficits that are identified by dealers and signalled by big price differences (Benoît et al. 1999)

In the advent of urbanization in Africa, an increasing share of national food consumption takes place at locations other than where food is produced. The marketing system must therefore be develop well to provide the necessary services required by the distant markets. Cassava marketing has however received much less than sufficient attention. It is worth noting that efficiency in cassava marketing is an important determinant of both consumers' living cost and producers' income.(Enete 2008). He further explains that there is an inter-acting and an equally reinforcing relationship between increased production and efficient marketing. To him, efficient marketing systems stimulate increased production, and the reverse constitutes a constraint to any development effort.

A malfunctioning marketing chain constitutes an impediment to food security as investment in production becomes both costlier and riskier.

The adding of value in the food marketing process complements the productive processes in farming, and the marketing process forms a vital linkage between farmers and consumers, all influenced by technological factors, socio-economic factors, natural resources, legal frameworks and norms of the society.

1.8 Marketing and value chains of Cassava

1.8.1 Cassava Value Chain Actors

The performance and the efficiency of a value chain is a result of its market structure, how well the actors are organised, and how well the chain is supported by a range of business development services (Barrett 2008). Business services include research entities, input suppliers, communication support, transporters, local administration, information services and financial services. A market analysis aims, therefore, to assess both goods and services along the chain and virtual strength of market signals. Cassava marketing chains have evolved to cope with the perishability of the root. Speedy marketing is ensured through a wide range of operators, including producers, travelling traders, transporters, wholesalers and retailers. The research and extension services influence the market chain by facilitating development and dissemination of new technologies, farmers' training and providing technical backstopping. Major actors in the cassava value chain such as farmers, traders and consumers are often connected through complex system of information flow, credit and transport. The actors are at various stages of the cassava value chain, and their function and outputs are summarised below.

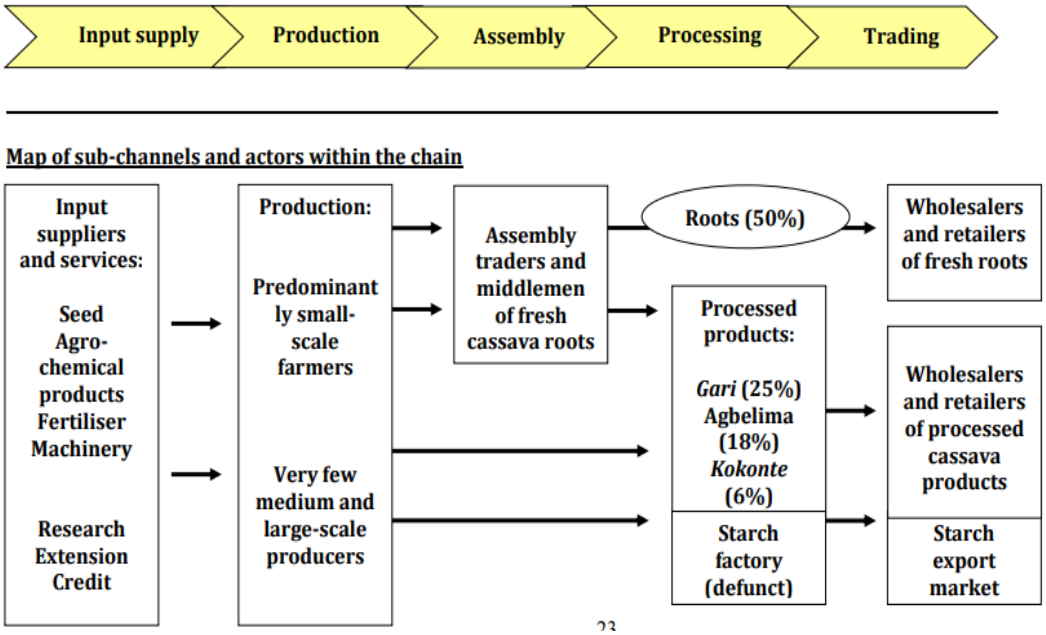

Figure 2: overview of functions in the cassava value chain

Source: Kleih et al. (2013*).*

1.8.2 Marketing Channel

A marketing channel simply refers to the pathway of a commodity from its raw form to its finished form (Mari 2009). Adejobi and Adeyemo (2012), refers to the Marketing channel as also a distribution channel and defines it as a set of various agencies (market intermediaries) organised in a particular way to accomplish the movement of a product from the producer to the final consumer. Lake (2007) also explains a marketing channel, to be an ordered network of agencies and institutions that combines to perform all the functions necessary to link producers with end customers to achieve the marketing task. In agriculture, distribution channels therefore move agricultural products from farmers to consumers and to other businesses. It is composed of a set of interdependent organisations that help in carrying out the market functions. These include wholesalers, retailers, and sales agents. It is important in evaluating marketing systems since it describes the organisation market participation to accomplish the movement of a product from producers to consumers (Mari 2009).

This invariably suggests a place where the farmer's products are brought together in large quantities to the central and terminal markets. Participation in the market channel of cassava in Ghana is composed of processors, wholesalers and retailers who move a

product from the farmer to the end user. In the marketing channel, wholesalers and processors may buy from the farmers. Most agricultural commodities, including cassava in Ghana, are marketed through such a channel.

1.8.3 Marketing Margin

Marketing margin refers to the portion of the consumers' food cost that goes to food marketing firms (Kohls & Uhls 1990). Alternatively, each margin is seen as constituting returns to the different factors of production used in marketing, such as land, labour, capital, entrepreneurs, and so on (Emam & Malik 2011; Achike et al. 2010).

Abbott and Makeham, 1990 also defines it as the price movement of a commodity along its supply chain. Marketing margins could be expressed as the percentage of the final weighted average selling price taken by each stage of the marketing chain (FAO 1999) and could be viewed as the difference in prices at two different points in the marketing chain (Kahkonen & Leathers 1999). It is used as a measure of the efficiency of the supply chain along an agricultural commodity. Kohls and Uhls (1980) further states that efficiency in the marketing margin could not be determined by the large or small margins." To them, the marketing margin varies among commodities and its size is dependent on the cost of the marketing function performed. They may also be different from one marketing level to the other and are very likely to vary between developing countries and developed countries. Min and Wolfinbarger (2005) viewed profit margin, market share and marketing efficiency as measures of retailing performance.

Marketing margins can be estimated at different levels of the marketing chain, at either the retail or wholesale level. The size of the margin depends on a number of factors ranging between the degree of processing of the product; the perishability of the product; its bulkiness in relation to value; any specific extreme seasonality of the product and institutional factors (Olukosj & Isitor, 1990). The volume of the product bought and sold, buying and selling prices of the product, the number of intermediaries involved and the distance between markets (Adekanye 1988, Kohls & Uhls 1985) influences the margin. In summary, the size of marketing margins for farmers are greatly influenced by the level of efficiency, storage capacity and the amount of value added to their product.

In addition, Wobst (2003), Minten and Kyle (1999) and FAO (1999), states that the influential factors affecting the proportion of the retail price received by farmers are: the level of marketing service provided by the grower; transportation costs; storage capacity and other marketing costs in economies with poor infrastructure and/or long transit distances. Minten and Kyle (1999) argue that institutions through which food distribution is organised also generate costs and that poor infrastructure also reduces the rate of diffusion of information on price.

More often than not, intermediaries with increased market authority spearhead agricultural supply chains. Mostly, forming a cram between the price offered to producers and that paid by final consumers due to the exorbitant margins, which distort the market (Mitchell 2011). These intermediaries because of their high profit margin dictate the prices of food items especially in the urban settings where there are numerous well to do who can easily afford the prices (Oguoma et al. 2010). They derive their market control due to their enormous access to information about market conditions along the supply chain. This invariably implies that if farmers abreast themselves with better market information, they could receive better prices which could boast their incomes and their production decisions (Mitchell 2011).

A study by Jakob and Yanagizawa (2009) in Uganda alluded to the fact that farmers could earn 15% higher farm gate prices through regular access to market information by means of a radio. Chau et al., (2016) sees intermediaries as performing the role of price informants, distributor or bulk assembler. Intermediaries as bulk assemblers in the supply chain narrow the gap between farmers' farms and the point of sale.

1.9 SWOT Analysis of Cassava production in Ghana

The SWOT analysis (alternatively SWOT Matrix) is one of the most popular analytical techniques. This method, through the analysis of internal and external business environment, allows in identifying its strengths and weaknesses, opportunities and threats (The SWOT analysis can be carried out for a product, place, industry or person. The technique is credited to Albert Humphrey (Ingaldi & Jagusiak-Kocik 2013). The SWOT analysis allows grouping factors affecting the organisation into two groups, namely: external and internal. By identifying the weakness and strengths of the production system of cassava, it will enable stakeholders to identify and choose appropriate systems of

production that support cassava cultivation, eliminate threats and capitalise on the opportunities a specific systems brings towards enhancing productivity.

Mvodo and Dapeng (2012), used the swot analysis technique to assess the favourable and unfavourable internal and external factors associated with production of cassava in Cameroun. The prevailing factors largely are consistent with conditions in Ghana. To understand the nature of cassava production systems in the study area, a swot analysis of the dominant cropping system used in the study area will be evaluated.

2. Aims of the Study

The objective of the research is to assess competitiveness of cassava production in the Birim South District Ghana and to discuss and evaluate options for production expansion.

Specific objectives are:

- Examine the effectiveness of available farming methods and practices (planting techniques, crop varieties etc.) on output.
- To investigate various governmental interventions in enhancing cassava farming
- To identify and assess the efficiency of the supply chain of cassava
- To identify new and existing opportunities for value addition to cassava

2.1 Research questions

- What are the available methods and practices for efficient cassava production?
- What are governmental interventions in cassava production?
- How efficient is the cassava value chain?
- What are the existing and new opportunities for value addition to cassava?

3. Methodology

This section describes the basic research plan. It entails the study area description, sampling procedure/technique adopted, data collection methods and tools, source of data as well as data analysis tools and methods.

3.1 Study Area Description

3.1.1 Profile of the Birim South District

The study was conducted in the Birim South District of the eastern region, created out from the Birim Central Municipal. It is one of the major cassava growing districts in the eastern region of Ghana (MOFA 2010).

It is bounded at the north with the Birim Central to the North, Assin north to the West, and Asikuma Odoben Brakwa and Agona to the South. Akim Swedru is its district capital. For administrative purposes, the district is divided into four main zones namely: Akim Swedru, Akim Achiase, Akim Aprade and Akenkasu. The population of the district according to the 2010 population and housing census stood at 119,767 with 57,981 males and 61,786 females with a growth rate of 2.4% per annum. The Youth (15-35years) constitutes nearly 35% of the total population. Nearly 60% of the population is concentrated in the rural areas in the district. Moreover, 90% of the inhabitants are Akans (mainly Akyems), the remaining 10% is constituted by Tribes like the Ewes, Krobos, Hausa and Northerners. The District is heterogeneous in terms of ethnicity and the greater proportion of the migrant tribes has lived in harmony and peaceful co-existence, a pre-requisite for development. The land size is approximately of 873 Sq km representing 8.6% of the total land area of the Eastern region.

Agriculture is the mainstay of the economy as nearly 70% of the working population are involved in the cultivation of major crops such as cocoa, citrus, oil palm, plantain, cassava and cocoyam. Major activities in Agricultural sector are crop farming and livestock production. Other economic activities that support the Agriculture sector are trade and commerce, industry and service, small scale mining and lumbering. (GSS Survey 2010)

3.1.2 Climate

The District falls within the wet semi-equatorial climatic zone which experiences substantial amount of precipitation/rainfall. Annual rainfall is between 150cm and 200cm reaching its maximum during the two peak periods of May to June and September to October. This promotes intensive farming activities. There is relative humidity of about 56% in the dry season and 70% in the rainy season. The temperature ranges from 25.2˚C to 27.5˚C. The undulating nature of the topography occasionally results in flooding in some communities during the peak period of the rainy season (GSS Survey 2010).

3.1.3 Agricultural Development

The agricultural sector is the single most important sector of the district's economy. This is because it employs more than half of the district's labour force, as more than 78.2 percent of households in the district are engage in agriculture. In the rural localities, 9 out of ten households (85.5%) are agricultural households while in the urban localities 7 out of every 10 (70.8%) households are into agriculture (GSS Survey 2010).

3.1.4 Major Food Crops Cultivated

Almost all the tropical food crops are cultivated in the district. Plantain is the highest produced food crop in terms of quantum. Cassava yields the highest output in tonnes per hectare, (9.6%) in the year 2002 and (11.04%) in the 2004 year (GSS, Survey 2010).

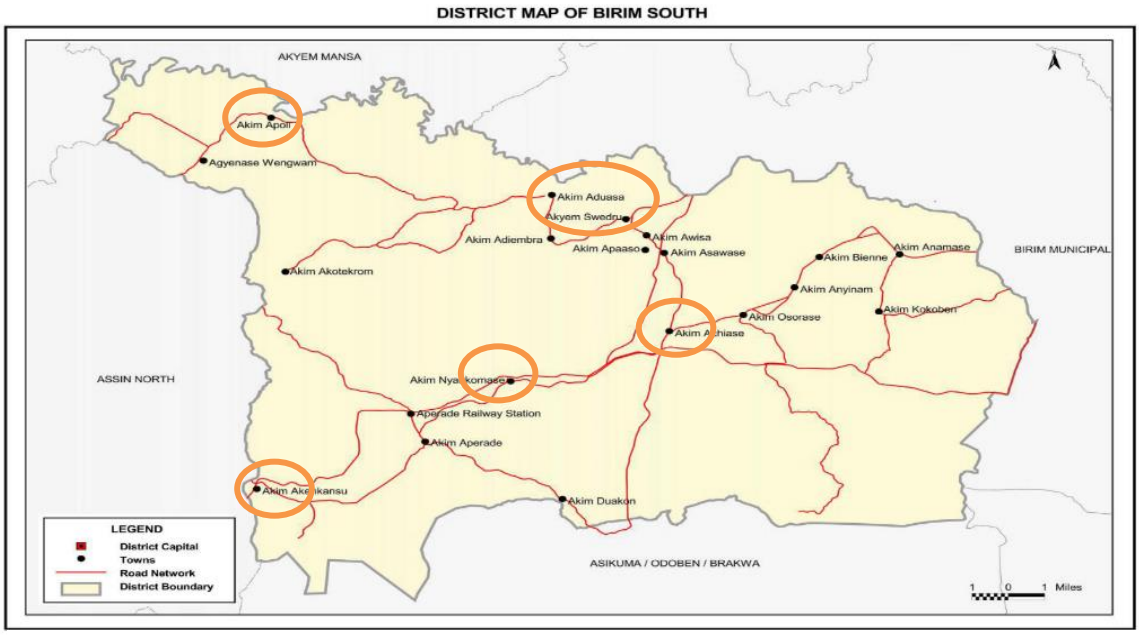

Figure 3: Map of the Birim South District

3.2 Data Collection

3.2.1. Sampling Procedure

The study targeted all cassava farmers both small and large scale, processors (macro and micro), cassava intermediaries and agricultural officers in the Birim South District. A sample of 239 cassava farmers was selected to represent the population from which primary data was collected. Two Agricultural officers were interviewed for general cassava situational analysis while a cassava processing company (medium scale) and ten middlemen involved in cassava marketing were contacted for information on the marketing of the product. Random probability sampling was employed to select six communities (Akim Nyankomase, Akenkensu, Achiase, Aduasa, Swedru and Akim Apoli) in the district. The snowball method was used to administer the questionnaires to the 239 respondents from the communities since no accurate data on cassava producing households in the Birim south district existed.

3.2.2 Data Source and Type

The study collected data from both primary and secondary sources to obtain credible data on the production methods and practices, inputs, costs, prices, characteristics of producers and intermediaries, review of policies on cassava production, identify marketing channels, calculate marketing margins, and perform a SWOT analysis of the cassava production systems in the study area. The primary data was sourced from respondents whilst data from the Ministry of agriculture (district office), scientific articles and other written documents were consulted for the literature review as well as the verification of the results of the study.

3.3 Tools and methods of data collection

This study used both quantitative and qualitative approaches of data collection. Semi-structured questionnaires, personal observations and face-to-face interviews were used to collect primary data from the respondents. An advantage of using the questionnaire as a tool for data collection according to Leedy, (2014) is the fact that it provide a long-term and verifiable record of the data collected. The study used both closed and opened-ended questions to elicit responses from the respondents. The use of closed-ended questions is mostly preferred since data collected can more easily be coded and analysed using

quantitative statistical methods. It ensured precise responses from the respondents as they are provided with options to choose from. In spite of the ease with the use of close-ended questions, open-ended questions were also included to allow for the expression of opinions of respondents as Geer (1991) mentions lack of freedom of expression as a major limitation of the close-ended questions. To ensure validity, the questionnaires were edited and corrected by some colleagues and the supervisor for the study and discussed with some staffs at the district's agricultural office. A pre-test with ten individual farmers from two of the selected communities was conducted in January 2017.

3.4. Method of Data Analysis

Both quantitative and qualitative analyses were used in analysing the data obtained from the field survey and existing literature. The main software used for analysis are the Statistical Package for Social Sciences (SPSS) and Microsoft Excel. A regression analysis was used to assess the effect of farming methods on yields. Farm profitability and marketing margin calculations were computed in MS excel to estimate the cost and revenue. Gross margin analysis was used as a proxy to measure farm profitability. Margin analysis was used to measure price spread from the farm gate to the market. Time series analysis to analyse the impacts of government policies on productivity and land expansion was used. The results are presented using descriptive statistics such as means, frequency distribution tables and percentages and inferential from multiple regression tables were made. The multiple response technique of analysing questions requiring more than one responses from respondents was used to elicit information on farmers' awareness and patronage of new cassava products.

3.4.1 Model specification

3.4.2 Effects of farming methods and practices on yield

3.4.2.1 Regression analysis

The multiple regression function analysis was used in four functional forms from which the lead equation was chosen based on the values of the coefficient of multiple determination (R2) as well as the signs and significance of the regression parameters. This is stated explicitly as; $Y = f(X_1, X_2, X_3, X_4, X_5, U)$

Where; $Y = \text{Total output of cassava (Kg)}$

$X_1 = \text{cassava density (ha)}$

$X_2 = \text{method of planting}$

$X_3 = \text{planting pattern}$

$X_4 = \text{routine weeding}$

$X_5 = \text{methods of land preparation}$

U = error term

3.4.2.1 Profitability Analysis

Gross Margins analysis is use as a proxy to assess the profit/gain to each farmer from the difference between the gross incomes earned (TR) and the total variable cost. This is because fixed cost was negligible in cassava production. It is calculated as Total Revenue-Total Cost and graphically represented as:

(1) $TC = TFC + TVC$

(2) $TR = P \times Q$

(3) $GM = TR - TVC$

Where; $GM = \text{gross margin}, TR = \text{total revenue}, P \times Q$ (P =price, Q = quantity) $TC = \text{total variable cost.}$

Benefit Cost ratio was used to measure the returns on investment and is calculated by dividing total cost by total revenue represented graphically as: TC/TR (Nandi et al. 2011). As a rule of thumb, any enterprise with benefit cost ratios greater than one, equal to one or less than one indicates profit, break-even or loss respectively (Abu et al. 2010).

3.4.2.3 SWOT Analysis of the Production System of Ghana

The SWOT Matrix is one of the most popular analytical techniques. It analysis the internal and external factors that are favourable and unfavourable to achieving an objective, thereby helping in identifying the strengths and weaknesses and the opportunities and

threats of a given method, product, practice or a venture among others (Ingaldi & Jagusiak-Kocik 2013). To understand the nature of cassava production systems in the study area, a swot analysis of the dominant cropping method, intercropping, was analysed by specifying the positives and negatives of the practice. The possible threats and opportunities for enhancing the practice in the face of its current weaknesses and future threats were also evaluated.

3.4.3 Review of Impacts of Government Policies on Cassava Production

3.4.3.1 Trend Analysis of Cassava Production from 1961 to 2014

The volumes of cassava yields and land area used from 1961 to 2014 were categorised under three year groups, 1961-1979, 1980-1999 and 2000-2014.The mean difference among the years were compared to provide a comprehensive picture of cassava performance in the respective year categories to allow for inferences.

3.4.4 Assessment of the Efficiency of the Marketing Channel

3.4.4.1 Marketing Margin Analysis

Margin analysis was used to measure the level of price spread from the farm gate to the market place. Intermediaries or farmers involved in the marketing of cassava received these levels of profit. The percent marketing margin was estimated using the following formula.

$MM = Ps/Sp * 100$

Where; MM = Marketing Margin

Ps = Price spread

Sp= Sale price

Price spread = Sale price – Purchase price

Gross marketing margin was estimated employing the following formula.

$GM = Sp–Pp$

Where; GM = Gross Margin

Sp= Sale price

Pp= Purchase price

Net marketing margin was estimated using following formula.

NM = GM–TC

Where; NM = Net Margin

GM= Gross Margin

TC= Total cost (Aslam et al.2013)

4. Findings from the study

4.1 Socio-economic and farm Characteristics

This section mainly discusses some of the basic demographic and farm characteristics of the respondents. The characteristics are gender, age, farming experiences, education level, household size, farmer extension contacts and land types, types of labour used in farming, sources of capital among others**.**

Table 6: Summary of variables and descriptive statistics

Variable	Mean	Standard deviation	Minimum	Maximum
Age of respondents(years)	39.75	20.07	18.0	75.0
Gender(Dummy1 male,2 Female)	1.30	0.45	1.0	2.0
Farmer experience(number of years in farming)	13.70	10.80	1.0	60.0
Level of education(years in school)	4.18	5.06	0.0	18.0
Farm size(ha)	0.88	0.59	0.2	4.8
Farm gate price of 170kg bag of cassava(GH¢)	34.80	4.70	25.0	50.0
Market price of 170kg bag of cassava(GH¢)	44.75	2.71	39.0	55.0
price of unapproved fields170kg(equivalent) bag of cassava(GH¢)	27.60	6.00	15.0	67.0
Output(kg/ha)	12,502.82	5757.85	2125.0	42500.0
Fallow periods(years)	3.11	1.79	0.0	8.0
Average number of labour per/season	16.50	5.57	4.0	47.0
Wage rate of labour(GH¢/day)	17.13	6.41	2.0	31.0

Source: Field survey 2017.

From table 6, the average age of cassava producing farmers in the study area is 39 years, with a standard deviation of 20.07, a minimum age of 18 years and a maximum of 75 years. The average years of experience in cassava farming among the respondents was found to be 13.7 years, with a standard deviation of 10.80. The average farm size for cassava cultivation in the area was approximately 0.88 hectares per farmer, with a deviation of 0.59 from the mean. The minimum land size was 0.2 whilst the maximum was 4.8 hectares. In this study, 57.5% of the respondents had never been formally educated. Whiles 19.2 had had 11years of schooling, 16.7 % had attained 8 years of schooling, 3.3% had attained 14 years of school, 2.9 % had spent 6 years in school whiles a paltry 0.4% had attained 18 years of schooling. Statistics from this study also shows that more men are actively involved in the cultivation of cassava than women in the Birim South District as a total of 167 respondents where males whereas only 72 were females representing 69.9 and 30.1% respectively. According to the findings from this study, a 170kg bag of cassava was sold averagely at GH¢ 34.8 and 44.7 at farm gate and market respectively. Average wage paid farmers per day was ¢17.13 whilst farmers averagely used 16.5 farmers for their entire cultivation. Farmers averagely had 12,502.82kg per hectares (12.5mt/ha).

4.1.1 Distribution of Household Sizes

The study shows a house hold size distribution of 159 farmers with households made up of 5- 10 people, followed by 66 for those below 5, household sizes from11-15 was 10 whilst 4 farmers had households sizes above 15.

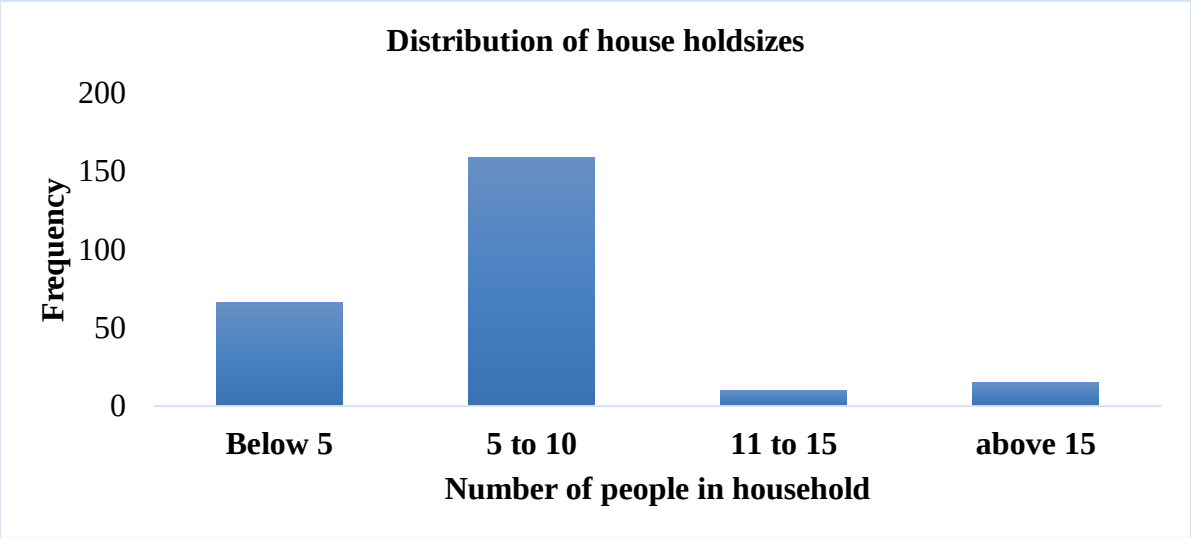

Figure 4: Distribution of household sizes

4.1.2: Distribution of cassava production systems practice

From the study, most farmers adopted the method of cropping cassava in combination with other crops such as legumes, palm fruits, maize etc. A total of 190 farmers intercropped cassava with another crops whilst only 49 planted it as the sole crop.

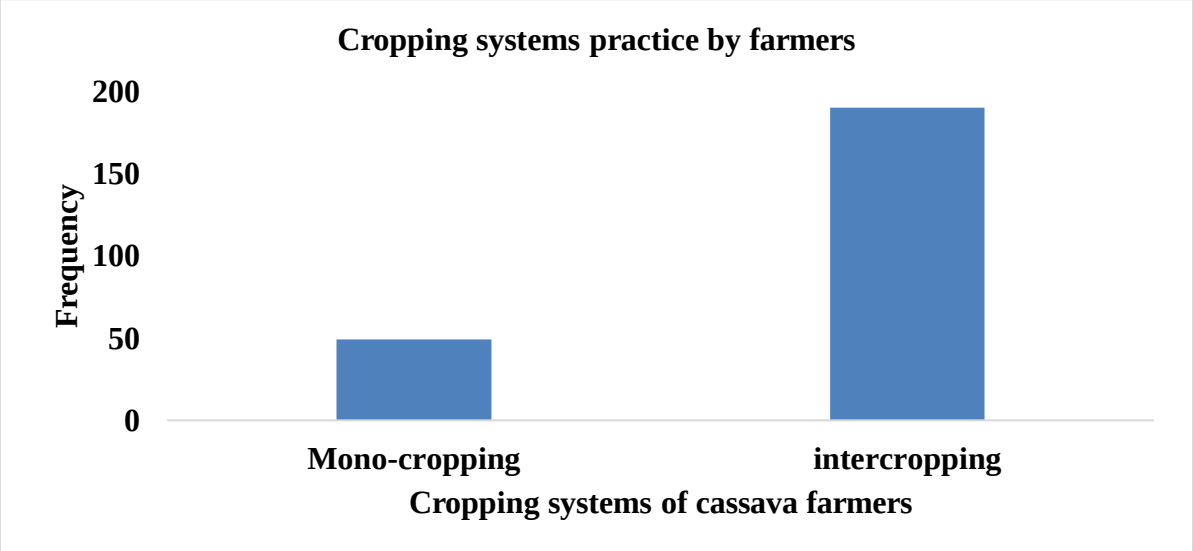

Figure 5: Cassava production systems

4.1.3: Distribution of farmers' access to extension.

The overall coverage of extension services was found to be 47.3 %(113) in the study area, which indicates that majority of the farmers 52.7 % (126), had no contacts with extension agents to learn about new ideas and methods in cassava production.

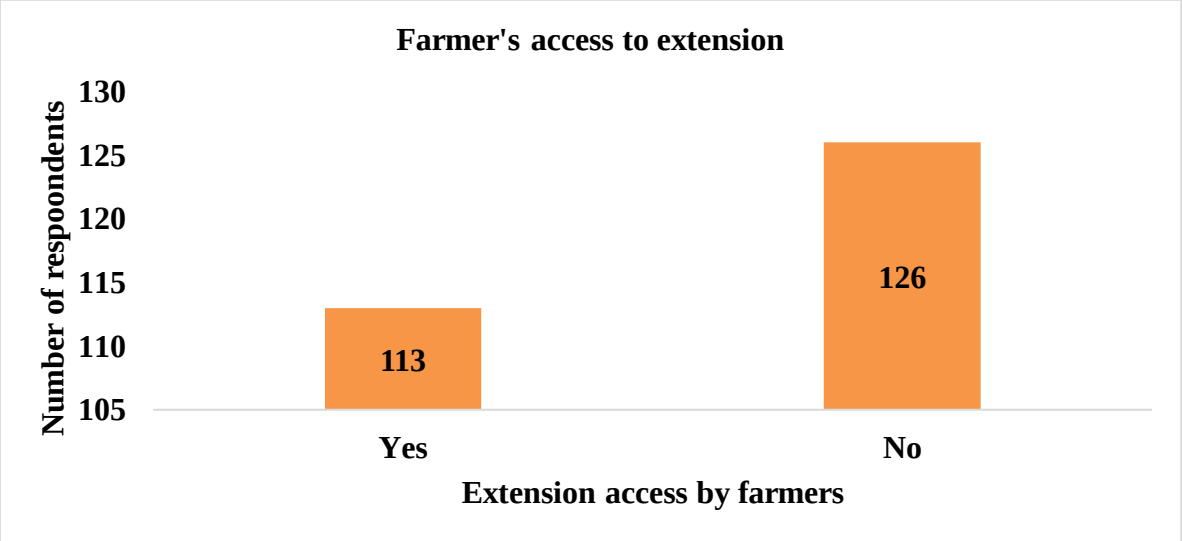

Figure 6: Distribution of farmer's access to extension

4.1.4 Distribution of the levels of farmers' access to extension

The frequency of the visits is shown in the table 7. The most frequent access rate was once in more than a month as 82 farmers were contacted occasionally. 28 farmers were once visited in a month whilst a few were visited once in a week (3).

Table 7: Distribution of the levels of farmers' access to extension

Level of contact	Frequency	Percent
Once a week	3	1.3
Once a month	28	11.7
Once in more than a month	82	34.3

4.1.5: Distribution of Access to credit

Data collected from the study area illustrates that 179-farmers depended on themselves to raise the required capital to start their operations as 55 farmers' accessed loans from the financial sector. Government assistance in terms of direct access to capital by farmers was not existent 4 farmers were however supported by cooperatives.

Table 8: Distribution on the Areas of accessing loans

Source	Personal savings	Loans from banks and MFIs	Government	Cooperatives
Frequency	**180**	**55**	**0**	**4**

4.1.6: Distribution of terms of loans repayment

From the study, it was revealed that, the payback period for loans contracted by farmers ranged from 3 months to 24 months. 23 people were given loans repayable in 12 months, 20 had 6 months to repay, 10 people had 3 months and the remaining 6 people had

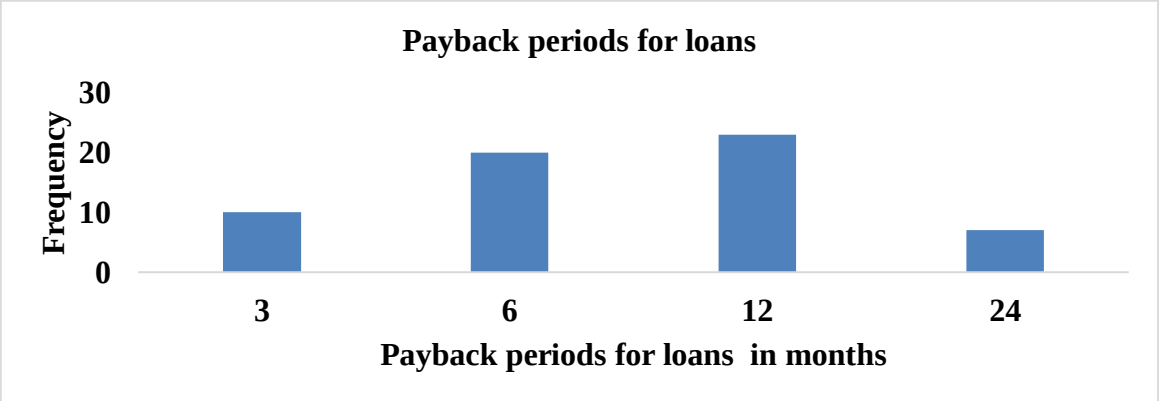

Figure 7: Payback periods for loans given to farmers

24months to payback.

4.1.7: Distribution for type of labour used for cassava cultivation

From the figure, hired labour was the main source of labour used for cassava cultivation in the Birim south district of Ghana, which is supplemented by family labour. 69.9 % of

households within the study area depended on hired labour while 25.5 % of labours used by farmers were sourced from their respective families. 3.8% was from communal labour while 0.8% independently worked on their farms without any external assistance in terms of labour.

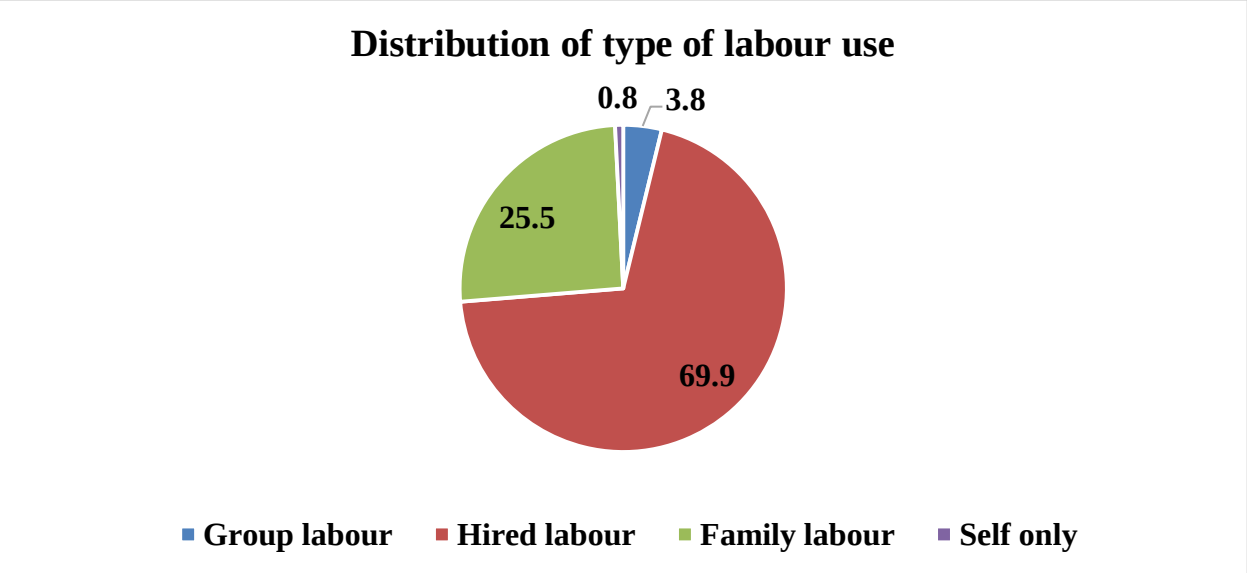

Figure 8: Distribution of type of labour used.

4.2. Measuring the Effect of Specific Agronomic Practices on Yields (Objective 1).

The study revealed an R Square of 0.510 which indicates that the independent variable used in the model explains the variations in the dependent variables (yields) by approximately 51%. Routine weeding and cassava densities positively and significantly at 1% ($\alpha = 0.01$) affect cassava yield whereas method of planting and planting pattern also influenced significantly at 10% ($\alpha = 0.1$) total yield. Albeit, the use of traditional tools for land preparation and cultivation reduces total yield whilst the use of modern tools increases yield although its impact on total yield is insignificant. A percentage increase in the number of cassava stalks per acre will correspond with 0.617 increases in yield as well as every weeding done leads to an increase in yield by 0.199 kilos. The method of planting (1=direct in the ground, 0= planting in mounds) had a significant impact on yields. Direct planting of cassava stalks in the soil increased yields by 0.084g/ha whereas a year increase in the fallow period leads to a 0.089 increases in yields.

Table 9: Summary of multiple regression results

Variables	Standardized	p-value
(Constant)		.000
Planting pattern	0.089	0.068*
Method of Planting cassava	0 .084	0.093*
Weeding routine	0.199	0.000***
Tools for land preparation	-0.014	0.775
Cassava densities per acre	0.617	0.000***

Source: author's calculation; ****, significant at 1%, *, significant at 10%, $R^2 = 0.51$

4.2.1 Measuring the Profitability of Cassava Production

Average Gross Margins analysis is used as a proxy to assess the profit of each farmer from the difference between the gross Incomes earned (TR) and the total variable cost. It is calculated as: Total Revenue-Total Cost.

Table 10: Analysis of the profitability of cassava production.

Sale of Tuber:	**Quantity**	**Price/kg**	**Total price**
Market	344,308.525	0.263	90553.14
Farm gate:			
Uproot	1,032,925.575	0.200	206585.1
	240,439.700		
Un-uprooted		0.158	37989.47
Cassava stalks	6787.000	0.818	5551.766
Chips and other processed products			420.000
Total Revenue			**335,547.71**
Farm Expenses			
Labour			
Fertiliser	67,600.00		
Herbicide	1017.000		
Pesticide	6526.500		
Transportation	7071.000		
Cassava stalks	7517.000		
Rent:	9200.000		
Land			
Machinery	23366.000		
	5930.000		
Total Expenses	128,227.00		
Gross Margin	335,547.71-128,227.00		**207,320.71**
Gross Margin per farmer	GM/TF		**867.4**
Gross Margin per ha	GM/TFM		393.4
Gross Margin per labour	GM/TL		52.5
Total Cost of Production	Tvc+Tfc		536

Source: Field Survey

From the table total, farm revenue was 335,547.71, farm expenses amounted to 128,227.00 resulting in a gross margin of 207,320.71. Total gross margin per farmer was approximately 867.4¢. Total gross margin per hectare was 393.4¢ whilst total gross margin per labour was 52.5¢. Farmers averagely incurred ¢536 on production per hectare.

4.2.2 SWOT Analysis of the Intercropping System of Cassava Cultivation

Data from the survey in figure 6 identified intercropping system of cultivation as the most dominant system of production in the study area. This system has been in used successfully for cassava cultivation over the years. An analysis of the strengths, weaknesses, opportunities and threats (favourable and unfavourable conditions) have been outline in table 11.

Table 11: SWOT analysis of intercropping system of cassava production

Strengths	**Weakness**	**Opportunities**	**Threats**
Reduction in the number of damaging insect populations useful insects are drawn Reduction in crop loses and failure Food security Efficient use of farm land and labour resources Improvements in soil fertility enhances biodiversity Increase crop productivity Weed and erosion control	Crops Competition for, water, light nutrients inadequate density of the Plants. Decreases in farm mechanisation Increased labour requirements Possible low yields Affects developments of an efficient harvesting tool for cassava	Timely planting of each crop • Adequate fertilization at optimal rate and times • Effective weed, pest and disease control increasing human population Diminishing land sizes Availability of improved crop cultivars Presence of experienced and literate farmers Availability of agro-chemicals	Adverse weather conditions can compromise entire production Labour scarcity Emerging commercial cultivation of cassava

Source: Input from field survey

4.3. Review of governmental interventions in cassava (Objective 2)

4.3.1: Distribution of farmers' awareness of government interventions

Findings from the study also show that 166 out of the 239 farmers knew of government's interventions in the region whilst the remaining 73 did not know the existence of such supports in the district.

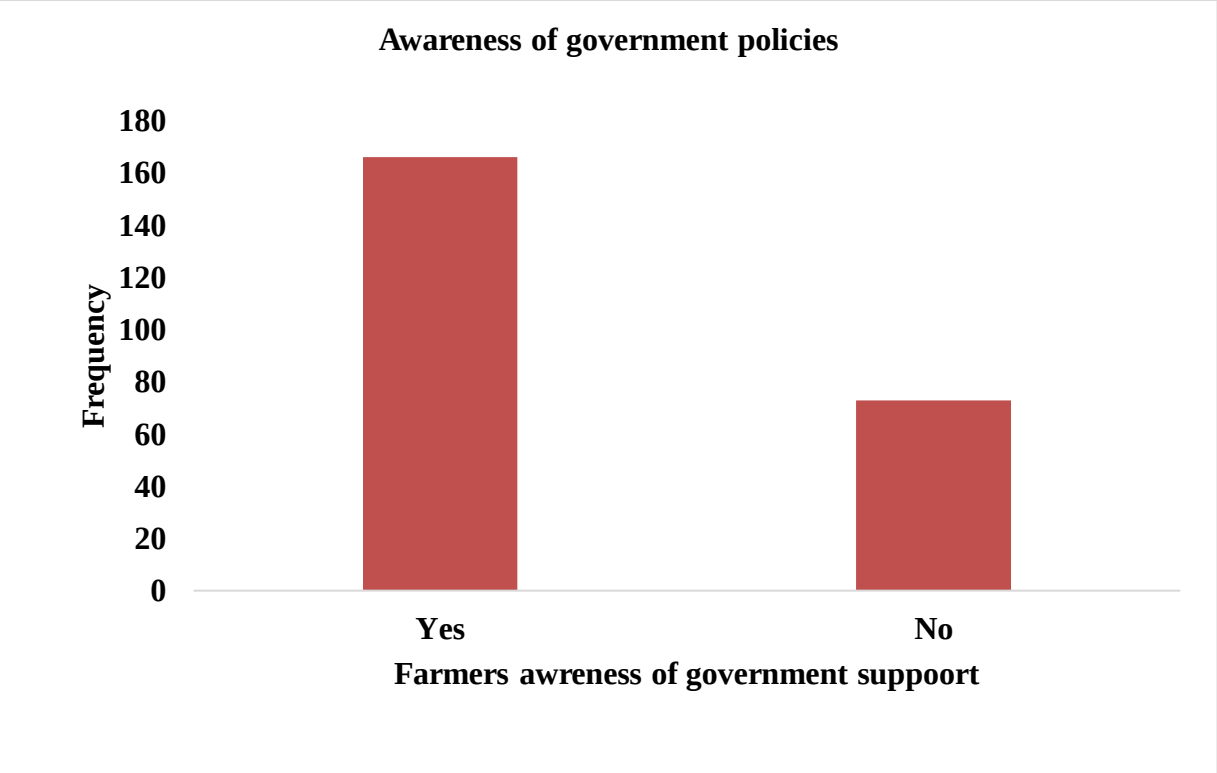

Figure 9: Farmers' awareness of government programmes

4.3.2: Distribution of farmers' benefits from government interventions

On benefits derived from government, the study reveals that, 113 (47%) percent had received extension advice whiles the remaining 126 representing (52.7%) had never had extension advice or support. Some farmer farmers also benefitted from various implemented programmes in the form of planting materials and visits to demonstrational farms.60 out of 239 farmers had visited demonstrational farms whilst 145 had also received stem cuttings for free.

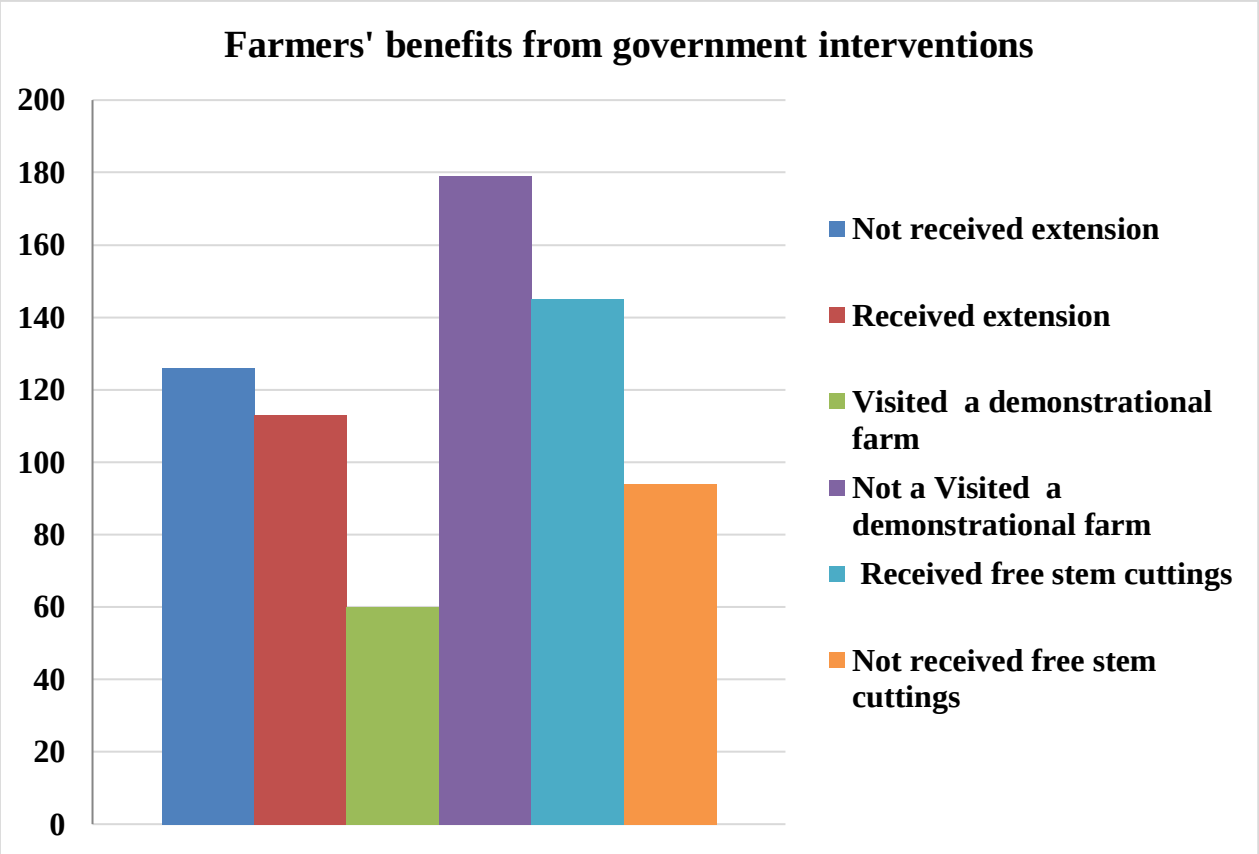

Figure 10: Distribution of supports received by farmers

4.3.3: Trend analysis of impact of interventions on cassava production

Trend analysis on the impact of governmental policies focused on two main outcomes, yields and cassava area planted, a literature review of FAOSTAT (2015) data obtained on cassava production figures from 1961 to 2014. Means of yields and land area used in these specific time periods are summarised in the table below. The means of yearly productions volumes and cultivated land areas across three categories of years: 1961-1979, 1980-1999 and figures 2000 to 2014. The average production in the period between 1961 and 79 was 1533235, planted on an average land size of 815683. Between 1980 and 1999, it was 4308786 cultivated on an average land size of 427475 and 11,724,457 on a land area of 200124 in the 2000s.

Table 12: Trend analysis of cassava production and land area cultivated.

Trends of cassava	Mean	Std. Deviation
Yield (per period)		
1961 -1979	**1533235.4211**	258394.68055
1980 -1999	**4308786.4500**	2191504.53790
2000-2014	**11724456.7333**	2866621.10214
Land area cultivated(ha)		
1961 to 1979	**815683.53333**	258394.68055
1980 to 99	**427475.10000**	2191504.53790
2000-2014	**200124.05263**	2866621.10214

4.4: Assessing the efficiency of the cassava value chain (Objective 3).

4.4.1: Identifying Marketing Channels and Marketing Margins

4.4.1.1: Identifying marketing channels/forms) used by farmers

Data obtained from the study shows that, majority of the farmers preferred selling of raw uprooted tubers. A total of 177 representing 74.1% used this form. 43 farmers (18%) sold raw un-harvested fields whereas 19 farmers added value to the product.

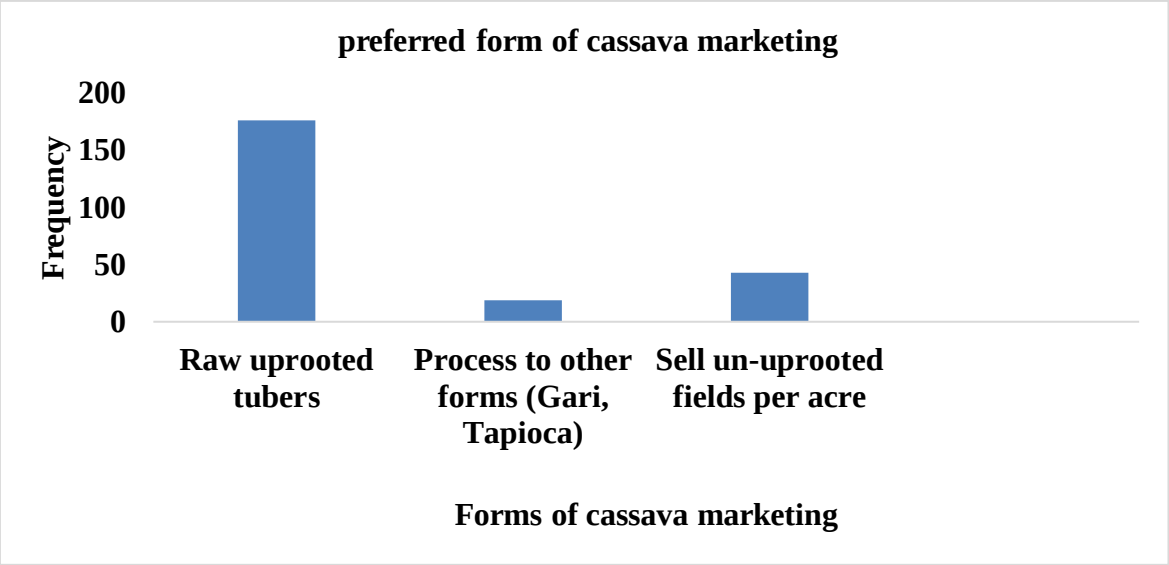

Figure 11: Distribution of cassava forms of cassava marketing

4.4.1.2: Distribution of place for cassava marketing

The study revealed that, Out of a total of over 1.6m kilogram of cassava produced, nearly 1273365.28 (uprooted and un-uprooted) were traded at the farm gate whilst 345978.53 (raw tubers and processed) was sold at the market. Apart from the 43 farmers who sold specifically at the farm gate by selling un-uprooted farms, some farmers utilised both channels by selling in both places whist others sold only at the market or farm gate.

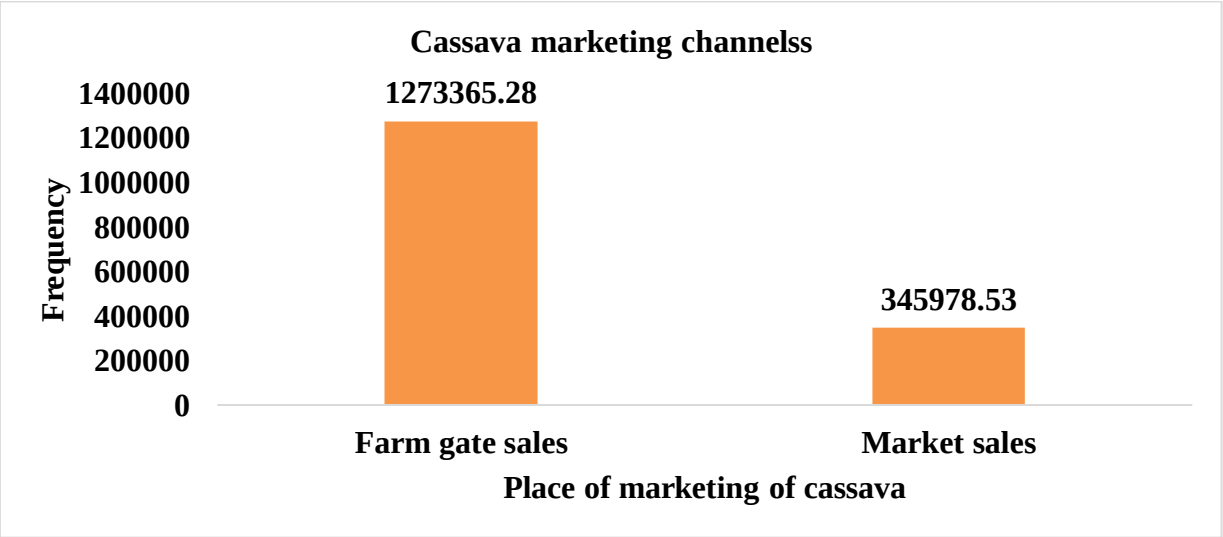

Figure 12: Distribution of place for marketing of cassava.

4.4.1.3: Reasons for preferred forms of Cassava Marketing.

Table 13: Reasons for farmers' preference of form of selling cassava.

Form	Reason
Raw uprooted tubers sold at the market and farm gate	The ease of marketing with increased demand, processing is costly, to know the actual market price per bag, its profitable
Uprooted fields	The ease of marketing, to avoid harvesting and transportation, avoid losses due to inadequate Storage and processing facilities. Quick and money in bulk, reduces stress as it saves time, money and energy
Processed in to Gari, Chips, Tapioca, Flour and other forms	To avoid spoilage through preservation, more income

4.4.2 Marketing Margins

Percent marketing margin denoted as MM = Ps/Sp * 100

Ps = Price spread, Sp = Sale price

Price spread = Sale price – Purchase price

Therefore, gross marketing margin between farm gate price and market price of cassava is calculated as

Ps = 44.7– 34.8 = **9.9**

Percent marketing margin = 9.9 /44.7 * 100 = **22.14%**

Transport (marketing cost) **(**GH¢/170kg**) = 4.85**

Net Profit **(**GH¢/170kg**) =** 9.9-4.85 = **5.05**

Net Profit as percentage of margin = 5.05 /9.9= **51%**

Net profit as a percentage of sale price (market price) = 5.05/44.7 * 100 = **11.29%**

Table 14: Summary of market margins of cassava

Table 14: Summary of market margins from cassava

Item	Average farm gate price	Average market price	Gross margin	Average Transport Cost	**Net** profit as a % of Gross Margin	Net profit as a % of Sales Price
	34.8	44.7	9.9	4.80	5.05	
Percent			22.1		51	11.29

Source: Field survey.

4.5.1: Distribution on the awareness and patronage of cassava derivatives (Objective 4).

4.5.2 Farmers awareness and actual patronage of new cassava products

This study further reveals farmers' awareness and actual use of new products derived from cassava. Using the multiple response technique, farmers Awareness of cassava derivatives are distributed as: 208 farmers knew about beer production, 196 farmers knew of it for making fufu flour and HQCF for baking respectively. 125 were aware of uses of dried chips as animal feed, 193 were aware of its use in making starch (glue). Awareness on uses in ethanol production was by 69 farmers and only 28 knew of uses in medicines. Actual usage of some of these derivatives were assessed. Cassava beer consumption was the highest as nearly 208 farmers had consumed beer made from cassava. Uses of dried chips in animal feed (poultry) was patronised by 33 farmers, 29 had tasted products from HQCF whilst 21 farmers had patronized fufu flour. No record of usage of ethanol and medicines derived from cassava were made.

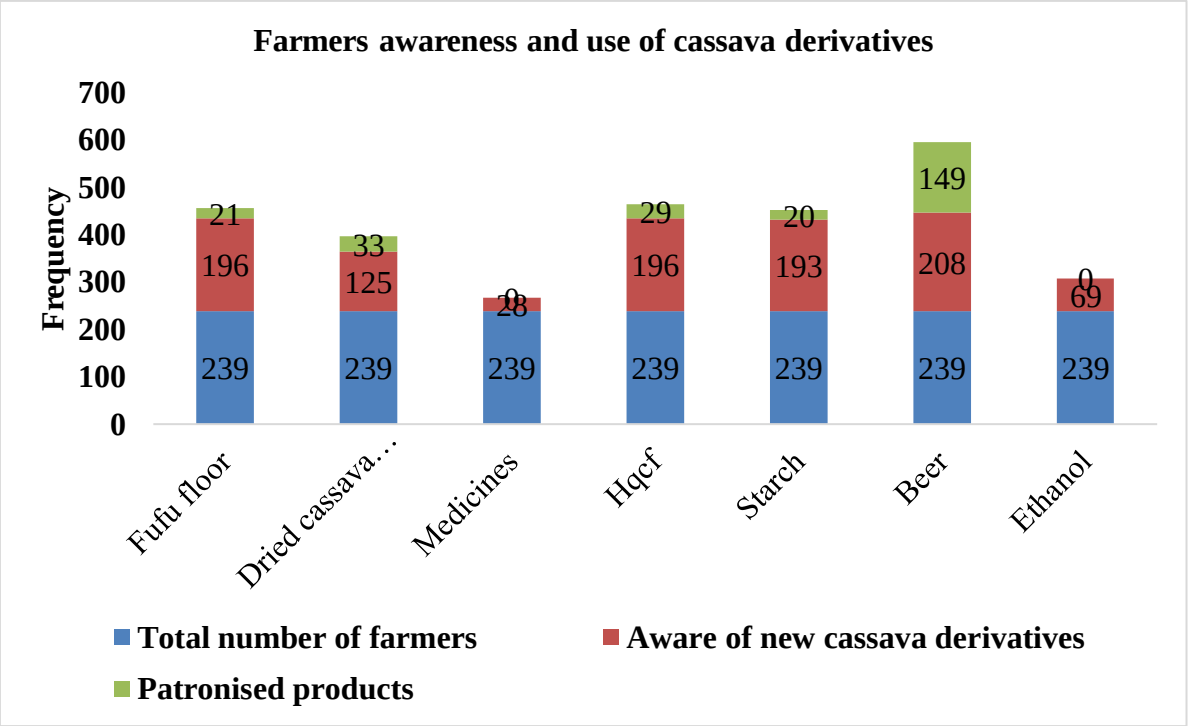

Figure 13: Farmers' knowledge and use of new cassava derivatives

4.5.3 Existing Traditional Utilisation of Cassava

In identifying existing traditional cassava derivatives in the stud area, farmers were asked of their patronage of the various traditionally known forms of cassava utilisation. Data available shows farmers patronage fufu as the highest (206), followed by gari (199), 165 for cassava flour (konkonte), 104 for agblima, 94 for animal feed (peels, leaves, fresh roots)) 30 for tapioca and 20 for traditionally manufactured starch as glue. No data was recorded for uses in the preparation of attieke among the sampled farmers.

Table 15: Distribution on traditional utilisation of cassava

Existing traditional Market	Frequency	Percentage	Percentage of cases
Fufu	206	25.8%	86.2%
Agblima	105	13.1%	43.9%
Gari	199	24.9%	83.3%
Tapioca	30	3.8%	12.6%
cassava flour (Milled konkonte)	165	20.7%	69.0%
Animal feed (leaves, peels and fresh roots)	94	11.8%	39.3%
Starch(glue)	20	2.4%	8.37%
Total	819	100.0%	342.7%

4.5.5: Analysis of reviewed literature

Extensive literature review on new markets for cassava reveals a current industry food and non-food uses of approximately 66,000, a total 1.6 million tonnes (domestic and regional demand) latent demand of by 2020. A growth in demand of more than 400,000 MT yearly as against a 6% current supply.

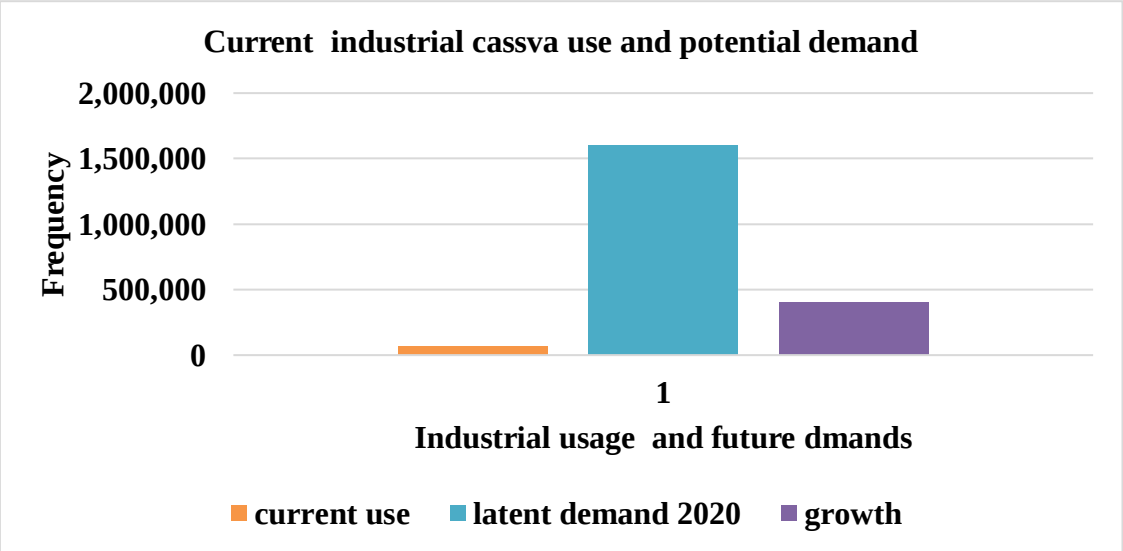

Figure 14: Distribution of current industry and future demand.

4.5.5.1 Drivers of the potential demand for cassava and current supply

The production of ethanol and other biofuels are seen as the main driver for the commercialization of the sector and it is estimated to account for 50% of the demand. The remaining is to be accounted for by the starch sector (35%) with the HQCF and other sub-sectors taking up 15% of demand. (Naoko et al. 2015, Kleih et al. 2013)

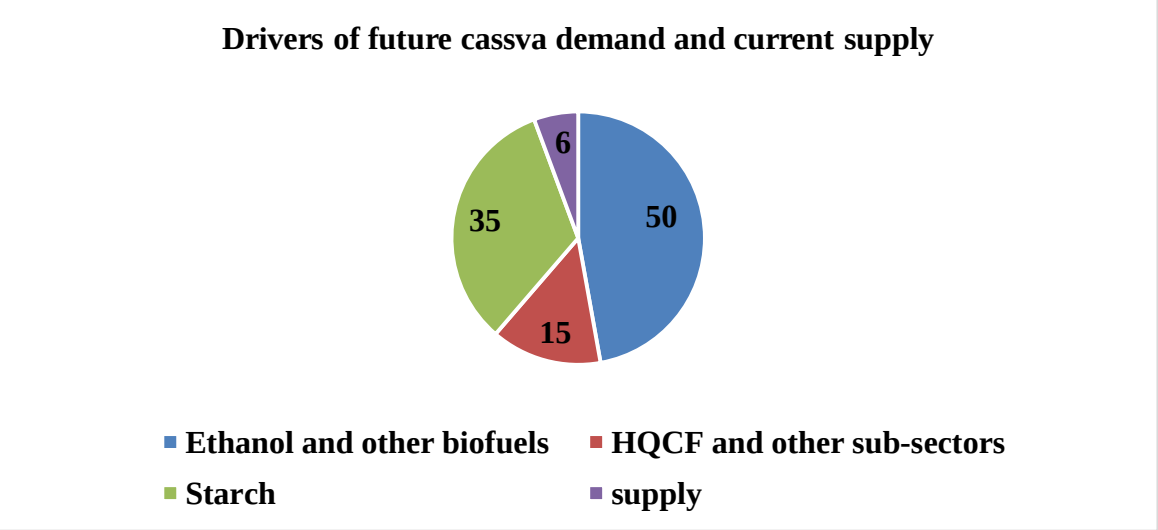

Figure 15: Drivers of cassava commercialisation and current supply.

4.5.6: Options for production expansion

From the study, a total of 125 farmers expressed their willingness to expand their production whist 114 were satisfied with their current land holdings.

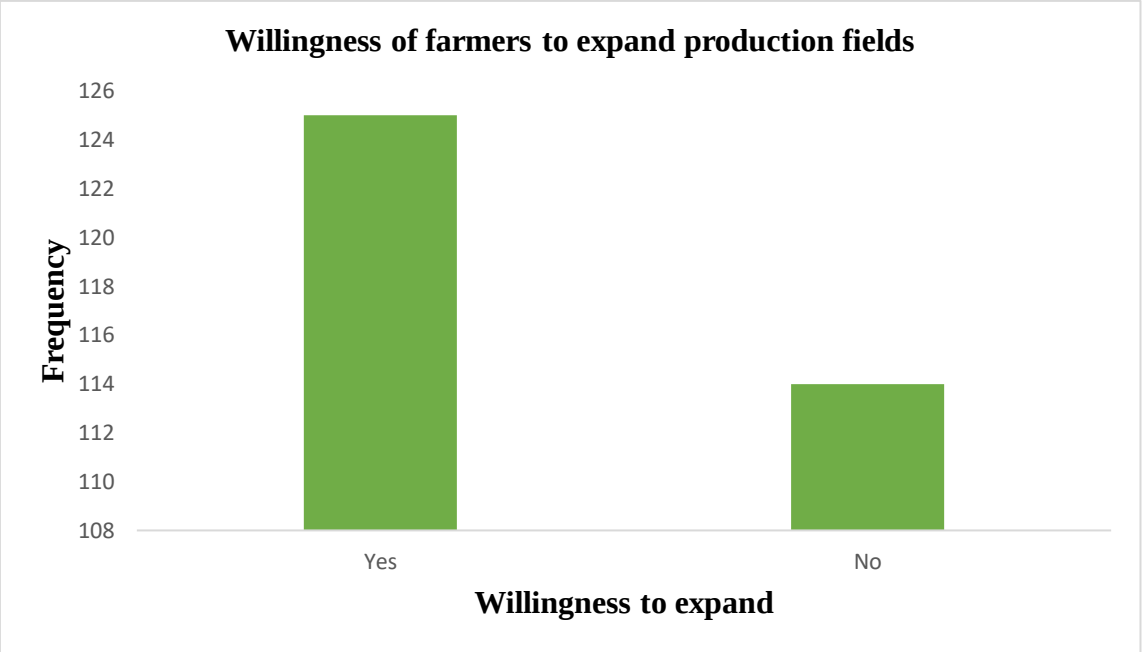

Figure 16: Distribution of farmers' willingness to expand.

Table 16: Reasons for farmers' preference on expansion

Reasons for choice	No	Yes
	Current land size and production okay for them	Easy to cultivate and has ready market
	Don't have enough funds	Move to commercial production and generate more income
	Health issues-too old	Food security
	High cost of and or scarcity of land	Have enough land

5. Discussions

5.1 Socioeconomic and farm specific characteristics.

Education is considered as an important factor influencing innovation and adoption of new technologies (Abang et al. 2001). High levels of education are therefore a good pointer to improved productivity. The study reveals an illiteracy rate of 57.3% among the farmers implying that this number could neither read nor write. Education is crucial in the utilisation of updated information about modern technologies required for good farm accounting and record keeping (Asadullah et al. 2005). Furthermore, education enables farmers to understand the social and economic factors influencing their production (Shamsudeen et al. 2011). The study specifies the mean age of farm head to be to 39, which invariable implies a large number of farmers are within the economic active age. This agrees with the findings of Magboul (2016) who reveals the existence of high levels of independence and economic activeness among people within the ages of 41 – 60 as compared to those below 20 or above 60 years. The age of farmers plays an important role in ensuring proper management and understanding of the farming activities as it reflects experience in farming and sometimes used as a proxy in most studies. (Kibaara 2005). The gender of cassava farm head also plays an important role in how cassava is cultivated. According to Mafimisebi (2007), cassava is mainly described as a women's crop, but data from this study shows that more men are actively involved in the cultivation of cassava than women, approximately 69.9 and 30.1 % respectively. This perhaps could be attributed to the fact that cassava production is laborious with the widespread use of rudimentary tools.

Findings from the study revealed that, hired labour was the dominant source of labour for cassava cultivation in the area, which is complemented by family labour. Resource-constrained farmers according to Baden et al. (1994), still make use of labour as farmers with relatively small land holdings usually under 1.6 hectares employed some form of hired labour along the production chain. Farming experience among farm respondents is an important factor to ensure agricultural productivity. Farmers with more experience in farming generally attain higher levels of technical efficiency. According to Nwaru (2004), farmers sometimes count more on their experience than education attainment in order to increase their productivity. Technical inefficiencies of farmers show significant

relationship to the farming experience of farmers (Matuko 2007). The average farming experience of cassava farmers in the area of studies was found to be 13.6 implying that a good number of the farmers are experienced and are expected to obtain higher technical efficiencies. Kibaara (2005) concludes that farmers become more skilled as they grow older, but added that the learning by doing effect depreciates as farmers' age, because of deteriorations in their health. Extension services play an important role in technology and information sharing; linking farmers and markets and acting as a bridge between researchers and farmers for new technologies. (Awerije 2014). According to Saliu and Ige (2009), high levels of agricultural production and income are not possible without agricultural services supported by agricultural research that is relevant to farmers. The overall coverage of extension services was found to be 47.3% in the study area, indicating that majority of the farmers (52.7 %) had no contacts with extension agents to learn about new ideas and methods in cassava production as well as receive market information. The level of extension contacts for those accessed were low as they were contacted occasionally during the cropping year. The reason might be low extension farmer ratio in the study area. This agrees with the 2012 McNamara et al 2014 of high farmer to extension ratio (1:3000) in Ghana. Operational and logistic challenges could be assigned as contributing to this phenomenon. This seriously have negative implications on farmers' acquaintances with modern production techniques and implementation. Kalirajan (1981) linked lack or inadequate extension visits to improper utilization of farming technologies, which according to him results in differences between yields among farmers and those recorded on demonstrational farms.

The average farm size for cassava cultivation in the area was averagely 0.88 ha (2.07 acres) per farmer. The smallest and biggest land size captured in this study was 0.2 and 4.8 ha respectively. This invariable implies the smallholdings nature of farmers in the area and contravenes MOFA's 2 hectares average (FAO 2013). It somewhat agrees with findings of an average 1.10 hectares (approximately 2.7 acres) by Mensah-Bonsu and Tsiboe (2014). This agrees with the Brundtland commission's categorization of agricultural system (WCED 1987), which suggests that resource poor agriculture generally had small farm units, fragile soil and rain dependent with minimum inputs. Average crop yield was 12,502.82 kilograms per hectare (12.5 Mt/ha) which falls below the current national average of 18.78 Mt/ha (MOFA 2016) these variations could be

attributed to the low plant densities per acre, non -application of fertilizer and probably the cassava root rot diseases which had a devastating effects considering the high volumes of rains recorded in the ensuing year. Fallow years is a period during which farmland is allowed to regenerate nutrients by natural means to support future agricultural production. The average fallow period found in this study was approximately 3 years although some could leave it for nearly 8 years whilst others cropped continuously on the land. This implies the dominance of the short fallow period which Nweke et al. (2002) attributes to urbanization, population growth, availability of fertiliser and other agrochemicals, and the low incidence of pest on the farm. This finding agrees with the AFRINT II village diagnostic survey in Ghana in 2009. This suggests that the fallow years were short such that fertiliser addition maybe required in keeping farmers in production but surprising fertiliser application to cassava was negligible as cassava grown, relied on fertiliser residues applied to other crops with which it is intercropped such as such as maize.

5.2 Discussions on results from objective 1

Results from the regression analysis confirmed the effect of the agronomic practices developed for cassava production. Improved cassava yields according to Nweke et al (2002), are highly influenced by strict adherence to these modern agronomic practices. The length of the cassava stalk, planting depth, routine weeding, method of planting, planting pattern, crop variety cassava densities among others are viewed to affect yields. From this study, results of a multiple regression analysis used to assess their respective levels of influence on cassava yields in the study area , reveals an overall good model fit as the R^2 explained the variations in the dependent by more than half (0.0510). Cassava densities per acre and the number of routine weeding were statistically significant at 1% whilst the method of planting and planting pattern was significant at 10%. The tools used in land preparation although had an influence on yields was not significant. This invariably implies that routine weeding, cassava densities, planting pattern and method were significantly correlated to yields based on this study. This is consistent with Adebayo et al (2014) who identifies these very variables as some of the factors that affect cassava productivity. This is also consistent with Sugino and Mayrowani's (2009) study in Asia. They established a positive correlation between the methods of planting, weed control to yields, and stressed that weeding by the use of herbicides had better results than hand weeding. They however cautions that the planting method used should be based on

factors such as the nature of the land and period of planting as they affect the effectiveness of planting method on yields.

The profitability analysis employed in the study revealed that the average Gross Margin of cassava farmers in the study area is 867.4¢/Ha and a benefit cost ratio of 2.6. This simply indicates that cassava business is profitable and competitive in the study area, corroborating earlier works by Nzech-Emeka and Ugwu (2014) and Omotayo and Oladejo in Nigeria on profitability of cassava production. The WAAPP socio -economic programme on assessing the profitability of cassava farming in some parts of the eastern region also confirmed the profitability of the venture but stress on the need for labour-saving technologies and improved practices. The Gross margins per farmer in this study is slightly higher than that of Omotayo and Oladejo who obtained 62,449.11 Naira (770 cedis) but lower than that of Okeowo et al. who identified 76,502.77N (944.85) and 129014.75 (1,593.39) in different cassava production systems in Nigeria. The average return to each cedi spent on the cultivation of cassava is also an important criterion for measuring profitability. It is estimated as ratio of gross return per hectare (Awerije 2014). The 2.6 BCR from the study is an indication that, every one cedi spent on cassava production will create a return of 2.6 cedis. This finding agrees with Awerije (2014) who obtained a BCR of 2.83 in a similar study in Nigeria. According to Abu et al. (2010), as a rule of thumb, any enterprise with benefit cost ratios greater than one, equal to one or less than one indicate profit, break-even or loss respectively. Intercropping cassava especially with maize is practiced extensively in Ghana to ensure food security and decrease crop failure by the complementary roles played by different crops. These observations are consistent with findings by Mutsaers et al. (1993) and Shetty and Rao (1981), who associate efficient use of physical resources (nutrients), high labour productivity, high soil fertility, crop risk reduction, better weed control, increases in yields (greater uptake and utilisation of nutrients), plant population pressures on the component crops leading to composition for nutrients and difficulties in crop mechanisation to the technique of intercropping.

5.3 Discussions on results from objective 2.

Government policies on agriculture to a large extend affects productivity since it shows direction of the sector and complement efforts of other actors within the sector. Since

1930, the government of Ghana and its development partners have rolled out several policies targeting crop expansion, marketing and mechanisation among others, to transform the sector. Results from this study found high levels of awareness of government interventions in the district as 166 people knew of government projects although low levels of coverage of some of these government interventions in the study region were evident in spite of farmer's awareness of their existence. On extension access, only 47.3 farmers were receiving free government sponsored extension and advisory services implying that more than half of the farmers had no access to new information. This is attributable to operational challenges faced by extension workers in the district. As only 12 Agricultural, extension agents were assigned to over 4000 (1:333) farmers in the district. This confirms the 2012 McNamara et al 2014, which bemoans high famer to extension ratios in Ghana (1:3000). This level of coverage is also consistent with findings by Mensah–Bonsu and Tsiboe although theirs where relatively lower approximately 26% of coverage. Possible variations for workers in both study region could be assigned. 60 farmers out of the 239 had visited demonstrational farms whiles 145 had received free cassava stem cuttings thanks to the government's extension services, WAAAP and the RTMIP programme respectively. The variations in the numbers of farmers aware of the programmes and those that benefited could be attributed to the exhibition of project signpost in communities as well as assigned quotas for beneficiaries coupled with inadequate funds. Farmers on their own never took the initiative to ask for some of these supports as farmer visits to agricultural offices to enquire about information and opportunities were virtually none existent. 'One farmer remarked that he lives far away and cannot pay for transport as he is not even sure of a fruitful journey worth his investments' whilst some did not even know where their offices were located. There is an ongoing farmer registration process to locate all farmers in the district for equitable resource distribution (MOFA 2016). An extensive literature review focusing on two outcomes: production volumes and area planted of cassava revealed a high mean difference of production volumes and land committed to cassava production for the period between 2000 and 2014 when compared with means of 1961-1979 and 1980 -1999. This could be attributed to Nweke (2004) assertion that government paid much attention to the sector after the 1982/83 drought in Ghana. This is evident in the number of interventions introduced after the 80s as well as production levels before the 80s. The trend however, shows overall increases in both production volumes and land size the studied periods.

These policies could be assigned to have wiped up awareness in farmers leading to expansion and intensification coupled with the availability of high yielding early maturing, disease resistant and other supports offered by the policies. Knowledge of new cassava uses and its attendant demand could also be assigned to have wiped up government interests in developing the sector. These findings are consistent with studies in Nigeria by Awerije and Rahman (2016) and Donkor et al. (2017) who found similar sharp increases in yields and area cultivated after the implementation of government interventions.

5.4 Discussions on results from objective 3.

Sustaining increases in cassava production without the development of an effective marketing system to link distant market to absorb excess supply according to Mutambatsere (2005), constitute a disincentive to production. Studies by Folayan and Bifarin, (2011), Kleih et al (2013) alludes to the fact that there are options for improved returns with processing. However, data from this study found that approximately 80.5% of farmers sold raw tubers in the form of uprooted (74.1%) and unharvested tubers (18.0%) whiles only a fraction of farmers added some form of value to the product (7.9%).This invariably suggest low levels of value addition practices in the study area. Lack of capacity and absence of modern methods and tools for effective processing as awareness of possible cassava derivatives were high among farmers. Kaine (2011), affirms that realising the full potentials from processing products is affected due to low levels of technical efficiencies, which results in increased expenses and decreased profits. This result is supported by Agyeman (2015), whose work found out low levels of processing below 10 % among smallholder farmers in the Efutu Ewutu Senya District of the central region of Ghana. Of the 1619343.8 kilogram (1619 MT) produced in the cropping season in the study area, 345,978.252 (raw tubers and processed products) were sold at the market whilst 1,273,365.28 (raw uprooted tubers and un-uprooted tubers). This implies that nearly 78% of produce are sold at the farm gate whilst the remaining 22% is sold at the market. This result agrees with findings by Mensah-Bonsu & Tsiboe (2012) whose work identified the sale of approximately 86% of farmers produce on the farm to urban wholesalers and retailer whist the rest were sold to local retailers or transported to local markets by farmers. This probably could be as a result some farmers not having the means to pay for the transport and avoid spoilage. Some intermediaries' preference to buy

from the farm gate where they offer low prices to farmer could be assigned, as only a few who are able and motivated by extra profits transported and sold at the market. The study interesting reveals the possibility of farmers to increase their profit margins should they participate actively in the marketing of the product as intermediaries involved in the marketing business gains net profits of 11.29percent. This implies that 37.5 of farmers who sell at the market places also earns 11.29 percent extra than those selling at the farm gate. This finding is consistent with similar study by Ahado (2017) who found 11.37 percent net profit by intermediaries involved in marketing of rice in Ghana.

5.5 Discussions on results from objective 4.

Results from the study again shows high levels of knowledge of new cassava derivatives among farmers, which is attributed to the numerous policies by state and non-state actors targeting the commercialization of the sector as well as demands by industries. This implies farmer's knowledge of possibilities to enhance their income by participating in these new markets but they are relatively constrained by the absence of the required technology and machinery due to lack of training and high capital requirements for entry into these new markets **(**Adebayo et al. 2014). Knowledge of cassava beer was the highest, followed by fufu flour, HQCF, starch and dried chips (animal feed) respectively whilst minimal awareness existed for its use ethanol production and medicines. This could be attributed to the increased advertisements on the two cassava beers by the two-major beer-producing companies. On actual patronage of these derivatives, beer again was the highest, which is attributed to the general low-price levels of the beers as well as farmers feeling of being part of the production. Patronage of cassava fufu flour was low owing to farmers preference for boiled roots coupled with its high price. Levels of patronage for other products such as HQCF products, starch, fufu floor and dried chips for poultry were low. This clearly provides a focus and destination for investments as new market products will invariably survive in urban and export markets where demands according Kapinga et al. (2009) is assured. Notwithstanding these opportunities for reducing wastage by opening up the cassava market for increased incomes of farmers, the transition to utilising cassava as a white gold has been slow. For instance, in the study area, the only industrial investment set up to transform cassava is a privately-owned processing factory that produces gari on a medium scale and starch on small scale to feed its subsidiary company known as Empamco printing press.

Nearly 90 of the uses were for food in the traditionally known forms distributed as : 25.8 percent uses in fufu preparation, followed by 24.9 utilization in the form of gari, 20.7 patronise cassava flour (konkonte), 13.1% patronised agblima, 11.8 patronize it usage as animal feed in the form of fresh leaves, roots and peels whilst 3.8 being the smallest enjoys tapioca this agrees with findings by Kleih et al 2013 who puts cassava utilization for food in Ghana at approximately 99 % and making allowance of 1 % for the industries. This implies the existence of opportunities not only in the industry but also a value addition to some traditional food as fufu flour an alternative to boiled roots were being traded in the district, gari and agblima (export bound). Grits of dried chips feed to poultry and high consumption of cassava beer were evident.

Extensive literature review on new markets for cassava reveals a current industrial food and non-food uses of approximately 66,000, a total of 1.6 million tonnes latent demand of by 2020 (domestic and regional demand). A growth in demand of more than 400,000 MT yearly as against a 6% current supply. This agrees with Kleih et al 2013 who puts the yearly growth in Demand to nearly 540,000MT. Given the current supply, efforts must be more than doubled to adapt productions to suit the demands of the industrial in other to avoid the periodic shortages and surplus experienced in Ghana. Right cultivars must be planted to stimulate the industrial demands. The production of ethanol and other biofuels are the main driver for the commercialization of the sector and it is estimated to account for 50% of the demand. The remaining is to be accounted for by the starch sector (35%) with the HQCF and other sub-sectors accounting for 15% of demand. (Naoko et al.2015, Kleih et al. 2013). This implies the need for improvements in technical and financial capacities of farmers to take advantage of these new markets. Balancing supply for food and industry would be possible by expanding cassava area in addition to other best practices.

From this study, it is observed that nearly 52.3 showed interest in expanding their production whilst 47.7 were unwilling. This finding is consistent with Kleih et al, (2013) who attributed nearly 45 % crop increases from 2007 to 2014 not only to the availability of improved and early maturing, disease and pest resistant cultivar, but also to expansion in cassava fields of nearly 11% in the period. Farmers attributed their willingness to expand mainly to the Ease of cultivating cassava. Availability of a ready market, desire to move into commercial production for increased income, Food security, availability of

deposable land. Others who showed no interest mainly explained their satisfaction with their current land size and production, inadequate funds, Health challenges as some were aging, scarcity and high cost of land. These very reasons featured as constraints to those who were even willing to expand; therefore, dealing with these challenges could spur up interest in expanding production.

6. Conclusions

The study aimed at assessing the competitiveness of cassava production and options for production expansion. Multiple regression, profitability, SWOT, trend and margin analysis were employed to examine the effectiveness of available farming methods and practices on output, investigate various governmental interventions in enhancing cassava farming, identify and assess the efficiency of the supply chain as well as identify new and existing opportunities for value addition to cassava.

The coefficient of determination (R^2) of 0.51 explained the variability in the dependent variable indicating the effect of cassava densities, routine weeding, planting pattern and the method of planting on cassava yields in the study area. Average gross margins of ¢867 per farmer confirms the competitiveness of the crop in generating incomes for farmers. There exist opportunities in Ghana to utilise the over 8million MT yearly cassava surpluses for industrial food and non-food uses by coordinating the value chain actors to ensure uniformity in demand and supply and prevent competition between food needs and industrial needs which has severally created shortages to either side.

Already, high awareness among farmers about new cassava derivatives and a noticeable modest rural demand suggesting attention on urban and export markets for key food and non-food products such as fufu flour, starch and dried cassava chips for poultry feed. High cassava beer consumption was also evident in the study area. Ghana should position itself to exploit the local, regional and international markets opportunities to improve incomes for farmers. The drivers of the growth in the cassava markets are the ethanol and starch markets. Policies implemented to transform the sector had seen improvements in productivity but had relatively impacts on mechanisation and value addition resulting from absence of required technology, training and capital among the small-scale farmers. The access rate of government policies by farmers is relatively low. The share of the

marketing margin along the cassava supply chain was 11.29% to intermediaries, an indication of extra incomes available to farmers should they participate in trading beyond the farm gate. Farmers contacted in the study are motivated to expand production to take up market opportunities.

The study based on these findings concludes that cassava production is competitive as farmers averagely earn incomes and that efforts aimed at scaling up production such as sound agronomic practices levels and post-harvest issues (processing, marketing and storage) would ensure increased incomes for farmers. Prioritising the sector to receive full government's attention (input support) could turn cassava production into a multimillion dollar industry just like in Thailand as there exist massive opportunities in both domestic and foreign markets.it could diversify the sources of exports for Ghana and respond to both the food and energy needs of the country.

6.1 Policy Recommendations

Based on the research findings, several policy recommendations have been suggested. Inputs on farmer's needs and experiences were considered. These suggestions on policy improvements by government merely centres on government prioritising the cassava sector just as the cocoa and maize sector.

First, there is the need for quality extension delivery in terms of content and frequency in access to information. The link between some agronomic practices and yields is an indication of the need to prioritise improvements in the technical knowledge of farmer's. Some farmers admitted the challenges faced by extension workers and recommend government to improve their numbers and provide them sound logistic support to enhance their work. The capacity of the extension workers should also be enhanced to be abreast with changing dynamics of cassava productions.

Secondly, emphasis should be placed on improving farmer's capacities to deal with post-harvest problems through training (value addition and marketing) and infrastructural provision to ensure accessibility and reduce transportation cost. Opportunities on training and access to capital to encourage processing as well as siting of a district cassava processing factory under the government's one district one factory programme is recommended.

Additionally, training farmers and processor on packaging of some cassava food based products should be prioritized since an increase in the consumption and marketing of gari and fufu flour has been attributed to its availability in a convenient form.

More over there is the need to bridge production and marketing gap so farmers can identify markets with opportunities and adapt their productions to the demands of the respective market. This could increase demand and help solve the yearly surpluses incurred. In the interim, the government through the buffer stock company must facilitate buying of farmers surpluses as this could help to stabilise root price and promote quantity standardisation in its marketing.

The study also recommends the need for input support by government in terms of improved seeds, capital, machinery, agro-chemicals either for free or highly subsidised to enable farmers to expand, employ modern methods and be competitive.

Farmers should take instructions from AEA serious, improve on their financial management by joining co-operative societies to enable them save and have access to credit facilities from MFIs in Ghana who are now opting to give group loans instead of individual loans.

Government must also carry out an aggressive land use reforms to protect farmers from exploitation by land owners as farmers cited unfavourable terms by landowners as one of their biggest constraints.

Finally, government and policy makers should harness the potentials and opportunities in the cassava sector to beef up food security and increase incomes of smallholder farmers in the country.

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