FINAL REPORT

The Ghana Advanced Maize Seed Adoption Program (ADVANCE)

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Various individuals and institutions have made significant contributions for the successful achievements of this baseline study. We would like to appreciate ADVANCE Technical Staff for their unreserved support during the study. Without their efforts this baseline studies would have not been successful. We would like to express our gratitude to all the numerous out-growers and nucleus farmers as well as key informants who undoubtedly spent their precious time to offer valuable information pertaining to this project. Moreover, our many thanks go to various CSO, NGOs, CBOs, MDAs, etc. related to the ADVANCE value chain who willingly hosted us during our visits and shared with us their experiences and thoughts. Finally, we would like to extend our thanks to all enumerators and supervisors for their vital contribution during the data collection and supervision process of the baseline studies.

LIST OF ACRONYMNS

ACDEP	Association of Church–based Development NGOs
ACDI/COCA	Agriculture Cooperative Development International
ADRA	Adventist Development Relief Agency
ADVANCE	Agriculture Development and Value Chain Enhancement
AgSSIP	Agricultural Services Sub-sector Investment Project
ATTP	Agriculture Technological Transfer Project
BIRD	Bureau of Integrated Rural Development
CAADP	Comprehensive Africa Agriculture Development Programme
CDCS	Community Development Cooperation Strategy
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CIP	Country Investment Plan
DO2	Development Objective Two
EAs	Enumeration Areas
EG	Economic Growth
F2F	Farmer to Farmer
FAO	Food and Agriculture Organization
FASDEP	Food and Agriculture Sector Development Policy
FBOs	Farmer Based Organizations
FGD	Focus Group Discussions
FTF	Feed The Future
ADVANCE	Ghana Advance Maize Seed Adoption Programme
GAPs	Good Agronomic Practices
GCAP	Ghana Commercial Agriculture Policy Programme
GDP	Gross Domestic Product
GOG	Government of Ghana
GPS	Global positioning system
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statistical Service
ICT	Information and Communication Technology
IFDC	International Fertilizer Development Sector
IRs	Intermediate Results
ISSER	Institute of Statistical Social and Economic Research
M&E	Monitoring and Evaluation
MEL	Monitoring, Evaluation and Learning
METASIP	Medium Term Agriculture Sector Investment Plan
METSS	Monitoring Evaluation and Technical Support Services
MoFA	Ministry of Food and Agriculture
MoU	Memorandum of Understanding
NDPC	National Development Planning Commission
NGOs	Non-Government Organizations
PMP	Performance Management Plan
PPME	Policy, Planning, Monitoring and Evaluation
PPMED	Policy Planning, Monitoring and Evaluation Department
SARI	Savannah Agriculture Research Institute
SoW	Scope of Work
SPSS	Statistical Package for Service Solutions
TOC	Theory of Change
UNIDO	United Nations Industrial Development Organization
USAID	United State Agency for International Development
ZOI	Zone Of Influence

EXECUTIVE SUMMARY

The Ghana Advanced Maize Seed Adoption Programme (ADVANCE) is a sub-component of the USAID funded Agricultural Development and Value Chain Enhancement (ADVANCE) project. ADVANCE is funded by USAID's Ghana Mission under the global Feed The Future (FTF) program. The overall goal of the FTF is to sustainably reduce global poverty and hunger. The ADVANCE is a US$4 million maize project aimed at improving productivity of small-holder maize farmers in Ghana. The four-year partnership of DuPont-Pioneer and the USAID will greatly impact on the agricultural production, food security and incomes of the beneficiaries. The project also seeks to strengthen trade and marketing linkages and to improve post-harvest management.

The ADVANCE baseline study aims to provide knowledge to test the project causal pathways as outlined in the Theory of Change; confirm the targets of key indicators; and lay the groundwork for impact assessment. Results will also be used to set targets to track output, outcome and impact indicators and will provide the basis of comparison for mid-term review and the final evaluation. Finally, the baseline will present the current climate for business development, growth, investment and innovation. The main objective of the study was to estimate and present baseline information for the required indicators. The study was undertaken in the Ashanti and Brong Ahafo regions in the middle belt of the country with maize as the crop of interest. Both quantitative and qualitative methods were used in data gathering and analysis. Structured questionnaire and interview checklists were used in data collection. Focus group discussions, household and key informant interviews were conducted in addition to field observations. The data collection was undertaken from 16th to 24th March, 2015 with a household sample size of 941 comprising 78.4% males and 21.6% and females.

The key findings are outlined as follows:

Males were dominant in the study and have larger farm sizes than females in both major and minor farming seasons. Average land sizes were comparatively higher in the major season (2.61ha) than the minor season (2.53ha). Across the zones, average land allocated to maize in the major season was estimated at, 2.76 ha in the Techiman zone, 2.74 ha in the Sunyani zone and 2.32 ha in the Ejura zone. The average land size in the Ejura zone increased in the minor season (2.48 ha). In Techiman zone, however, the average farm size decreased from 2.76 ha in the major season to 2.43 ha in the minor season whiles that of Sunyani remained the same

Maize production in the major season recorded the highest average gross margins of GHS 525.27 whiles the average gross margin in the minor season was estimated at GHS 542.68. Gross margins for males were higher than females in both seasons. Male gross margins were estimated at GHS 562.73 and GHS 597.17 whiles that of females were estimated at GHS 487.82 and GHS 488.19 in the major and minor season respectively. Yield among males and females did not differ much in both seasons. However, women invest more in maize production than their male counterparts. Farmers were found to pay less for inputs in the minor season and sell their produce at a higher price, accounting for the higher gross margins in the minor season.

Farmers used a number of local practices to improve soil fertility, among these are: rotation of maize with nitrogen fixing crops; land to fallow to replenish soil fertility; and cover cropping to decrease soil erosion. Practices such as Integrated Pest management and application of organic matter were not popular among most farmers.

The survey recorded a high savings culture (65.5%) among farmers in the ZOI. Females in Ejura recorded the highest (86.1%) savings culture across the ZOI. Generally access to credit in the ZOI was low (27.3%). Credit was more accessible to farmers in the Ejura zone. Farmers

were not interested in obtaining loans due to the cumbersome procedures involved and the fear of defaulting.

In the study area, private investments were mainly concentrated in tractor services, inventory credit, post-harvest services (shelling/threshing, drying and bagging, warehousing, tarpaulins), input credits, transporting goods and processing (grinding mills). However, there was an FBO that was engaged in extension and soil management services. Investment threshold within the study area is said to be medium per the MOFA standard, i.e. investments are in the threshold of GHS 100,000.

Among all technologies, weedicide application was the most practiced technology among surveyed farmers, with 890 farmers (94.58%) practicing the technology. Row planting, fertilizer application and minimum tillage are other technologies with relatively high usage. Row planting was practiced by 803 farmers (85.33%), 538 farmers (57.17%) practiced fertilizer application whiles 529 farmers (56.2%) practiced minimum tillage. However, among users of these technologies, the percentage of new users across the ZOI did not exceed 5%.

Generally, the use of hybrid seeds was low among farmers in the ZOI. Among all seeds, Obaatanpa recorded the highest percentage usage of 31.46% (296 framers) and this portrays farmers' reliance on local varieties. Pioneer 30F32 (White maize) was used by 36 farmers (3.83%) whilst 27 farmers (2.87%) were users of Pioneer 30Y87 (Yellow Maize) across the ZOI. The application of crop genetic technologies was low among farmers in Sunyani and Ejura. In the Ejura zone less than 8% of all farmers were users of hybrid seeds while only 4.24% of framers in the Sunyani zone did so.

Most farmers regardless of gender and zone, used between six (6) and ten (10) technologies out of a possible forty four (44). At the zonal level, at least 82% of the farmers in Ejura and Techiman and 45% of those in Sunyani used between Six (6) and ten (10) improved technologies.

The following variables: access to extension services; access to training; level of education; inputs usage and land size, were examined to assess their influence on maize yield in the major and minor seasons within the Zone of Influence.

The results indicated that the variables contributed 3.9% to maize yield per hectare in the major season and 3.9% in the minor season. In the major season, inputs usage was the highest contributor to yield per hectare (16.1%, p=0.000) and this was followed by land size (7.7%, p=0.019). Access to extension, trainings and level of education were not significant contributors. However, in the minor season, variables contributed 7.6% to yield per hectare. Land size had the highest contribution to yield per hectare (16.5%, p=0.000) followed by inputs usage (15.8%, p=0.000) whiles access to trainings recorded the least (9.4%, p=0.016) to yield per hectare in the minor season. The baseline indicators are summarized in the matrix below.

Type	Indicator	Baseline 2015					
		Regional	Zone			Sex	
			Ejura	Techiman	Sunyani	Male	Female
Outcome	Yield per hectare for major season (MT/ha)	1.52	1.79	1.44	1.33	1.52	1.52
	Yield per hectare for minor season (MT/ha)	1.27	1.53	1.15	1.14	1.30	1.22
Outcome	Gross margins of maize for major season (GHS)*	525.27	441.02	444.40	747.08	562.73	487.82
	Gross margins of maize for minor season (GHS)*	542.68	499.46	361.81	936.80	597.17	488.19
Outcome	• Number of targeted farmers and others who have applied new technologies or management practices	933	306	324	303	733	200
	• New application of technology	218	69	89	60	169	49
	• Continuing application of technology	715	237	235	243	564	151
Outcome	Value of sales of maize for major season (GHS)	1,804,665.04	508,414.05	822,581.54	473,669.45	1,130,921.05	673,743.99
	Value of sales of maize for minor season (GHS)	1,119,343.35	421,925.50	427,983.01	269,434.84	720,761.94	398,581.41
Output	Number of hectares under hybrid maize, and other new technologies or management practices	2405.8	771.2	841.8	792.8	2081.8	324
Output	Percentage of farmers who applied Pioneer (both yellow and white)	6.7	5.6	11.6	2.6	5.9	9.4
Output	Number of hectares applying pioneer hybrid seed (both yellow and white)	99	23.4	66.4	9.2	77	22
Output	Percentage of farmers with access to agricultural training	18.4	25.8	16.2	13.4	18.3	18.7
Output	Percentage of farmers with access to credit	27.3	30.4	28.7	22.8	27.1	28.1

* The Regional Gross Margin figures are averages from extrapolated values
1USD=GHS 4.1

Generally, the baseline indicators are adequate to support the project implementation processes and performance assessment. Farmers are expectant of the project being fully rolled out in the beneficiary zones.

Recommendations:

From the observations and lessons learnt, the under listed are recommended:

Productivity

- Improve access to hybrid seeds to producers in the value chain to increase farmers' margins.
- Training should be targeted at women to help improve their efficiency in maize production.
- Train farmers on Good Agronomic Practices (GAPs) to improve their production
- Easy access to farm inputs and support services such as credit, tractor services, improved seed and fertilizer should be improved to enhance productivity.
- Provision of adequate and well-structured post-harvest facilities.
- Farmers should be trained on appropriate post-harvest handling of maize to reduce post-harvest losses.

Market access and trade linkages

- To enhance income generation marketing strategies, storage facilities such as silos, credit and technical know-how should be readily available to farmers.
- Nucleus farmers should be supported to enhance the provision of services to the out-growers particularly marketing and storage facilities.
- Facilities such as tractors, harvesters, shellers, tarpaulins and dryers be readily available in communities either for rent or hiring.
- Improve accessibility and linkages between out-growers and nucleus farmers/Aggregators.
- Market systems should be improved to curtail exploitation of farmers by buyers.
- Trainings by MOFA and other organizations should incorporates marketing programs
- Farmers should be exposed to available marketing information and communication platforms such as ESOKO.

Local capacity

- The link between farmers and credit institutions must be enhanced to streamline and help farmers acquire credit.
- Strengthen the capacity of financial institutions providing credit services to farmers.
- More women should be encouraged to go into maize production by enhancing their access to resources
- Farmer based organizations should be encouraged among farmers to enable easy access to credit facilities and enhance experience sharing among members.
- Strengthen leadership capacity of already existing FBOs.
- Encourage the use of group savings to help investment in agriculture.eg VSLA
- Increase extension services and training.
- Individual farmers should be encouraged to have better savings culture.
- Farmers should be trained in record keeping and other relevant management practices to enable them know how well or not their business is doing.

1.0 INTRODUCTION

1.1 Brief Project Background

Agriculture development in Ghana has since independence received massive boost from her development partners. There have been concerted efforts by government and her development partners to ensure the growth of the sector.

The program intervention areas which include Ashanti and Brong Ahafo regions (coverage area for the baseline study) have tremendous agricultural potential and are considered among the most vibrant in terms of agricultural business. But like several other parts of the country, agricultural technology transfer and adoption are considered very slow due partly to under-developed value chains for most food crops including maize. Therefore, the USAID/Ghana Mission Economic Growth (EG) office interventions in Agricultural Development and Value Chain Enhancement (ADVANCE II) Project and its subcomponent, the Advanced Maize Seed Adoption Program (ADVANCE) are appropriate and timely. The latter which is a US$4million, four-year partnership of DuPont-Pioneer and the USAID aimed at increasing the productivity and profitability of smallholder maize farmers in Ghana, is expected to impact on the agricultural production, food security and incomes of the beneficiaries.

The overall goal of the Feed The Future (FTF) program is to sustainably reduce global poverty and hunger. ADVANCE contributes specifically to the strategic objectives of improved nutritional status, especially of women and children; and inclusive agriculture sector growth. ADVANCE adopted a long-term sustainable and comprehensive value chain approach by working through commercial actors as conduits for reaching out to large numbers of smallholders, ensuring that improved practices remain in the market system after the end of the project. The baseline study for ADVANCE hybrid maize component of ADVANCE will enhance the development of a very good performance management plan for the project.

1.2 Program Description, context and rationale

The overall goal of ADVANCE sub-component is to sustainably increase the productivity of smallholder maize farmers and link them to profitable and predictable supply chain systems and markets. Its intermediate results are; (i) increased maize productivity and (ii) increased access to market and trade opportunities. The ADVANCE sub-component will achieve the stated goal of improving farmers' productivity and value chain competitiveness in maize production and directly benefit 13,000 smallholder farmers in the project intervention areas below the 8^{th} parallel through increased gross margins and incomes by leveraging new private sector investment. The project envisages achieving this through a multidimensional strategic framework that strengthens incentives for investment, builds local capacity and broadens and catalyzes relationships to increase agricultural productivity, expand access to markets and trade and improve the enabling environment. Through the judicious use of technical assistance, training, dynamic facilitation and cost-sharing grant funds, the project aims to ensure that private sector actors remain the drivers of change, while Government of Ghana (GoG) and local stakeholders are empowered to lead as facilitators through enhanced capacity building and learning . The approach is underpinned by the wealth of knowledge and established relationships developed in northern Ghana during the implementation of ADVANCE I.

The ADVANCE II Project has been designed by carefully examining the context of Ghana's overall agricultural sector development policy and the USAID Ghana mission's FTF program to ensure optimal system performance. For instance, its monitoring, evaluation and learning

plan (MEL) has been designed to ensure compliance and compatibility with critical continental and national specific policies and projects including, the Comprehensive Africa Agriculture Development Program (CAADP) and Ghana's Ministry of Food and Agriculture's Food and Agriculture Sector Development Policy (FASDEP II). Other strategies, policies, and initiatives considered in designing this MEL plan include the following:

- Feed the Future, the USA Government's global hunger and food security initiative
- USAID Forward: USAID's Reform Agenda
- USAID Evaluation Policy
- USAID Ghana, Multi-Year Strategy to Feed the Future (FTF)
- USAID Ghana, Feed the Future Strategy, Monitoring and Evaluation Plan
- USAID Ghana's Economic Growth office's PMP
- USAID Ghana and GoG Country Investment Plan (CIP)

ADVANCE is one of the activities under USAID Ghana FTF Intermediate Result (IR) 1: increased competitiveness of agricultural value chains and it focuses on maize production. Indeed, the project has been planned to take advantage of the other USAID activities, their overlap with its specific activities, and potential challenges. ADVANCE is intended to coordinate with these other activities to leverage those that benefit its targeted value chains and identify and pursue synergies where there is potential for duplication.

The program intervention regions are considered amongst the most sophisticated and advanced in agricultural business. The project which is aimed, among others, at empowering farmers with better agronomic practices and value chain connectedness will enhance productivity and profitability of maize production in the beneficiary regions. It will also strengthen the actors in the maize value chain including nucleus farmers, aggregators, and small holder farmers. It also seeks to strengthen trade and marketing linkages and improve post-harvest management.

1.3 Objectives of the Assignment

The assignment is a baseline study of ADVANCE in the Brong Ahafo and Ashanti regions. The assignment responds directly to DO2 of the FTF program which encompasses the following:

1. key challenges that constrain broad-based and sustained economic growth including low productivity in agriculture;
2. weaknesses in key agricultural value-chains that limit competitiveness;
3. weaknesses in the business climate that undermine private sector growth and development;
4. disparities in income and economic vulnerabilities along regional lines within Ghana; and
5. Constraints in regional trade within the West Africa sub-region.

The timing of the baseline study is appropriate as FTF projects move into a new phase. This will not only help in getting very good performance management plans for the projects but ensure the achievement of evidence based results needed to inform policy. ADVANCE will be the main focus of the study. The contract to execute the assignment was signed by the offeror on 22nd of December, 2015 for work to effectively begin on the 1st January, 2015.

The specific objectives of the baseline study were to:

- provide knowledge to test the Partners projects' causal pathways as outlined in their Theories of Change (see Figure 3)
- confirm the targets of key indicators

- lay the groundwork for impact assessment
- generate results that will be used to set targets to track output, outcome and impact indicators
- provide the basis of comparison for mid-term review and the final evaluation
- capture the current climate for business and technological development, growth, investment, policy and innovation.

1.4 Specific Tasks and Scope of Work

The specific tasks of the assignment were embedded in the above-mentioned objectives. But more specifically it covered a baseline study for the FTF Program with special focus on the ADVANCE Project.

The assignment is detailed in the SoW attached as Annex 1. It laid emphasis on collecting and testing values for baseline indicators for future impact assessment of the FTF interventions.

1.5 Outputs

The overall output of the assignment is a Baseline Report detailing among others results that will be used to track the outputs, outcomes and impacts of ADVANCE interventions. Specific interim outputs included the following:

1. Inception Report
2. Development of data gathering instruments
3. Enumerators' Training Manual
4. Progress reports
5. Field related outputs (including clean data set with variable and value labels, Syntaxes used for the analysis).
6. A final report

1.6 Organization of the Report

The first section of the report has dealt with the introduction of the study. The rest of the report is structured as follows: section two reviews the literature and presents the conceptual frameworks on food security in the study regions, value chain, theory of change of the ADVANCE project and gross margins in agriculture. These reviews have, in part, guided the study. Section three presents the research methodology of the study. The main findings of the study are presented in section four. Sections five and six present key observations and summary of the indicators framework respectively. The conclusion of the study is presented in section seven while section eight details out the recommendations.

2.0 LITERATURE REVIEW

Key sources of literature have included the ADVANCE performance Management Plans, Feed the Future (FTF) indicators handbooks, FTF M&E Guidance Series Volume 8: Population-Based Survey Instrument for Feed the Future Zone of Influence Indicators and other literature which helped the Consulting Team to gain a better understanding of the project. We have also taken special notice of the Theory of Change of ADVANCE Some highlights from the literature are included in the introduction section of the report, and have also informed the write up in the other sections.
The team also collected information on the crop of interest from PPMED-MOFA and this included production levels, farmer population in terms of gender at regional and district levels. Some data was also sourced from the internet, journals and publications relevant to the study and the ADVANCE regional offices. In the narratives below we have highlighted essential summaries from our literature review.

2.1 Profile of the Zone of influence

Geo-physical characteristics
The ZOI lies between longitude 0^0-3^0W and Latitude 5^0 -7^0N (see Figure 1). It consists of the Ashanti and Brong Ahafo regions with Kumasi and Sunyani as their respective administrative capitals. It has a total land size of 63,947 square kilometers (km^2) forming 26.8% of the total land area in Ghana; Ashanti region represents 10.2% and Brong Ahafo is 16.6%.

The topography of the study area is low lying and gently undulating with height not exceeding 152.4m above sea level. There are also few elevations between 533.7m and 712.6m. Major soils include the forest and savannah ochrosols within the south-western and the north-eastern parts respectively. It is typically drained by the Bosomtwe Lake, Tano, Tain, and Offin rivers.

The area experiences the tropical (hot and humid) climate with temperatures between 24^0C and 32^0C. Rainfall is bi-modal with peaks in May/June and October averaging between 1000mm and 1800mm and an average relative humidity of 75%. The predominant vegetation zones are the moist semi-deciduous forest and Guinea Savanna woodland found mainly in the southern and northern zones respectively.

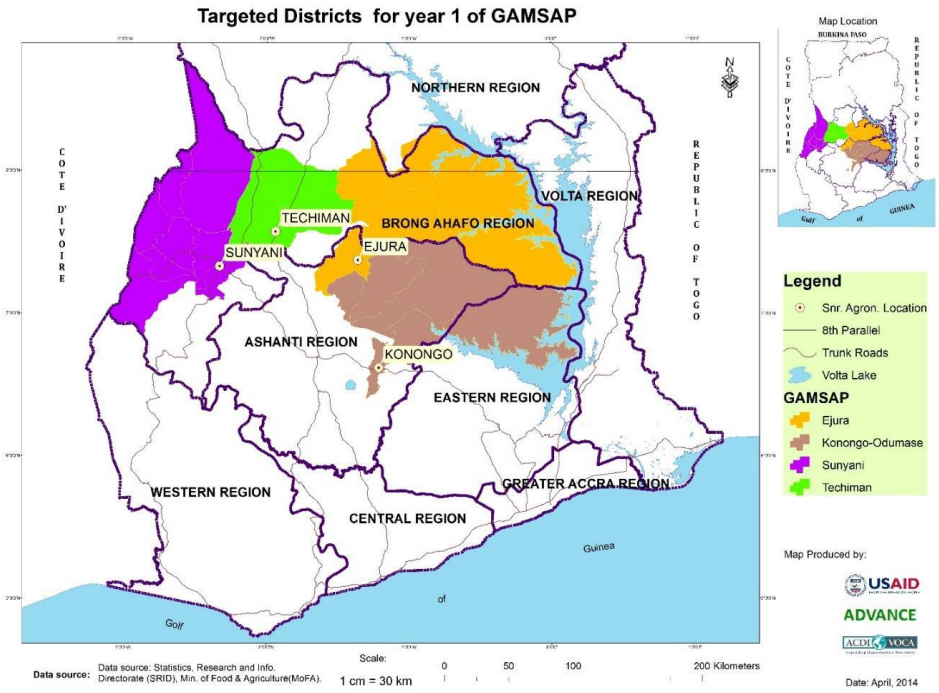


Figure 1: Map of the Zone of Influence

p2.2 Demographic characteristics

The total population of the Ashanti region is 4,780,380 being the most populous region in Ghana (GSS, 2012). The rural population of the region is 1,883,090 and the population density is 196.0 per sq. km is higher than the national average of 103.4 persons per square kilometer. The total number of farm households is 412,055 and total number of farmers is estimated at 602,492 comprising 310,715 males and 291,777 females. The average household size is estimated at 4.1 (GSS, 2012).

The total population of Brong Ahafo Region is 2,310,983 representing 9.4% of the national population. The population comprises 49.6% males and 50.4% females with a rural population of 1,282,510. The region's population density of 58.4 persons per square kilometer (GSS, 2012) is below the national density of 103.4 persons per square kilometer and the average household size is estimated at 4.6 which is higher than the national average of 4.4. The rural population of the region is 1,282,510. The total number of farm households is 490,519 and the total number of farmers is estimated at 608,445, comprising 323,447 males and 284,998 females.

2.3 Agriculture

Agriculture remains the largest economic sector in Ghana employing about 42 percent of the economically active population aged 15 years and older (GSS, 2012). Landholdings in Ghana are typically small. The average farm size is 2.27 ha, and more than 60% of farms are smaller than this average figure (Chamberlin, 2008). The bulk of production is by smallholders who constitute about 80 to 90% of the farming population (PPMED, 1991). Cash crops such as cocoa, citrus, oil palm, and food crops like cassava, plantain, cocoyam, maize and vegetables like okro and tomatoes are the main agricultural produce cultivated in the study area. Large-scale mechanized farming is not common in the study area.
The study area lies in the forest zone and has vast tract of arable land and favorable rainfall patterns. About 60% of land area in both Ashanti and Brong Ahafo regions are arable. In

Ashanti region, about 81% of the arable land is under cultivation as compared to 46% of arable land under cultivation in the Brong Ahafo region (MOFA, 2010). The regions predominantly depend on Agriculture as the major source of income, food supply and employment. The sector is dominant in the study area and therefore any meaningful development effort must necessarily be based on improved performance in the sector.

Livestock production is concentrated within the rural areas in the study zones and forms about 25 percent of agricultural activities (GSS, 2013). Major among the animals kept are poultry (constitutes 64% of total livestock), goat, sheep and cattle (GSS, 2013). Although, livestock rearing is not common within the study area the Atebubu, Kintampo, Pru and Techiman districts in the Brong Ahafo region are increasingly becoming well noted for livestock production.

Fishing is trivial in the study zones contributing 0.5 percent boost to their economy (GSS, 2013). In spite of its little contribution to the country's economy, the Brong Ahafo region is considered one of the best fishing grounds in Africa and the Middle East (Fish maps, 2008). Inland fishing is mainly found along water bodies in Yeji, Sunyani, Dormaa and Tano.

Presently, maize is Ghana's most important cereal crop, accounting for 55% grain output (Angelucci, 2012). Its production is essentially by smallholder farmers under traditional tillage and rain-fed conditions. More than 70% of maize output comes from five regions (Brong-Ahafo, Ashanti, Eastern, Central and Northern) in three of the six agro-ecological zones of the country (guinea savanna, forest savanna transition and semi-deciduous rainforest)., Estimated total annual value of maize is about GH¢1,343.5 million, while the total value of sales is about GH¢977.2 million, or 73 % of harvest value (GSS, 2008).
The cultivation of the crop is characterized by limited use of improved seeds, fertilizer, mechanization, and post-harvest facilities. As a result, average yields are well below attainable level and compounded by high post-harvest losses. However, there is the potential of realizing yields of 4 or 5 tons per hectare with the adoption of improved cropping practices and the use of appropriate inputs e.g. improved seeds (MOFA-SRID, 2006).

Bulk of the country's maize production is from the study area, Brong Ahafo region is the largest maize cultivating region in Ghana accounting for 29% of maize produced in southern Ghana (SRID, 2011). Over the past decade maize production has steadily increased in the region. From 2003 to 2010, maize production has increased from 301 metric tons to 510 metric tons. Ashanti region contributes significantly to the national production of maize with an average yield of 1.65 Mt/ha. The production figures of 2010 as reported by MOFA indicate that the region is the second largest producer of maize in the country, producing 253,375MT.

2.4 Value Chain and agricultural productivity in Ashanti and Brong Ahafo regions

2.2.1 Value Chain

The value chain is a concept which can be simply described as the entire range of activities required to bring a product from the initial input-supply stage, through various phases of production, to its final market destination (Dolan and Humphrey, 2000). The production stages entail a combination of physical transformation and the participation of various producers and service providers to the final disposal after use. The concept stresses the importance of value addition at each stage, strengthening the linkages from one stage to another and thereby treating production as just one of several value-adding components of the chain (Dolan and Humphrey, 2000). The Value Chain is a business-oriented approach, which aims at capturing the best possible value at all stages of input supply, production, processing, trading and consumption (United Nations Industrial Development Organization, UNIDO, 2009).

A typical value chain showing relevant actors is illustrated in Figure 2 below. In a Value Chain, different actors may have different expectations of which some may conflict. For producers it is the expectation of better income through:

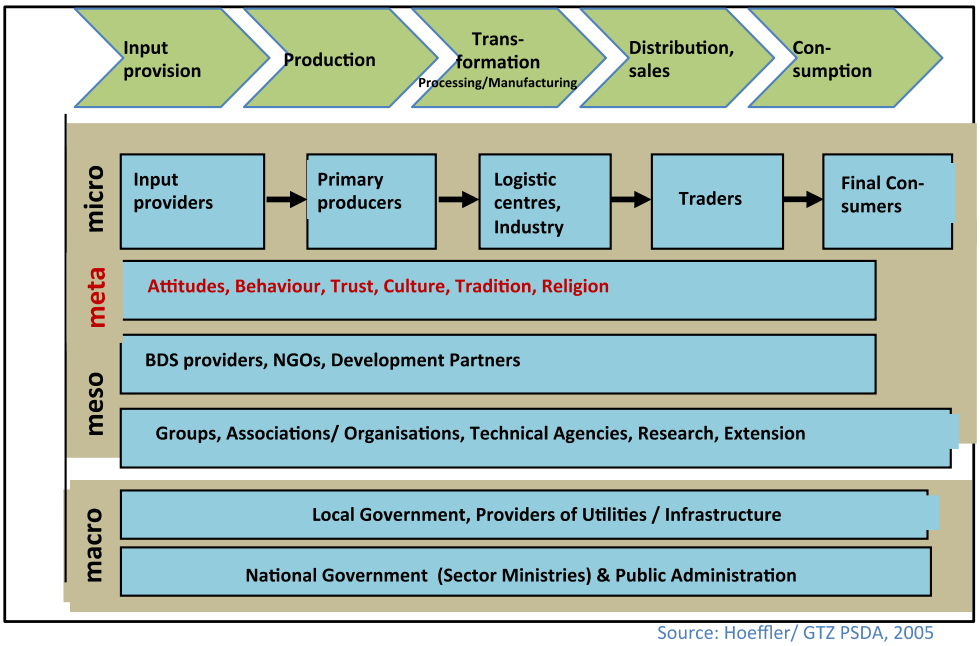
i. improved market access (marketing)
ii. Improved/ wider product offer (value addition).

For processors/ traders/ exporters it is the expectation of:

i. access to more reliable and improved raw materials (supply)
ii. improved/ wider product offer (value addition)
iii. access to more reliable distribution channels (marketing)

For consumers it is better value for money through:

iv. Wider choice of better products
iv. healthier food at affordable prices



Source: Hoeffler/ GTZ PSDA, 2005

Figure 2: Relevant Actors along the Value Chain

The competitiveness of a Value Chain depends on trust, cooperation and effective communication between all actors. The strength of the entire Value Chain depends on the performance of every single partner in the Chain whereas the competitiveness of the final product corresponds to the capacities of the weakest link in the Value Chain (Dolan and Humphrey 2000).

The value chains of maize and rice in Ghana (ADRA, 2008) have structure similar to the traditional ones described above. Indeed, the value chains are comprehensive with all the primary and secondary actors adequately represented. The structure, though fairly comprehensive, most actors of major food value chains in Ghana, including rice, soya and maize, are dormant (Alidou et al., 2010).

It must, however, be noted that for food value chains to function properly there should be cooperation among all actors at every stage of the chain (Bolwig et al., 2008). Commodity Value Chain is an inclusive systems approach to agricultural sector development. The approach promotes pluralism for a vibrant and dynamic agricultural sector, recognizing the diversity that exists in the sector and acknowledging the importance of a range of stakeholders in providing

individual actors especially smallholder farmers' access to continuous productivity and market (Chen et al., 2006).

2.5 Theory of Change of ADVANCE

2.5.1 Consistency with national development Agenda

ADVANCE supports the vision of the Ghana Medium Term Agricultural Sector Investment Plan (METASIP), which is "a modernized agriculture sector culminating in a structurally transformed economy and evident in food security, employment opportunities and reduced poverty". USAID's own Feed The Future (FTF) initiative and other development partner efforts in Ghana recognize the importance of the private sector in increasing agriculture productivity to achieve food security. Ghana's agriculture is dominated by small scale producers, with average farm size of about 1.2 hectares and low use of technology. Maize smallholder farmers also account for over 80% of production, though their yield per hectare averages around 2 tons per hectare and they are not well integrated into coordinated supply chains. ACDI/VOCA will employ tested tools and practices from ADVANCE as well as more recent learning to implement ADVANCE in maize production areas across Ghana.

The TOC of ADVANCE is consistent with the national development agenda of reducing poverty and improving the living conditions of citizens (NDPC, 2010; MoFA, 2010).The emphasis on expanded development of production infrastructure, accelerated agriculture, modernization and agro-based industrial development, enhancing competitiveness in Ghana private sector among others as emphasized in the Ghana Shared Growth and Development Agenda (GSGDA) are well articulated in ADVANCE TOC. An important common link is enhancing competiveness of the private sector, in this case, value chain actors, which is the focus of ADVANCE.

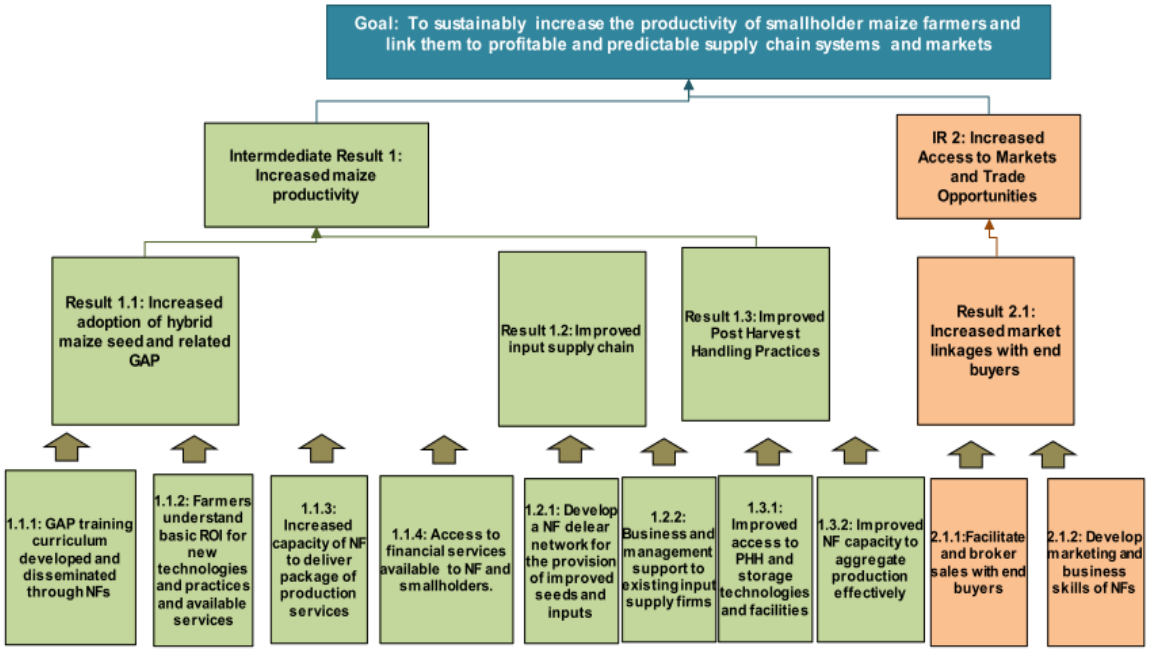


Figure 3: ADVANCE Theory of Change

A critical look at the TOC reveals that investment in complementary infrastructure particularly in transportation is not well elaborated, although mention is made of private and public sectors

support. From rural development point of view, and the general socio-economic conditions in the study area, farmers are ill-motivated when they are unable to sell their produce at competitive prices. Aggregators and other actors in the value chain are also constrained by poor production infrastructure, particularly road and warehousing facilities. However, the TOC lays little emphasis on how the road network and related transport sector will be enhanced by the ADVANCE project. All too often, farmers produce in response to interventions such as those proposed in the ADVANCE TOC only to find that their produce are bought at uncompetitive prices because they are unable to access markets due to poor enabling environment especially poor roads to markets.

2.6 Gross Margins in agriculture

The FTF Indicator Handbook Definition Sheets on the gross margins essentially defines the indicator (gross margin) in its intermediate results 1 (IR 1: Improved Agricultural Productivity) as the difference between the total value of small-holder production (crops, milk, eggs, meat live animals, fish) and the cost of producing that item, divided by the total number of units in production (hectares of crops, number of animals, etc.). And indeed its five points for calculating the gross margin for its project beneficiaries, which is summarized below are no different from those we found in our literature search (Zandstra et al., 1981: p. 63 quoted in FAO, 2014):

1. Total production by direct beneficiaries during the reporting period (TP)
2. Total value of sales (USD) by direct beneficiaries during reporting period (VS)
3. Total quantity (volume) of sales by the direct beneficiary during the reporting period (QS)
4. Total recurrent cash inputs costs (USD) of direct beneficiaries during reporting period (IC)
5. Total units of production hectares planted for crops, total number of animals in /flock/etc. for the direct beneficiary during the production period (UP)

And the formula for the calculation as summarized by the FTF indicator definition for gross margin is: Gross margin per ha, per animal, etc. = [(TP x VS/QS)-IC]/UP. The formula is consistent with others derived by FAO (2014).

The findings of Winter-Nelson and Aggrey-Fynn (2008) cited in Akramov & Malek (2012) suggest that all existing maize farming systems contribute to economic growth and private income generation among farmers in Ghana. It was suggested that there is possibly higher efficiency in maize systems than other cereal systems. However, the authors recognize that these results could be explained, at least in part, by the high prices prevailing in 2007 when the data were collected. The main finding of their study is that more intensive use of inputs, such as fertilizer, could help to make the crop more profitable. Overall, Winter-Nelson and Aggrey-Fynn (2008) assessed the profitability of maize farming in Ghana by dealing with observed average farmers' behavior, implicitly assuming that all farmers behave efficiently.

Akramov & Malek (2012) found that maize production is profitable with or without accounting for family labor in variable input stream. Efficient farmers make substantial positive profits and the society also makes welfare gains from resources allocated to maize production. Therefore, policies based on dissemination of best practices could improve overall efficiency of cropping systems.

3.0 STUDY METHODOLOGY

The approach and methods that were used by the Consultant to carry out the fieldwork (from 16th March, 2015 to 24th March, 2015) were premised on our understanding that, a baseline study simply defines the 'pre-operation exposure' condition for the set of indicators that will be used to assess achievement of the outcomes and impact expressed in the program's logical framework (WFP, n.d). The data gathering instruments used (see Annex 3) were prepared based on the general purpose of baseline study, which is to provide an information base against which to monitor and assess an activity's progress and effectiveness during implementation and after the activity is completed (USAID, 2006). The study findings and its recommendation will also help the project to better frame the implementation strategy.

Both quantitative and qualitative data were collected for the study. The Consultant worked in close collaboration with the two M&E Coordinators, Regional Coordinators and their M&E support staff (ADVANCE task team).

3.1 Sampling methods and procedures

The sampling frame for the survey included all potential beneficiaries of the targeted implementation areas of the two regions and other value chain beneficiaries, i.e. smallholders, aggregators, members of farmer based organizations, production and business development service providers in the targeted regions. The sample was randomly selected from farmers from each district in the potential beneficiary communities. The Consultant worked within this sampling frame matrix which was agreed upon with the Zonal Coordinators during the reconnaissance survey.

The selection processes were based on enumeration areas (EAs) as per the 2010 Ghana Population Census using the probability to size method. A multi-stage sampling was used to select districts, communities and ultimately farmers for the survey in conformity to the suggestions by the Zonal Coordinators and the Project Director. Sample size that was representative to give a reliable data set was surveyed. And in doing so, we were guided by the fact that the sample should be randomly selected from farmers from each district in the beneficiary communities and the sample must include not less than 40% females.

Sample Size Determination

As a best practice, the sample size used in the study was statistically representative; it was based on 95% confidence level and 5% error margin, of all the potential beneficiaries in all regions. This was applied to both sexes, the target commodity, and as permitted by available population figures, of all potential beneficiary types. Provision for non-response was set at 10%.

Looking at the potential beneficiaries, the Consultant used a statistical formula for the determination of the sample size at 95% confidence level and +/-5% confidence interval (5% margin of error) as given below:

$$\boldsymbol{n = \frac{N}{1 + N\,(\propto)^2}}$$

Where:
N= Proportionate commodity frame
n= Sample size
α = confidence interval
α =0.05= Confidence level 95%
The final sample sizes were determined based on proportionate sampling method with 100,000. The sample size was 941 maize farmers.

The sample sizes selected at the household levels were further stratified into the following groups:

- Regional Level
- District Level
- Community Level

The disaggregation of the sample size is shown in Annex 5.The total sample used in the study was 941; this was arrived at by adding the ten percent non responsive to actual calculated sample size.

3.2 Data collection

3.2.1 Quantitative data collection method

Survey objectives
The main objective of the quantitative survey was the collection of the baseline values of the impact and outcome indicators for the ADVANCE (see SoW, Annex 1).

Mode of Data Collection
Data was collected in two phases. Phase 1 included but not limited to technologies and management practices applied, input cost, size of farm, commodity setting, and other qualitative information. Phase II involved crop cut area, technology and management practices for the yield estimated. The second phase of the survey was to complete the data needed to calculate Gross Margin of the value chain commodity; maize. We employed efficient and effective supervision of the enumerators and their supervisors which ensured high level of quality and enhanced data cleaning exercise.

Pretesting of Questionnaires
Draft questionnaires were carefully prepared and pretested in 15 households comprising potential beneficiaries of ADVANCE. This helped in determining appropriateness of the questions, formatting and wording, appropriateness of verbal translation of questions to respondents, readiness of trained data enumerators for the task and it also allowed for revision of the questionnaire.

Training of Field Enumerators
Field enumerators were trained prior to the field data collection. They were trained in community entry and given hands-on training in proper administration of questionnaires in similar communities as part of the pre-testing of the questionnaires. Emphasis was placed on the quality assurance procedures that were agreed with the Client. The processes were facilitated by the Team Leader, the supervisors and some selected members of the team.

Field work
The under listed steps were followed:

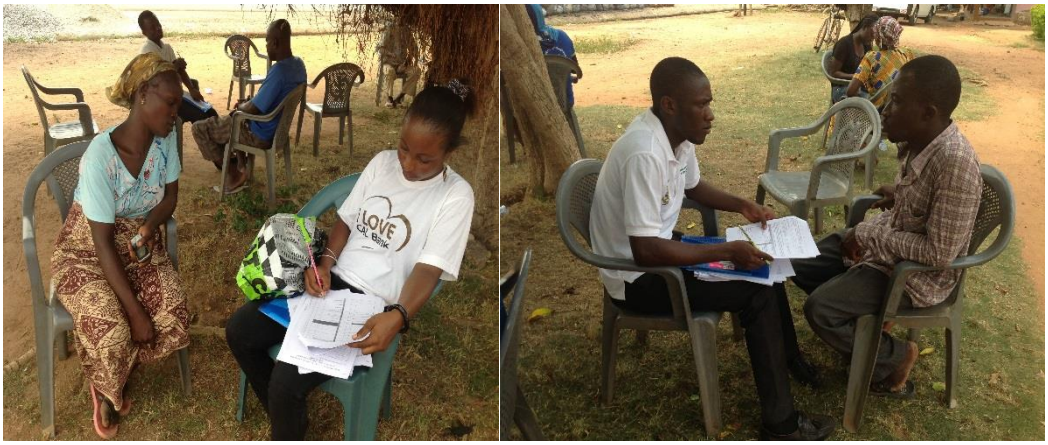
- field enumerators were paired or grouped to serve as 'self-supporting and complementary';
- itineraries were worked out for each pair or group and revised when it became necessary;
- transportation arrangements, routes used to get to destinations were agreed upon in collaboration with the Client, to cover the itineraries i.e. to and from sampled

communities within the ZOI was worked out to enhance timely deployment of enumerators
- The field supervisors of the enumerators were experienced Assistant Research Fellows of the Consulting Firm.

3.2.2 Qualitative data collection method

To complement the quantitative data, some qualitative information were collected from Government Institutions, Input Dealers, Farmer Based Organizations, Nucleus Farmers, Aggregators, Transporters, Financial, Insurance, and ICT Institutions acting in the value chain of the three project commodities. Interview schedules were used (see Annex 3) to facilitate focus group discussions and key informant interviews of selected key resource persons/subject matter experts in the areas concerned by the baseline survey. The focus groups comprised mainly of men and women groups of out-grower farmers.

The key informant interviews and the focus group discussions were facilitated by the Team Leader and his Deputy with some support from the Supervisors. We used informal discussions to probe issues and concerns of the beneficiaries, and made relevant observations all of which provided additional anecdotal data for the interpretation of the quantitative data and provided recommendations for the project implementation strategy.



Face-to-face interviews with farmers

Data Entry and Analysis

Responses to the questionnaires were re-coded for statistical analysis using the Statistical Package for Social Scientists (SPSS Version 20.0). Data was analyzed following the guidance of USAID/Feed the Future and the Partners' PMPs. SPSS was used for quantitative data entry and analysis. Atlas Ti, a qualitative data analysis software was used to transcribe data (written and voice recordings). Recordings of focus group discussions and key informant interviews were played and transcribed.

Disaggregation of data was done to bring out gender and zonal comparisons. The Consultant ensured that the disaggregation of data was done to reflect key variables as appropriate, and as required by the Feed The Future indicators handbooks and the Partners' PMP. All processing and analysis steps were recorded under syntaxes which the Consultant is obliged to hand over to the Partners among the deliverables. The raw data is also to be handed over with the Final Report to the client.

In order to minimize clerical errors and enhance accuracy, data from field were entered by the enumerators and re-entered by the Consultant in separate groups. The two datasets were compared, cleaned and merged. The statistical approaches used in assessing the effect of one variable on the other using variable indicators came from both the ADVANCE and the BIRD Teams.

A cross-section of focus group participants

3.3 Study limitations

- Few females were readily available for the study, hence their less representation.
- Farmers used the recall method to provide information on production levels, cost of inputs and sales. Some of the information received might not be accurate in the absence of documented records; probing and prompting were used to get farmers to give close to approximate figures; the errors emanating from these were also minimized by triangulating the information with other farmers in the communities through focus group discussions and key informant interviews
- Some respondents were unclear about their farm sizes. Interviewers had to probe to obtain approximate sizes.

4.0 MAIN FINDINGS

4.1 Demographic and Social Profile of Respondents

Socio-demographic characteristics are important factors that could have implications on an individual's development trend (Leinbach, 2003) and are relevant for agricultural policy formulation. For instance, Gupta and Malhotra (2006) have observed that in many African contexts, age and sex could influence a person's contribution to decision making in the family. The baseline study therefore explored the respondents' characteristics in terms of sex, age, marital status, household size, educational status and housing.

4.1.1 Sex and age distribution of respondents

Gender disaggregation of the respondents as shown in Figure 4 indicates that within the zones, male farmers were more than females. From a total of 941 respondents, 78.4% were males and 21.6%, females. Females were not readily available, hence, their less representation. It was mentioned that maize farming is labor intensive and women prefer crops such as cassava and plantain. Significantly, Sunyani recorded the highest (86.6%) and least (13.4%) proportions of males and females respectively.

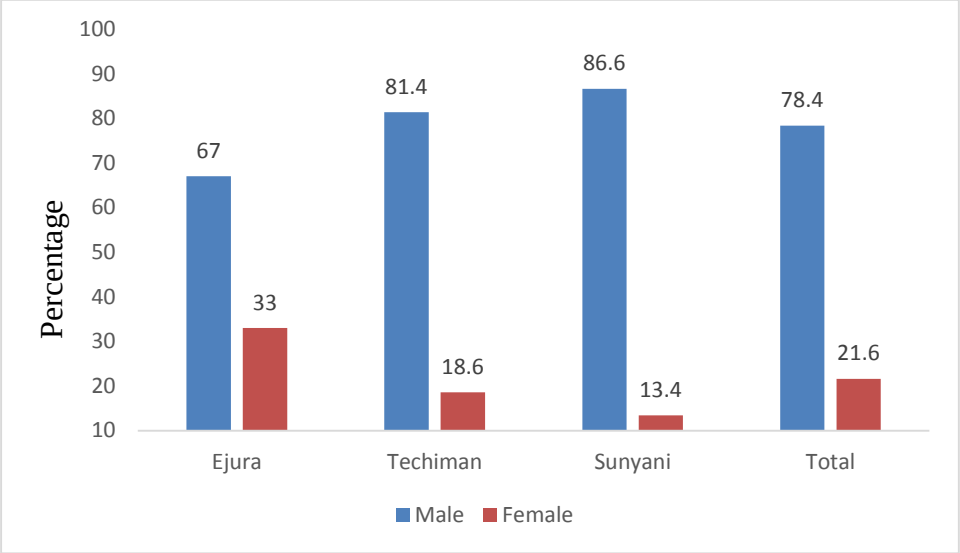


Figure 4: Distribution of respondents by gender and zones

Table 1 shows that 15% of respondents were below 30 years and about 76.1% were between 31 and 60 years. The study indicates that the mean age of the respondents was 43years. The minimum age was 17years whilst the maximum age was 85years. The majority (76.1%) of respondents were within the economically active group.

Table 1: Distribution of Age of respondents by gender and zone

Age of Respondent	Ejura				Techiman				Sunyani				Total	
	Male		Female		Male		Female		Male		Female			
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
<30	26	8.5	14	4.5	45	13.7	6	1.8	43	14	7	2.3	141	15
31-40	63	20.6	29	9.5	83	25.3	21	6.4	73	23.8	14	4.5	283	30.1
41-50	57	18.6	25	8.2	62	18.9	13	4	78	25.4	9	2.9	244	25.9
51-60	30	9.8	26	8.5	57	17.4	18	5.5	49	16.0	9	2.90	189	20.1
Above 60	29	9.5	7	2.3	18	5.5	3	0.9	19	6.2	2	0.7	78	8.3
Don't know					2	0.6			4	1.3			6	0.6
Total	205	67	101	33	267	81.4	61	18.6	266	86.6	41	13.4	941	100

4.1.2 Marital status of respondents

In the survey conducted across the three (3) zones it came out that 82 percent of the respondents were married. Across the ZOI, some farmers stated that married people in the society are seen to be more responsible and as such marriage is greatly upheld. The percentage of married people in the survey was higher than that of the national average of 58.5 percent (GSS, 2010). It is well documented that marital status can influence the roles and responsibilities as well as occupation of members of households and their families (Dennis &Peprah, 1995).

Table 2: Distribution of Marital status by gender across zones

Zones	Gender	Married (%)	Single (%)	Divorced (%)	Separated (%)	Widowed (%)
	Male	57.5	3.3	1.6	1.3	3.3
Ejura	Female	22.2	1	2.6	1.3	5.9
	Male	70.7	6.1	1.2	1.5	1.8
Techiman	Female	12.2	0.9	2.2	0	3.4
	Male	73.3	6.8	2.9	1.6	2
Sunyani	Female	10.1	0.3	1.6	0.3	1
Total		82	6.2	4	2	5.7

Generally, the study revealed that most male respondents (48.4%) in the zones had attained formal education than the females (12%). From Table 3 majority of respondents had no formal education (39.5%) and this was high among males in Ejura (31.0%). Among all respondents only 23 males (2.4%), had received tertiary education. None of the female respondents had received tertiary education.\

Education among surveyed female respondents in the ZOI showed that majority (44.3%) of them had no formal education, followed by 30.5% who have had JSS/JHS education. Also, 17.7% and 7.4% of the respondents had primary and SSS/Voc. education respectively. Techiman had the highest percentage of female respondents (65.60%) with no formal education and Sunyani (22%) with the least (See Annex 6).

Table 3: Educational levels by gender and zones

Zones	Gender	None		Primary		JSS/JHS/MSLC		SSS/SHS/Voc./ Tech		Tertiary	
		N	**%**	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Ejura	Male	95	31.0	34	11.1	55	18.0	18	5.9	3	1.0
	Female	41	13.4	18	5.9	34	11.1	8	2.6	0	0.0
Techiman	Male	101	30.8	51	15.5	60	18.3	48	14.6	7	2.1
	Female	40	12.2	9	2.7	10	3.0	2	0.6	0	0.0
Sunyani	Male	86	28.0	28	9.1	108	35.2	31	10.1	13	4.2
	Female	9	2.9	9	2.9	18	5.9	5	1.6	0	0.0
Total		372	39.5	149	15.8	285	30.4	112	11.9	23	2.4

4.1.3 Household composition

The household types were categorized into male no female, male and female and female no male.

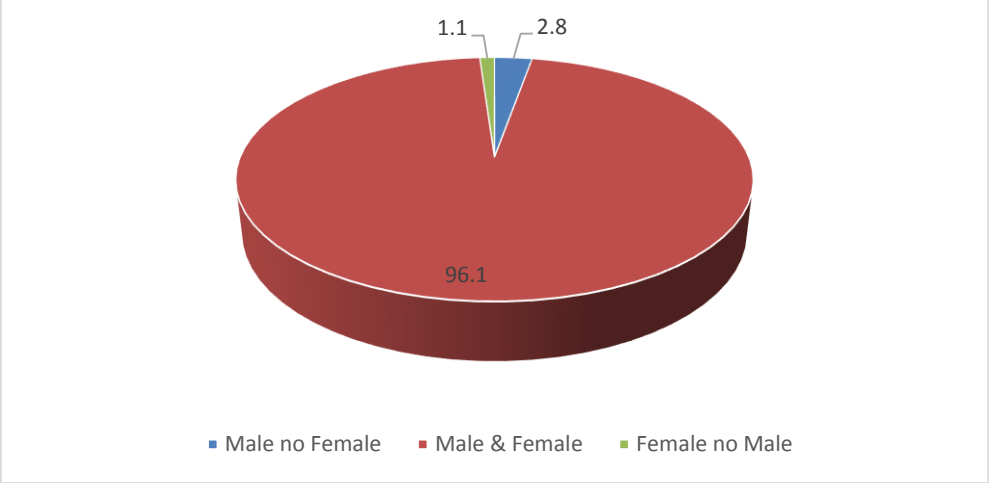


Figure 5: Distribution of household composition of respondents

From Figure 5 households were predominantly male and female (96.1%). Households with male no female made 2.8% and households with only female no male was 1.1%. There was no respondent with household type of child no adult. And this clearly shows that in the Ghanaian culture the marriage institution and the external family system have a central place in the social structure.

Table 4: Household Size distribution by zone

Zone	Household size distribution	N	Mean	SD
Ejura	Number of children under 0-5yrs	202	1.99	1.36
	Number of children under 6-17yrs	254	2.86	1.71
	Male Adults over 18yrs	291	1.92	1.37
	Female Adults over 18yrs	302	1.93	1.44
Techiman	Number of children under 0-5yrs	211	1.81	1.19
	Number of children under 6-17yrs	269	2.19	1.29
	Male Adults over 18yrs	324	2.01	1.27
	Female Adults over 18yrs	309	1.90	1.27
Sunyani	Number of children under 0-5yrs	193	1.97	2.41
	Number of children under 6-17yrs	258	2.97	1.79
	Male Adults over 18yrs	297	1.94	1.51
	Female Adults over 18yrs	277	1.84	1.44

Large household sizes could adversely affect the wealth and health of the members of the household. Household sizes have a direct effect on household wealth, which influences nutrition and poverty (Agbaje et al., 2013). According to the survey the average household size was 7.17 (SD = 4.03) which is higher than the regional average (4.3) of the study area.

4.1.4 Religious status of respondents

Three major types of religion were captured; Christianity, Islam and Traditional Religion. Figure 6 shows that 54.9% of households were Christians and 40.9% were Muslims with, 2% being traditionalist and only 2.2% of respondents forming other religions. Thus Christians dominate in the zones.

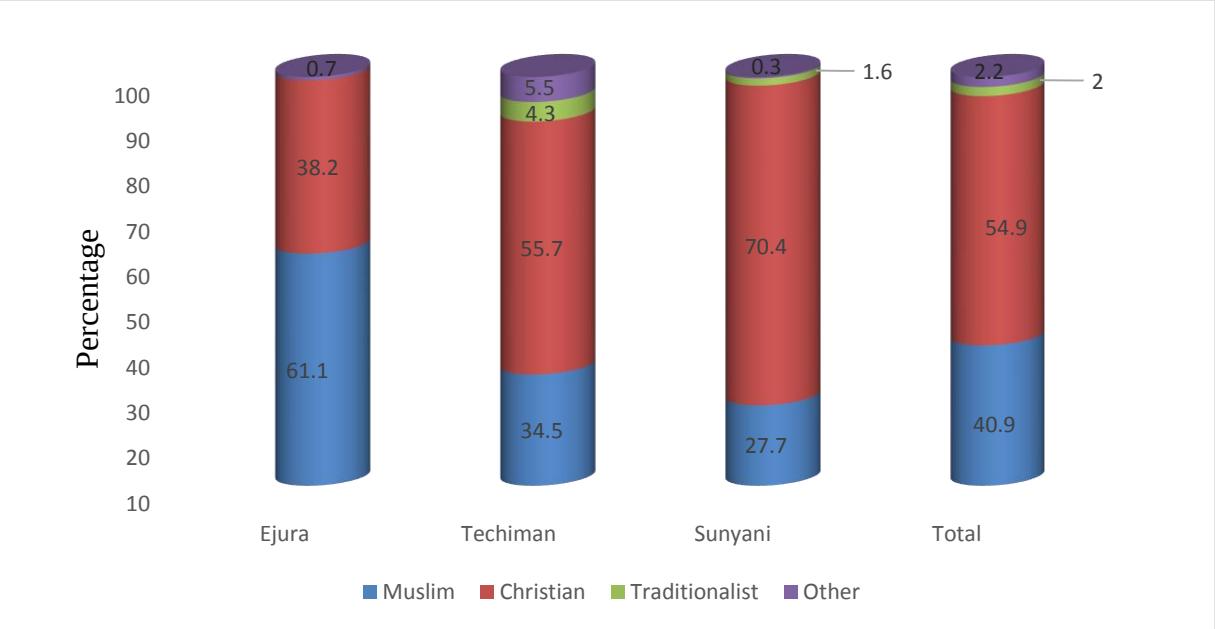


Figure 6: Distribution of respondents by Religion

4.1.3 Housing and Services

Table 5 depicts houses are mostly owned by respondents (59.6%) across the study area. This is consistent with GLSS -5 results indicating that 59% of rural dwellers in Ghana own the houses they live in (GSS, 2008) while a relatively small section (22.8%) live in family houses. Renting of houses is not common among respondents as only 12.2% confirmed such occupancy status. Free dwelling and Temporary shelter are however not significant in the study regions as attested by 4.9% and 0.5% of respondents respectively. Significantly, Techiman recorded the largest proportion (68.6%) of houses owned by respondents, with no temporary shelter whereas Ejura had the highest dwellers (31.8%) in family houses across the study regions, with no free dwellings.

Table 5: House occupancy status

	Ejura		Techiman		Sunyani		Total	
Occupancy Status	**N**	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Own	169	55.2	225	68.6	167	54.4	561	59.6
Renting	39	12.7	36	11	39	12.7	114	12.2
Dwelling provided for free			24	7.3	22	7.2	46	4.9
Temporary shelter	1	0.3			4	1.3	5	0.5
Family house	97	31.8	43	13.1	75	24.4	215	22.8

Construction materials for walls were mostly concrete/brick and accounted for 68.4%, 58.5% and 54.6% in Sunyani, Ejura and Techiman respectively. Mud was mostly used in the Ejura Zone (39.9%). Bamboo (0.6%) was the least used construction material for walls across the ZOI.

Table 6: Materials used for wall structures

Materials	Ejura (%)	Techiman (%)	Sunyani (%)	*Total (%)
Concrete/Brick	58.5	54.6	68.4	60.4
Wood	1.6	4.6	5.2	3.8
Mud	39.9	39.3	26.1	35.2
Bamboo	0	1.5	0.3	0.6
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

Aluminum sheet was the major roofing material in the ZOI, recording 84.2%. The use of Thatch was high in Techiman (22.3%) and low in Sunyani (3.9%). Bamboo was the least used roofing material across the ZOI (2.8%). The quality of building in the Sunyani zone was comparatively better.

Table 7: Roofing materials of buildings

Type of roofing	Ejura (%)	Techiman (%)	Sunyani (%)	*Total (%)
Aluminium sheets	85.6	73.2	94.8	84.3
Thatch	12.1	22.3	3.9	13
Bamboo	2.3	4.6	1.3	2.8
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

Water and sanitation

From Table 8, borehole served as the primary source of drinking water for respondents across the ZOI (58.1%). Piped water was higher in Sunyani (34.9%). Stream/pond/river as a primary source of water was significantly higher in Techiman (31.1%).

Table 8: Sources of water

Source	Ejura (%)	Techiman (%)	Sunyani (%)	*Total (%)
Supply Water (piped)	4.2	19.5	34.9	19.6
Borehole	89.9	35.7	50.5	58.1
Own tube well	0.7	3	7.2	3.5
Neighbor's tube well		6.4	1.3	2.7
Community tube well	1.3	4.3	3.5	3.1
Stream/River/Pond	3.9	31.1	2.6	13
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

From Table 9 open field defecation was common in the Ejura (30.4%) and Techiman (20.4%) zones. From Focus Group Discussions, respondents indicated the absence of toilet facilities in the communities as the main cause of their actions. Traditional pit latrine was the predominant toilet facility used in Techiman (59.1%) and Sunyani (47.6%). Ejura recorded the highest

(54.2%) in the usage of improved pit latrine. Septic tank as a toilet facility was recorded only in Sunyani (1.3%).

Table 9: Toilet facility

Toilet facility	Ejura (%)	Techiman (%)	Sunyani (%)	*Total (%)
None (open field)	30.4	20.4	1.3	17.4
Traditional pit latrine	14.4	59.1	47.6	40.8
Improved pit latrine	54.2	19.2	44.3	38.8
Septic Tank	0	0	1.3	0.4
WC linked sewer	1	1.2	5.5	2.6
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

ENERGY

Electricity from the national grid, Charger Light and Lantern constitute the major sources of lighting across the ZOI representing 71.8%, 21.7% and 3.5% respectively. This suggests that electricity use in rural households has increased over the years as against 27% of rural households' electricity use in 2008 (GLSS-5; GSS, 2008). Ejura records both the highest (83.3%) and lowest (1.6%) proportion of electricity and Lantern use respectively. Sunyani records the highest (25.7%) use of Flashlight across the study area.

Table 10: Sources of lighting

Source	Ejura (%)	Techiman (%)	Sunyani (%)	*Total (%)
Electricity (government provided)	83.3	63.1	69.7	71.8
Private Generator			1.3	0.4
Solar Electricity	0.7	0.9	1	0.9
Kerosene		1.9		0.6
Candles		3		1.1
Lantern	1.6	6.4	2.3	3.5
Charger Light (torch flashlight)	14.4	24.7	25.7	21.7
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

Generally, the study shows the predominant use of firewood (78.5%) and charcoal (17.4%) as the main sources of energy for cooking, affirming the IMANI survey (2014) that a large proportion of rural populace in Ghana use firewood and charcoal for cooking. Results in the various zones clearly indicates that, highest amongst firewood users are households in Techiman (83.5%) and a significantly higher charcoal users of 26.8% in Ejura. This notwithstanding, the use of LPG for cooking is quiet substantial (6.2%) in Sunyani as shown in

Table 11.

Table 11: Sources of energy for cooking

Source	Ejura (%)	Techiman (%)	Sunyani (%)	*Total (%)
Electricity	1	0	0.7	0.5
LPG	0.7	2.7	6.2	3.2
Kerosene	0.7	0.3	0	0.3
Firewood	70.9	83.5	80.8	78.5
Charcoal	26.8	13.4	12.4	17.4
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

4.2 Harvesting and post-harvest handling

4.2.1 Harvesting

Harvesting is the operation of gathering the useful part or parts of a crop or plant. Delaying harvest until the crop has reached a very mature stage, could be a simple and low-cost measure to increase dietary starch. Harvest at a lower dry matter content may result in low starch contents and wasteful losses. The survey found that less than 10% of the respondents across the ZOI did not harvest at maturity. Sunyani recorded the highest percentage of farmers who did not harvestat maturity (13%) whilst Ejura recorded the least (1%) as shown in Figure 7.

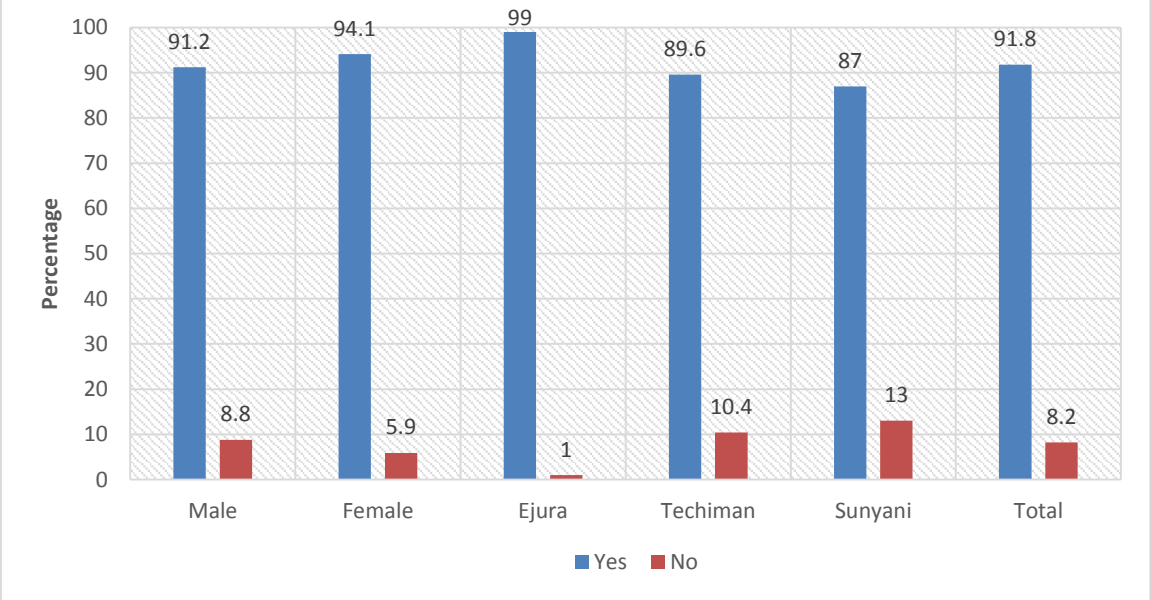


Figure 7: Ability to harvest at maturity

There were several reasons why farmers did not harvest their crops at maturity. These included; no labor available, other activities in this period, lack of storage facilities. Unavailability of labor (84.4%) was the major reason why farmers were not harvesting at maturity across the ZOI.

From the survey, more than 88% of farmers across the ZOI did not harvest green maize as shown in Figure 8. Only 11.4% of farmers harvested green. On zonal basis, Ejura recorded the highest percentage (16 %) for harvesting in green while Sunyani recorded the least (2.3 %). On

gender basis, 11.8% (males) and 9.9% (females) harvested green. This indicates most farmers harvest when the crop has reached a much matured stage.

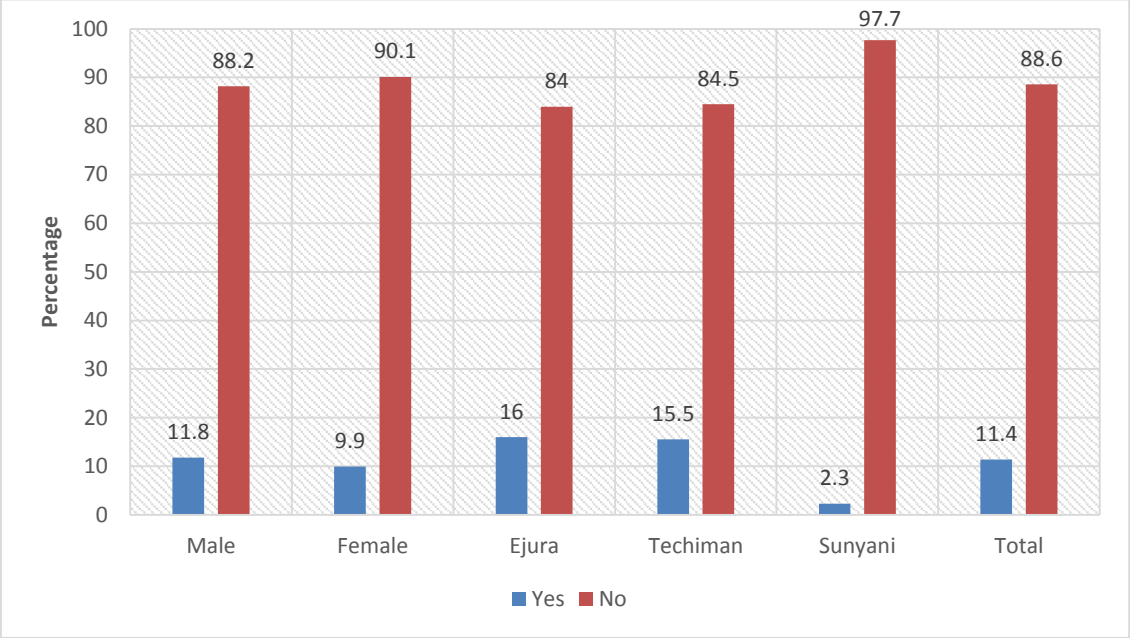


Figure 8: Harvesting green maize

From the survey, 70.1% of the respondents encountered a situation where the cobs of maize were not well covered by the husk at harvest. Ejura recorded highest (86.9%) followed by Sunyani and Techiman recording 67.8% and 56.7% respectively as shown in Figure 9. Among female respondents, 79.3% recorded cobs not well covered by the husk whereas 67.6% of males recorded such situation. Among all respondents, 71.3% sort out certain cobs after harvest. The criteria used for sorting out cobs were; color, cob size, grain size, damage and color and damage. Damage was the main criteria for sorting recording 55.1% followed by color (15.5%). Majority (55.3%) of the respondents sort their harvested maize on the farm while 24% did so at the village and 20.7% at the site of the storage facility (See tables in Annex 7).

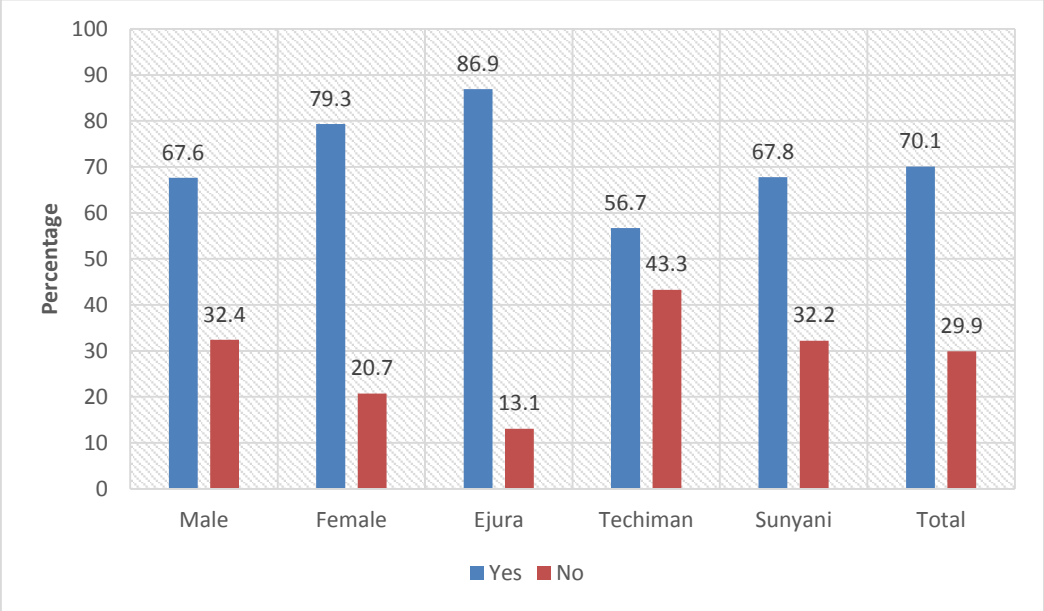


Figure 9: Cobs well covered by husk.

Farmers store their maize in different states. Maize is either stored in husked, dehusked or shelled states after harvest. Majority (43.1%) of the respondents shelled their maize before storage while 35.2% stored their maize in the dehusked state as shown in Annex 9.
Across the ZOI, most farmers (90.8%) cleaned their storage facilities before storing their produce. Ejura recorded the least respondents who did not clean their storage facility before storage (7.8%).

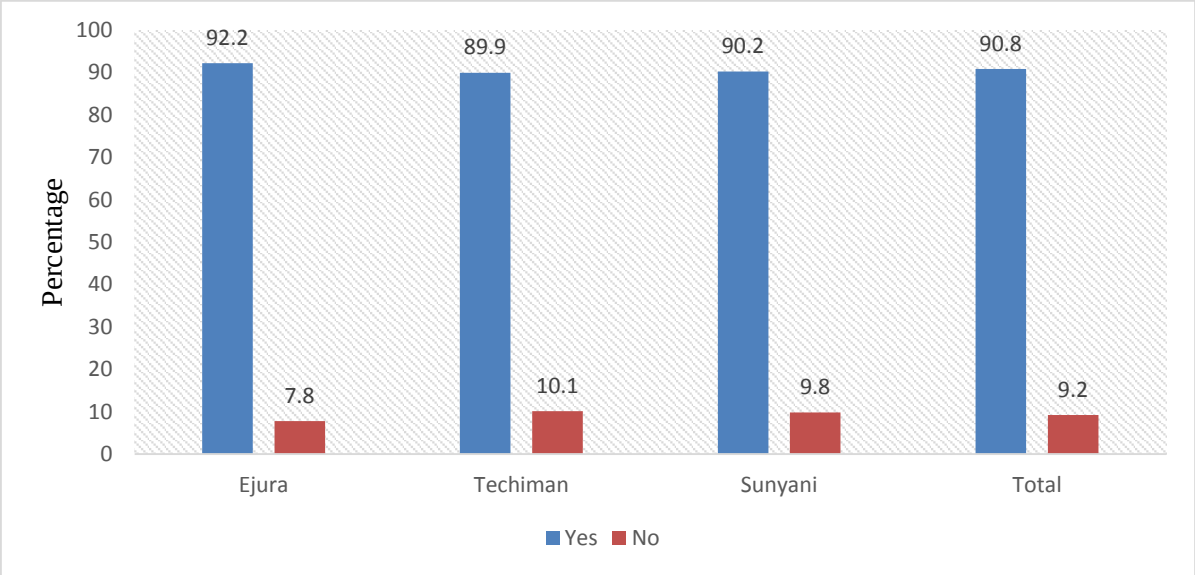


Figure 10: Cleaning facility before storage of maize

Insect pests and diseases play a significant role in reducing production and productivity. Storage facilities are treated before storage to reduce insect, pest and disease infestation. A significant number of respondents (67.4%) treated their storage facilities before storage across the ZOI. Techiman recorded the highest percentage of respondents (51.5%) who did not treat their storage facilities while Sunyani recorded the least (15.3%) as shown in Figure 11. The methods of treatment that the farmers used were application of insecticide/pesticide, manure, smoke and ash. About 98% of the farmers used insecticide/pesticide in treating their storage facilities before storage (see Annex 10).

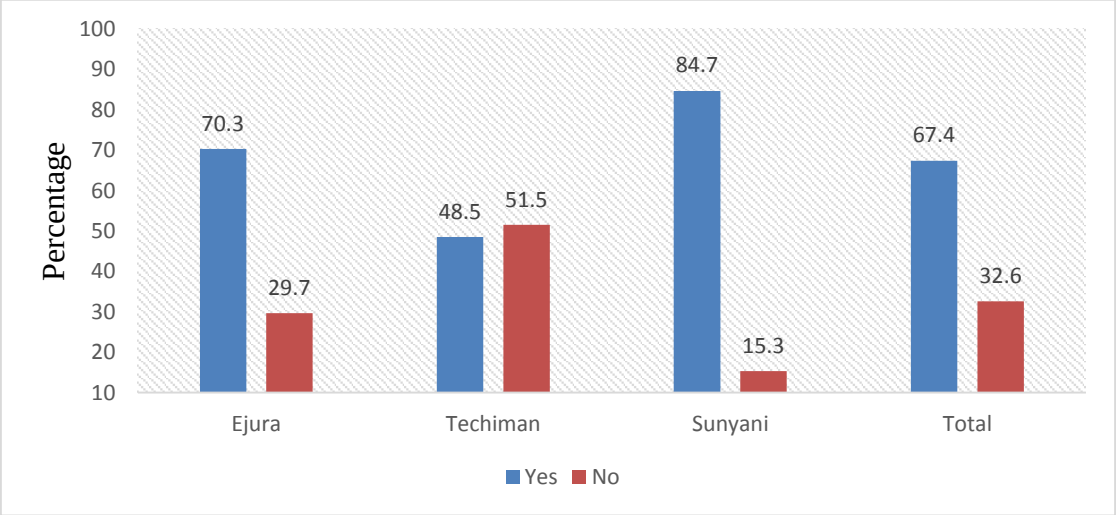


Figure 11: Treatment of storage facilities before storage

Generally, 61.5% of farmers have their storage facility located at their residence, 30.9% on their farms and 7.6% in the villages. Majority of farmers in Ejura (90.1%) had their storage facility located at their residence. Techiman recorded the highest percentage (47.4%) of farmers who had their storage facility at their residence. As shown in Figure 12, there was not much difference between Sunyani and Techiman in terms of storage facility location.

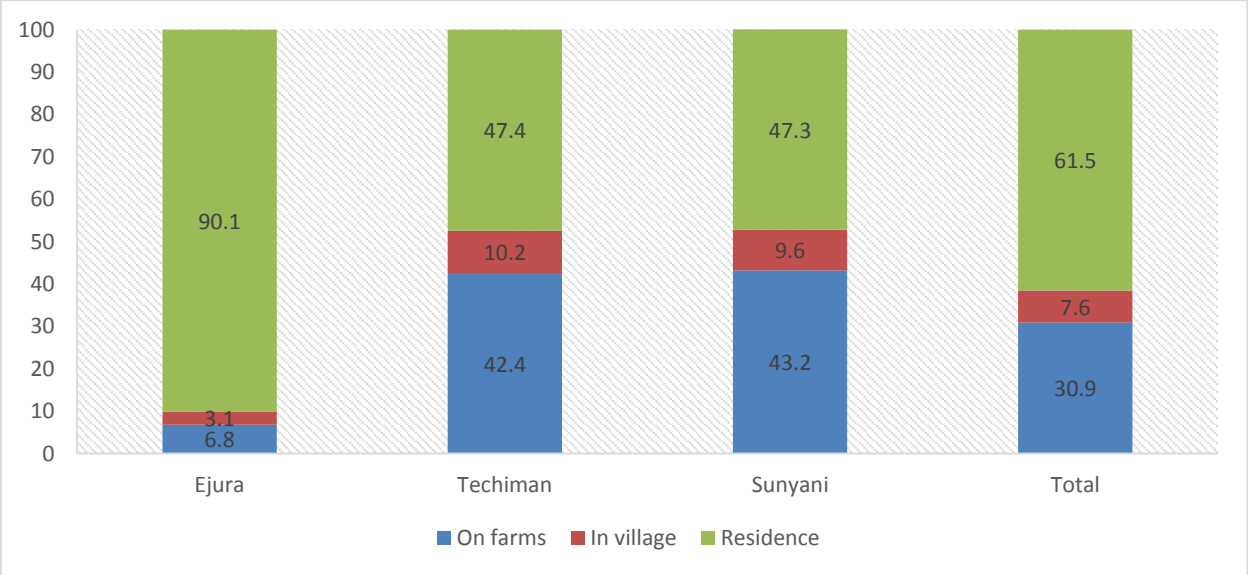


Figure 12: Location of storage facility

Chemicals are used in treating maize in storage to reduce insect pest infestation. The study revealed that 52.9% of the farmers did not use chemicals to treat maize in storage. Sunyani recorded the highest (64.8%) of respondents who used chemicals in treating maize in storage as shown in Figure 13. Most farmers did not use chemicals in treating maize because produces were not stored for longer periods.

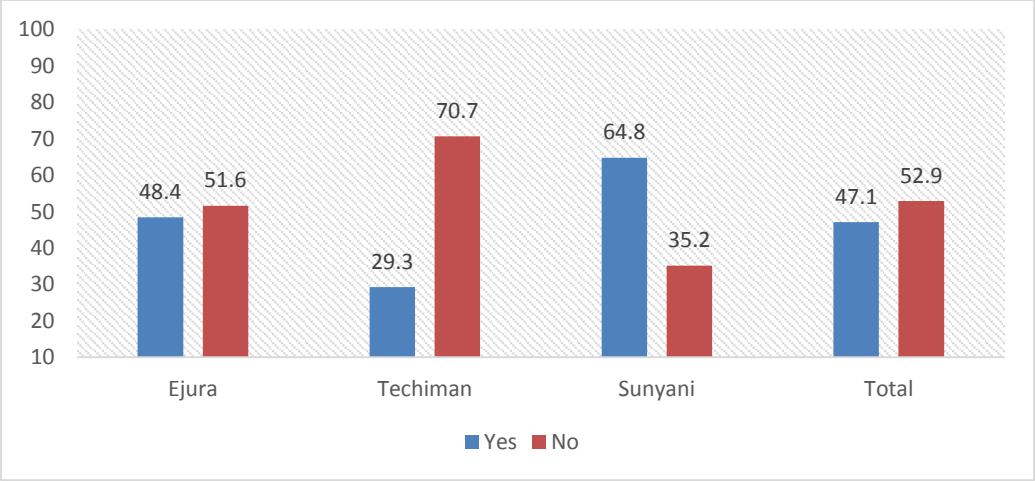


Figure 13: Use of chemicals for treating maize in storage

4.2.2 Post-Harvest Handling

The principal objective in any maize storage system is to maintain the stored grains in good condition so as to avoid deterioration both in quantity and quality. However, most farmers sell off their maize grains cheaply soon after harvesting due to anticipated losses in storage and later

buy food at higher prices. There are improved storage structures that can prolong the storage duration until market prices for grains are favorable. Some of the storage facilities or structures farmers used in the ZOI were Traditional granaries (crib), Indoors-in baskets/bags, Indoors-open storage, Outside-open storage and warehouses. The major problems in using these structures are attack by rodents, weevil infestation, moisture and theft. The type of storage facility used by respondents in the ZOI and their estimated capacity are displayed in Annex 11 and Annex 12. Adequacy of storage structures used by farmers, major problems associated with the use of these structures and their estimated seasonal losses are shown in Annex 13 to Annex.

Traditional granary

Silo

Traditional granaries (cribs) were the storage structure that most farmers used in the ZOI recording 41.3% with Sunyani recording the highest (60.6%). About 64% of respondents revealed that traditional granaries were adequate for their storage purposes. The major problems with using these structures were attacks by rodents (45.5%) and weevil infestation (38%).

Less than 16% of the respondents in the ZOI used Indoors-in baskets/bags as a storage structure. 22.9% of the farmers used this structure in Ejura with Sunyani recording the least 3.3%. 86.6% of the farmers in the ZOI revealed that Indoors-in baskets /bags is adequate for their storage purpose. Attacks by rodents (66.4%) were the major problems associated with using this structure.

Farmers in Ejura (40.5%) used Indoors-open storage to store maize. Generally, 25.1% of the respondents in the zone used indoors-open storage. 83.7% of the respondents found it adequate using this structure to store maize. Attack by rodents (70.6%) is a major problem in indoors-open storage.

An underutilized warehouse in Ejura *Community-based storage facility in Dromankuma*

Generally, 11.2% of the respondents in the ZOI used Outside-open storage. Farmers in Techiman recorded highest (15.5%) in using this structure. 81.9% of the farmers found it adequate in using outside-open storage. The major problem associated with using this structure is attack by rodents (41.4%), weevil infestation (28.6%), moisture (21.4%) and theft (8.6%).

Certified warehouse recorded the least in structures being used to store maize. Less than 1% of the farmers in the ZOI used this structure. All the farmers who used the structure indicated they were satisfied with its usage.

Farmers used different methods for harvesting maize. These methods were; cutting the whole stalk, collecting the ears, bending the stalk before harvest to let it dry then harvest. 73.6% of the respondents across the ZOI cut the whole stalk of their maize plant when harvesting while 20.5% bend the stalk before harvest to let it dry then harvest.

Maize is harvested in bits or at once by farmers. 71.9% of the respondents harvested their maize at once across the ZOI. Sunyani recorded highest in farmers harvesting in bits (43.6%) and Ejura recorded lowest (3.9%) as shown in Figure 14. The reasons for harvesting in bits by farmers were labor problems, non-uniform drying, and lack of storage facility. Labor problem (95.8%) was the main reason farmers harvested in bits.

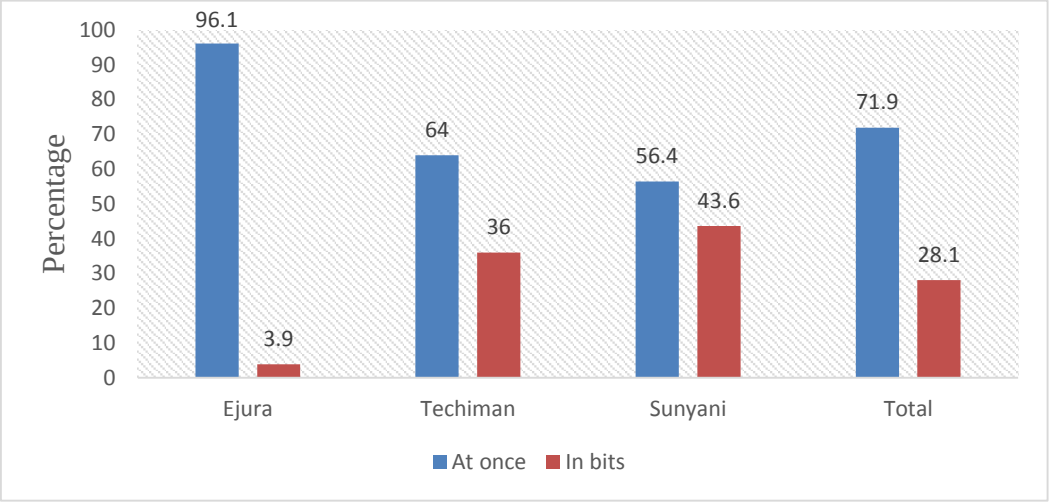


Figure 14: Pace of harvesting.

4.3 Farming characteristics and practices

4.3.1 Land tenure

Land tenure system in Ghana, especially in the rural areas, is still predominantly communal. Communal land ownership is the expression used to describe the system whereby land is collectively owned by an extended family, clan or community of ancestrally related people with the control or administration of the vested in the leader or appointee (Gyasi, 1995).

Access to land: Although all household members have free access to family land, the socio-cultural setting of most African societies have always tended to favor males to be more dominant and acquire more resources than females and hence having relatively higher incomes (Keele et al., 2005; Duze and Mohammed, 2006).

The study revealed that land access differed among the communities across the various zones. Land was mostly accessed through; inheritance, renting and sharecropping. Apart from these

means of accessing land, there were instances where farmers paid tokens for usage of land; this was common in the Ejura zone.

4.3.2 Land ownership

From the survey, majority of respondents either rented or use family land for farming while a few had purchased lands. Across the ZOI, 32.4% of the surveyed farmers obtained their lands by renting whiles 30.8% were family lands. The highest percentage of farmers who rented land was found in Ejura (43.5%) with the least in Techiman (14.7%). On gender basis, land ownership among males and females did not differ much as 92 percent males and 91 percent females were land owners. Farm lands were mainly family and rented lands among both sexes. There were more females (20.2%) who obtained land through inheritance than males (16.4%). However, among the zones, respondents in Ejura did not practice sharecropping. Techiman also recorded the highest response for inheritance (33.8%). Land obtained as gift was generally low among the zones with Techiman having the highest and the least in Ejura; 7.9% and 3.3% respectively.

4.3.3 Average farm sizes

Table 12 gives the mean acreage of all agricultural lands owned by respondents on zonal and gender basis. Most people in the ZOI have land holdings averaging above 5.00 hectares except in the Techiman zone (4.12 ha). The mean acreage for the males was higher than females in all zones with the highest in Sunyani (7.79 ha).

Table 12: Agricultural lands in Hectares by Zone and Gender

Zone	Male			Female			Total		
	Mean	SD	Sum	Mean	SD	Sum	Mean	SD	Sum
Ejura	5.57	5.32	1142	3.91	3.32	394.4	5.02	4.82	1536.4
Techiman	4.42	4.44	1179	2.84	2.86	173	4.12	4.23	1352
Sunyani	7.79	23.92	2073.2	3.62	2.89	148.4	7.24	22.33	2221.6
Total	5.95	14.92	4394	3.53	3.12	715.8	5.43	13.33	5110

Major season average Farm sizes

From Table 13, the mean farm size for most farmers in the major season is low (less than 3.00ha) with the highest (2.76ha) in Techiman and lowest (2.32ha) in Ejura. Females had low average farm sizes (1.70ha) across the ZOI.

Table 13: Major season average Farm sizes in hectares

Zone	Total			Male			Female		
	Mean	SD	Sum	Mean	SD	Sum	Mean	SD	Sum
Ejura	2.32	2.33	694.20	2.60	2.50	516.80	1.77	1.83	177.40
Techiman	2.76	2.50	849.40	2.98	2.65	750.20	1.77	1.24	99.20
Sunyani	2.74	5.02	837.00	2.94	5.34	778.80	1.42	1.47	58.20
Total	2.61	3.52	2380.60	2.86	3.84	2045.80	1.70	1.61	334.80

Minor season average Farm sizes

Table 14 shows the average farm size for the minor season across the ZOI. The mean farm sizes in the minor season were low with the highest being 2.74ha for the Sunyani zone and Techiman having the least (2.43ha). Females had an average farm size of 1.67ha while males had 2.78ha. However, a careful comparison of the average farm sizes between the minor and major seasons showed that the average land size in the Ejura zone increased in the minor season; 2.32ha against 2.48ha. In Techiman zone, however, the average farm size decreased from 2.76ha in the major season to 2.43ha in the minor season but the average farm size for Sunyani remained the same.

Table 14: Minor season average Farm sizes in Hectares

Zone	Total			Male			Female		
	Mean	SD	Sum	Mean	SD	Sum	Mean	SD	Sum
Ejura	2.48	2.59	693.08	2.79	2.74	529.28	1.84	2.14	163.80
Techiman	2.43	2.58	570.40	2.64	2.75	502.00	1.52	1.35	68.40
Sunyani	2.74	5.85	528.20	2.94	6.23	494.20	1.36	1.27	34.00
Total	2.53	3.77	1791.68	2.78	4.13	1525.48	1.67	1.83	266.20

4.3.4 Technology and management practices

This section presents technologies and their application among farmers in the ZOI. The percentage users of crop genetic and improved agronomic practices are displayed in Table 15. New users of the technologies are shown in **Error! Reference source not found.**. Percentage users and new users of post-harvest, weather mitigating, ICT and water management technologies by gender and zones in the ZOI are displayed in
Annex 14 and Annex 15. Cultural practices, management practices and disease management technology users and new users are presented in Annex 16 and Annex 17. Annex 18 and Annex 19 show the land allocated to technologies by zones and gender. All percentages were determined relative to the number of farmers within gender and zone.

Land based Technologies

Across the ZOI, weedicide application is the most practiced technology among surveyed farmers, with 890 farmers (94.58%) practicing the technology. Row planting, fertilizer application and minimum tillage are other technologies with relatively high usage. Row planting was practiced by 803 farmers (85.33%), 538 farmers (57.17%) practiced fertilizer application whiles 529 farmers (56.2%) practiced minimum tillage. However, among users of these technologies, the percentage of new users across the ZOI did not exceed 5%. The practice of all these technologies was comparatively higher in the Ejura zone. For example, 304 farmers (99.35%) and 301 farmers (98.37%) in the zone were found to practice row planting and weedicide application respectively. Zero tillage was practiced among farmers only in Sunyani (67.10%) and Techiman (45.43%).

On gender basis, fertilizer application was high among females in the Ejura zone with 100 farmers (99.01%) practicing the technology. This was however low in the Sunyani zone with only 3 female farmers (7.2%) being fertilizer users. Except for zero tillage, percentage of female users of weedicide application, insecticide application, and row planting was high among

females in Ejura than Techiman and Sunyani. The practice of zero tillage was high among females in Sunyani (60.98%). Among male farmers across the ZOI, weedicide application, row planting and fertilizer application was high in Ejura and low in Sunyani. However, Sunyani recorded the highest percentage of new users in row planting (11.54%) and fertilizer application (27.78%).

Generally, Obaatanpa recorded the highest percentage usage of 31.46% (296 framers) and this portrays farmers' reliance on local varieties. On zonal basis, Obaatanpa was used by 193 farmers (62.87%) in Sunyani, 65 farmers (19.82%) in Techiman and 38 farmers (12.42%) in Ejura. Pioneer 30F32 (White maize) was used by 36 farmers (3.83%) whilst 27 farmers (2.87%) were users of Pioneer 30Y87 (Yellow Maize) across the ZOI. Techiman zone recorded the highest percentage usage of the Pioneer seed. There were 44 male (5.9%) and 19 female (9.4%) users of the Pioneer seed. The application of crop genetic technologies was low among farmers in Sunyani; users of all hybrid seeds did not exceed 5%.

Table 15: Percentage users of crop genetic and improved agronomic practices across zone and gender

	Ejura						Techiman						Sunyani						Total users	% of farmers (N=941)
	Male (N=205)		Female (N=101)				Male (N=267)		Female (N=61)				Male (N=266)		Female (N=41)					
	Users	% Users	Users	% Users	Total	% of Total	Users	% Users	Users	% Users	Total	% of Total	Users	% Users	Users	% Users	Total	% of Total		
Pioneer 30Y87 (Yellow Maize)	6	2.93	3	2.97	9	2.94	13	4.87	3	4.92	16	4.88	2	0.75	0	0	2	0.65	27	2.87
Pioneer 30F32 (White Maize)	6	2.93	2	1.98	8	2.61	13	4.87	9	14.75	22	6.71	4	1.50	2	4.88	6	0.33	36	3.83
Other Hybrid Seeds	3	1.46	1	0.99	4	1.31	59	22.10	16	26.23	75	22.87	2	0.75	0	0	2	0.65	81	8.61
Pan 53	1	0.49	0	0	1	0.33	10	3.75	2	3.28	12	3.66	3	1.13	0	0	3	0.98	16	1.70
Pan 12	0	0	0	0	0	0.00	14	5.24	0	0	14	4.27	4	1.50	1	2.44	5	1.63	19	2.02
Etubi	0	0	0	0	0	0.00	0	0	0	0	0	0.00	0	0	0	0	0	0.00	0	0
Mamaba	0	0	0	0	0	0.00	13	4.87	1	1.64	14	4.27	1	0.38	0	0	1	0.33	15	1.59
Obatanpa	22	10.73	16	15.84	38	12.42	59	22.10	6	9.84	65	19.82	167	62.78	26	63.41	193	62.87	296	31.46
weedicide	202	98.54	99	98.02	301	98.37	262	98.13	57	93.44	319	97.26	235	88.35	35	85.37	270	87.95	890	94.58
insecticide	63	30.73	27	26.73	90	29.41	12	4.49	7	11.48	19	5.79	20	7.52	2	4.88	22	7.17	131	13.92
Planting in rows	203	99.02	101	100	304	99.35	233	87.27	52	85.25	285	86.89	188	70.68	26	63.41	214	69.71	803	85.33
Fertilizer	199	97.07	100	99.01	299	97.71	163	61.05	37	60.66	200	60.98	36	13.53	3	7.32	39	12.70	538	57.17
Minimum Tillage	205	100	101	100	306	100.00	118	44.19	39	63.93	157	47.87	56	21.05	10	24.39	66	21.50	529	56.22
Zero Tillage	0	0	0	0	0	0.00	131	49.06	18	29.51	149	45.43	181	68.05	25	60.98	206	67.10	355	37.73

Analysis of land allocation to various land related technologies in terms of gender and zone indicated that, weedicide application has the most extensive land allocation. Across the ZOI, 890 farmers allocated 2400.4 Ha to weedicide application. Row planting, fertilizer application and minimum tillage were allocated total acreage of 2038.4 Ha, 1512.8Ha and 1278.6 Ha respectively in the study area. Insecticide application was allocated the most land in the Ejura zone (248.4 Ha) compared to the other zones. Within the zone, whilst most land was allocated to row planting, there was no land allocated to zero tillage. The zone also tops in fertilizer application (765.4 Ha) and minimum tillage (772 Ha). Most land was allocated to weedicide application (804.6 Ha) in the Sunyani zone, followed by row planting (596.6) and zero tillage (575.8). This trend was not different in the Techiman zone, however 200 farmers within the zone allocated 564.6Ha to fertilizer application. Among these technologies, insecticide application recorded the least (361.4 Ha) land allocation across the ZOI.

The study revealed Obaatanpa as the seed with most land allocation. Across the ZOI, 296 farmers allocated 831.2 Ha to the cultivation of Obaatanpa with an average acreage of 2.81 Ha. Pioneer 30F32 (White Maize) and other hybrid seeds were allocated 64.4 Ha and 201 Ha respectively. Land allocation to hybrid seeds was least in the Ejura zone. Apart from Obataanpa which had land allocation of 133.8 Ha, all lands allocated to other hybrid seeds did not exceed 30 Ha. Obaatanpa was allocated comparatively most lands (503 Ha) in the Sunyani zone. In the Techiman zone, 43.6 Ha was allocated to Pioneer 30F32 (White Maize).

Annex 18 displays the gender disaggregation of land allocation to land based technologies. More lands were allocated to technologies by males than females. Whereas 48 female farmers allocated 87.6 Ha (average of 1.8Ha) to the cultivation of Obaatanpa, 743.6 Ha (average of 3.0Ha) was allocated to the same technology by 248 male farmers. On an average, female farmers apply fertilizer on 1.73 Ha whiles their male counterparts apply fertilizer on an average land of 3.19 Ha. Among both males and females, weedicide application had the largest area allocation.

Application of Post-harvest, weather mitigating, ICT and water management technologies

Percentage users and new users of post-harvest, weather mitigating, ICT and water management technologies by gender, zones and the ZOI are displayed in
Annex 14 and Annex 15. Sheller (84.91%), tarpaulin (54.52%) and multi-purpose thresher (30.18%) were the mostly used postharvest technologies among farmers across the ZOI. Usage of these technologies was high among farmers in the Ejura zone, recording 99.02% and 95.42% in tarpaulin and Sheller usage respectively. Less than 10% among users of all post-harvest technologies were new. Only two male respondents were found to be users of climate mitigation technologies across the ZOI. Mulching was practiced by 8 farmers (0.85%) across the ZOI as a water management technology. However, there was no record of irrigation among surveyed farmers. Silo, power tiller, irrigation, Ignitia weather update and Weather Crop Insurance Index are among the least practiced technologies among farmers, with less than one percent of farmers using these technologies. Accessing information by farmers was mainly through radio. This is indicated by the high percentage of farmers using the technology relative to the use of the Esoko platform. Across the ZOI, 312 farmers (33.16%) were users of farm radio, among which 28 (8.97%) were using the technology for the first time. The Esoko platform was not popular among farmers in the ZOI; only 11 farmers were found to be users of the technology. Apart from one farmer from the Sunyani zone, all users (11) of the technology were from the Techiman zone. There were no users of Esoko in the Ejura zone. Only one female was found to be using the technology.

Sheller used by farmers

Application of improved management practices, cultural practices and disease management technologies

Sustainability planning, book keeping and farm budgeting are the technologies that were comonly used among all farm business management practices across the ZOI. Sustainability planning was practiced by 84 farmers (8.93%), users of book keeping were 78 (8.29%) while farm budgeting was practiced by 60 (6.38%), majority of these users were not new to the technologies. Among the management practices, costing and pricing, warehouse receipt and SMS did not record a project wide percentage usage exceeding 3% of surveyed farmers. The application of these technologies was high among farmers in the Sunyani zone, recording the highest percentage usage among the top three management practices. IPM as a disease management technology was mostly used by farmers in Ejura (5.56%) and Techiman (4.27%) with Sunyani recording the least percentage of users (1.30%). (See Annex 16 The study revealed that, maize is cultivated as a sole crop by majority of farmers (58.34%) in the study area and this is mostly among farmers in the Ejura zone; where 98.04% of farmers had use the practice. Other cultural practices with relatively high usage were rotation with leguminous crops and land fallowing. Among users of these technologies, there were 38 farmers (15.64%) who were practicing rotation with leguminous crops for the first time while 30 farmers (16.30%) were also new to land fallowing. Cover cropping was practiced by 19 farmers (2.02%) across the ZOI with Techiman recording the highest percentage (3.05%) of usage and Sunyani recording the least (1.63%).

Among users of all improved management and cultural practices there were more males compared to females. Among farmers who were practicing book keeping, there were 69 males (9.35% of males) as compared to 9 females (4.43% of females). This trend is not different from the application of other management and cultural practices (see Annex 17).

Determinants of Technology Application

The section below discusses the distribution of farmers by number of technologies applied, application index and factors influencing the application indices. Application Index (AI) is computed as a percentage of technologies in continuous usage relative to all technologies under consideration. A total of 44 technologies were considered. The technologies ranged from crop genetic, climate mitigation, post-harvest handling, ICT and business management as well as pest, soil and water management.

The number of farmers and technologies that are in new usage were found to be very small across all zones. For instance, a typical farmer was found to use only 2 technologies at most, for the first time. The numbers of technologies that are continuously being used were higher

and vary significantly from one zone to the other (see the f-statistics and p-values of the test of means in

Table 16). Whereas across the ZOI, about 8 technologies were continuously used by a typical farmer, fewer technologies are used by farmers in Sunyani (6 technologies on the average). Farmers in Ejura used more technologies than the zonal average (8) whereas those in Techiman equal the Zonal average. Number of technologies used continuously is most in Sunyani as revealed by the relative sizes of the standard deviations in

Table 16. The differences amongst the zones could be partly attributed to variations in exposure of the farmers to maize production. For instance, in the Ejura zone which had the highest mean of technology usage, farmers were found to have been well exposed to various forms of agricultural technologies. Indeed, the study revealed that the advantage farmers in this zone have over the others was that the Ejura zone has the largest number of larger scale maize farms and a long history of exposure to demonstration sites. The differences could also be due to the number of training farmers in the zones might have benefited from. For example, the study revealed that the Ejura zone recorded the highest percentage (25.8%) of farmers who had attended trainings in the last farming season whilst in the Sunyani zone 13.4% farmers had attended such trainings.

Table 16 also shows that rate of usage of the technologies under consideration are generally low as it averages only 18% across the 3 zones. The three zones are ranked in descending order of technology application index as Ejura, Techiman and Sunyani with 21%, 18% and 15% application indices respectively.

The study also revealed as shown in Table 17 that the number of technologies a maize farmer may use newly or continuously has no relationship with the gender of the farmer. No significant difference was recorded between the number of technologies used by female and male farmers.

Table 16: Descriptive statistics for number of technologies used across the Zones

Zone	Statistics	Number of technologies		Application Index (%)
		Continuous	New	
Ejura	Mean	9.15	1.33	20.79
	N	306	69	306
	SD	1.37	0.63	3.11
Techiman	Mean	7.74	2.39	17.59
	N	324	89	324
	SD	1.89	2.02	4.28
Sunyani	Mean	6.40	1.68	14.54
	N	303	60	303
	SD	2.84	1.20	6.45
Total	Mean	7.77	1.86	17.65
	N	933	218	933
	SD	2.38	1.54	5.42
	F-stat	128.85	10.56	128.86
	p-value	0.00	0.00	0.00

Table 17: Number of technologies used and application index by gender

Gender	Statistics	Number of technologies			Application index (%)
		None	Continuous	New	
Male*	Mean	-	7.73	1.89	17.57
	N	5	733	169	733
	SD	-	2.44	1.56	5.54
Female*	Mean	-	7.89	1.76	17.93
	N	3	200	49	200
	SD	-	2.18	1.49	4.96
Total	Mean	-	7.77	1.86	17.65
	N	**8**	**933**	**218**	**941**
	SD	-	2.38	1.54	5.42
	F-stat		0.684	0.304	0.685
	p-value		0.408	0.582	0.408

* The number of male and female farmers who use some technologies continuously and those who did not practice any of the listed technologies is equal to the sample size of 941. Those who are new practitioners were also found to be continuous users of some selected technologies. Therefore, adding the figures across would not add up to the sample size because of the multiple responses.

Table 18 shows the number of farmers practicing a given number of technologies. Column 3 of Table 18 shows the number of technologies used without regard to time of commencement. It is thus not a sum of the number of new and continuous users as displayed in this table per se. Since very few farmers were encountered as new users, the study explored further the gender and zonal distribution of number of technologies continuously used by maize farmers. The results as displayed in Table 18 shows that most farmers regardless of gender and location within the zones, used between six (6) and ten (10) technologies out of a possible forty four (44). About 70% of males use this number whereas 76% of females used a similar. At the zonal level, a least 84% of the farmers in Ejura and Techiman and 45% of those in Sunyani also used between Six (6) and ten (10) improved technologies.

Table 18: Distribution of farmers' by number of technologies in continuous usage

Farmer categories		**Number of Technologies used**						
		≤ One	**2 - 5**	**6-10**	**≥ 11**	**Total**	**χ^2 test**	**Pearson χ^2**
Gender	Male	13	145	514	66	738	Value	3.968
	%	1.76	19.65	69.65	8.94	100.00	df	3
	Female	4	29	155	15	203	p-value	0.265
	%	1.97	14.29	76.35	7.39	100.00		
Zone	Ejura	0	1	260	45	306	Value	256.593
	%	0.00	0.33	84.97	14.71	100.00	df	6
	Techiman	6	35	271	16	328	p-value	0.000
	%	1.83	10.67	82.62	4.88	100.00		
	Sunyani	11	138	138	20	307		
	%	3.58	44.95	44.95	6.51	100.00		
	Total	17	174	669	81	941		

%	1.81	18.49	71.09	8.61	100.00	

Determinants of technologies with wide continuous application

Improved technology usage is not only low but also concentrated on just a limited array of technologies. As shown in Table 19, only 10 technologies have percentage usage rate exceeding 30%. Most of these technologies relate to improved agronomic practices including; soil management (row planting, fertilizer application, minimum and zero tillage), pest management (weedicides application), and post-harvest handling (use of shellers, Multipurpose threshers and tarpaulins). Weedicide application, the most predominantly used technology, is continuously practiced by 92% of all farmers. The next technologies with highest percentages of farmer usage include use of shellers (82%), row planting (81%) and mono cropping (57%). These top ten technologies also double as the top 10 most practiced among male and female maize farmers with only slight modification in ranking. An assessment of technology specific determinants of usage was done for the top ten technologies because farmers were more interested in soil, pest and post-harvest related technologies. Determinants of multiple usages of technologies were evaluated using a series of logit models and the results are as shown in Table 19.

Table 19: Distribution of ranking of technologies in continuous usage among maize farmers

Rank	Type of technology	Male		Female		Total	
		Mean	SD	Mean	SD	Mean	SD
1	Weedicide	92.14	0.27	92.12	0.27	92.14	0.27
2	Sheller	81.71	0.39	83.25	0.37	82.04	0.38
3	Row planting	80.08	0.40	84.73	0.36	81.08	0.39
4	Mono cropping	53.93	0.50	69.95	0.46	57.39	0.49
5	Fertilizer	50.95	0.50	67.49	0.47	54.52	0.50
6	Minimum tillage	49.46	0.50	71.92	0.45	54.30	0.50
7	Tarpaulin	47.29	0.50	63.05	0.48	50.69	0.50
8	Zero tillage	41.19	0.49	21.18	0.41	36.88	0.48
9	Farm radio	29.27	0.46	33.00	0.47	30.07	0.46
10	Multi-purpose thresher	29.13	0.45	31.03	0.46	29.54	0.46
11	Obatanpa	26.56	0.44	22.17	0.42	25.61	0.44
12	Crop rotation	20.46	0.40	27.09	0.45	21.89	0.41
13	Pioneer white	18.97	0.39	11.33	0.32	17.32	0.38
14	Land fallowing	17.89	0.38	11.33	0.32	16.47	0.37
15	Insecticide	11.92	0.32	17.73	0.38	13.18	0.34
16	Weighing scale	12.47	0.33	5.42	0.23	10.95	0.31
17	Moisture meter	11.65	0.32	4.43	0.21	10.10	0.30
18	Inter cropping	10.43	0.31	7.88	0.27	9.88	0.30
19	Sustainability planning	8.67	0.28	6.90	0.25	8.29	0.28
20	Recordkeeping	8.81	0.28	4.43	0.21	7.86	0.27
21	Other hybrid seed	7.32	0.26	7.88	0.27	7.44	0.26
22	Crop budgeting	7.18	0.26	3.94	0.20	6.48	0.25
23	IPM	3.79	0.19	1.97	0.14	3.40	0.18
24	Sale receipts	3.52	0.18	1.97	0.14	3.19	0.18
25	Pricing costing	2.17	0.15	2.96	0.17	2.34	0.15
26	Pioneer yellow maize	1.76	0.13	2.46	0.16	1.91	0.14
27	Warehousing	1.90	0.14	0.99	0.10	1.70	0.13
28	Cover cropping	1.63	0.13	1.48	0.12	1.59	0.13

Rank	Type of technology	Male		Female		Total	
		Mean	SD	Mean	SD	Mean	SD
29	Erosion control	1.22	0.11	1.48	0.12	1.28	0.11
30	Mulching	0.81	0.09	0.49	0.07	0.74	0.09
31	Pan53	0.81	0.09	0.00	0.00	0.64	0.08
32	Esoko price update	0.81	0.09	0.00	0.00	0.64	0.08
33	Warehouse receipt	0.68	0.08	0.00	0.00	0.53	0.07
34	Pan12	0.54	0.07	0.00	0.00	0.43	0.07
35	Mamaba	0.27	0.05	0.00	0.00	0.21	0.05
36	Silo	0.14	0.04	0.49	0.07	0.21	0.05
37	Weather crop insurance index	0.27	0.05	0.00	0.00	0.21	0.05
38	SMS	0.27	0.05	0.00	0.00	0.21	0.05
39	Igntia weather update	0.14	0.04	0.00	0.00	0.11	0.03
40	Etubi	0.00	0.00	0.00	0.00	0.00	0.00
41	Power tilling	0.00	0.00	0.00	0.00	0.00	0.00
42	Irrigation	0.00	0.00	0.00	0.00	0.00	0.00

It may be inferred from Table 20 that weedicide application is mainly enhanced by access to chemical input dealers. At a 1% significance level, average probability of using weedicides increases by 89% among maize farmers across the ZOI with access to input dealers (as shown by the marginal effect). Land owners and farmers who incurred higher input and labor cost (typically resource endowed farmers) were more likely to use weedicides. On the other hand, cultivating larger farm parcels and using improved seed decreased the probability of usage of weedicides. The latter may suggest depletion of available funds as cost of production in that sense would have risen. Gender did significantly explain weedicide usage. A similar pattern was observed for the practice of row planting.

For chemical fertilizers usage, however, gender, education beyond primary school and possession of cash savings were statistically significant but with negative marginal effects. These are contrary to the a priori expectations of being more resource and information endowed once one is male and having savings. Cultivation of larger farms and increasing expenses on labor was found to reduce the probability of using fertilizer. Given suspension of fertilizer subsidies in the 2014 production season, managing large farms at relatively higher labor cost will surely tire up resources leading to low participation in input markets. Access to input markets, training in improved agronomic practices and FBO membership increased the likelihood of fertilizer usage by 18%, 12%, and 3% respectively at 10% alpha levels. A 20% increase in fertilizer usage is likely with a unit increase in the number of male household members above 18 years.

Female, more educated and land owning farmers were found to be less likely to cultivate maize under minimum tillage but were more likely to do so under zero tillage. Same is the situation among larger maize farmers who had extension/NGO visits. Whereas conventional land preparation may be costly and hence deterrent given constrained access to tractors, the observed pattern here argued to be more likely determined by awareness (education and extension visits) and a drive towards land sustainability (practice by land owners). A GHS 1000.00 rise in per hectare labor cost lowers the use of minimum tillage by 16% whereas a metric ton rise in output per hectare raises it by 4%. Access to credit and possessing of savings impacts the practice of minimum and zero tillage in opposite directions contrary to a priori expectations. Accessible credit leads to an 11% growth in the likely practice of minimum tillage at 1% significance level but decrease zero tillage by a similar margin at 10% alpha level. Increasing number of male household members above 18 and rising labor cost are positively related to the practice of zero tillage.

Usage of Sheller is explained significantly solely by access to production and market information. From the average level of usage, a 9% increase may recorded with more visits of NGOS, 14% increase for accessible market information and an additional 14% with access to input markets. This suggests awareness and participation in input and output markets are the major drivers of farmers into application of more efficient and quality improving technologies. Pursuant to quality improvement via post-harvest handling, the study reveals that females are more 11% more likely to further enhance grain quality via the use of tarpaulins. More trained, more informed and investors of larger finances in input purchases are between 8-25% more likely to use tarpaulins at 5% level of significance.

Whereas larger households do not find multi-purpose threshers attractive (likely due to larger available labor), the technology is almost entirely reserve of more aware and market oriented farmers. This is revealed by the significant positive estimates of access to market information, access to input dealers, training and larger expenses on purchase input. The probability of usage of the only representative of ICT usage among maize farmers, farm radio, is explained significantly by education, training, access to market information and land ownership. Farmers who are education above primary/basic levels are 5% more likely to rather source production information from media other than the farm radio project.

Perhaps the most significant impact of gender on the use of major technologies across the ZOI is seen in the practice of mono-cropping. A 13% fall in preference for the practice is recorded given that the maize farmer is male. More educated farmers, land owners, receivers of extension visits will rather optimize the use of their land by producing other crops on a given piece of land. The fact that local production of maize is not mechanized lends credence to this assertion. This is buttressed by the marginal impact of rising average annual gross margin on the practice of mono-cropping. At a 5% alpha level, a 5% decrease in expected probability of practicing mono-cropping is obtained.

A disaggregated view of technology as dealt with here reveals that the impacts of gender as statistically significant especially on the use of chemical fertilizer, zero and minimum tillage and post–harvest handling technologies. The impact of possessing some cash savings and access to improved seed dealers are at variance with the norm nearly for all technologies. Explanations include the likely insignificant quantum of savings and relatively non-specialized seed dealers or markets. Savers do not really have much to invest and users of improved seed dealers seem not to attach any importance to doing so. All through, the impacts of FBOs also seem non-existent in determining application of improved technology. Institutions aiming at technical exchange via FBOs should consider again what model is more suitable to ensure success. The current situation where farmers aggregate and feign membership of farmer groups only as long as external support and freebies can be sourced is to say the least counterproductive.

Table 20: Logit model estimates of major technologies in continuous usage

	Weedicide usage	Row planting	Fertilizer	Minimum tillage	Zero	Sheller	Tarpaulin	Thresher (Multi)	Farm radio	Mono cropping
gender	0.231	-0.0582	-0.524*	-0.746***	0.790***	0.0980	-0.566**	0.0443	-0.0286	-0.700***
	(0.69)	(-0.23)	(-2.34)	(-3.66)	(3.60)	(0.39)	(-2.87)	(0.23)	(-0.15)	(-3.38)
Age	-0.185	-0.120	0.0381	0.124	-0.145*	0.0558	0.00526	-0.0411	0.0383	0.0653
	(-1.56)	(-1.42)	(0.51)	(1.85)	(-2.09)	(0.65)	(0.08)	(-0.60)	(0.56)	(0.97)
Education	-0.310	-0.174	-0.400*	-0.401*	0.569***	-0.290	-0.625***	-0.132	-0.293	-0.309
	(-1.08)	(-0.85)	(-2.17)	(-2.46)	(3.37)	(-1.39)	(-3.86)	(-0.80)	(-1.74)	(-1.89)
Household size	0.206	-0.224	0.0213	0.170	-0.115	0.301	0.128	-0.741*	0.293	0.0784
	(0.44)	(-0.67)	(0.06)	(0.59)	(-0.38)	(0.77)	(0.44)	(-2.18)	(1.01)	(0.27)
Males over 18	0.931	0.464	1.270	-1.153	1.239	0.0361	0.270	1.217	0.574	0.156
	(0.74)	(0.54)	(1.64)	(-1.62)	(1.71)	(0.04)	(0.38)	(1.62)	(0.80)	(0.22)
Females over 18	-0.465	0.583	0.0780	-0.0659	0.125	-0.624	-0.0531	0.643	0.567	0.00837
	(-0.38)	(0.64)	(0.10)	(-0.09)	(0.17)	(-0.68)	(-0.08)	(0.88)	(0.82)	(0.01)
Land ownership	0.231	0.751*	0.618	-1.503***	1.550***	-0.182	-0.0422	-0.209	0.600	-1.065***
	(0.49)	(2.39)	(1.87)	(-4.40)	(4.03)	(-0.50)	(-0.15)	(-0.74)	(1.80)	(-3.35)
Access to market	0.0886	0.720	0.553	0.269	0.240	1.172	-0.624	-0.829	.	0.751
	(0.08)	(0.83)	(0.57)	(0.30)	(0.25)	(1.38)	(-0.71)	(-1.01)	.	(0.86)
Access to market information	0.394	0.246	0.549	-0.334	0.112	1.201**	0.294	0.986	0.149	0.00529
	(0.66)	(0.53)	(1.12)	(-0.80)	(0.26)	(2.73)	(0.71)	(1.78)	(0.30)	(0.01)
Access to chemical input	1.056**	0.891***	1.173***	0.227	0.0414	1.163***	-0.0904	0.539*	0.882***	0.0164
	(3.21)	(3.55)	(5.28)	(1.17)	(0.21)	(4.67)	(-0.47)	(2.56)	(4.03)	(0.08)
Access to seed	-0.755*	-1.459***	-1.243***	0.0331	-0.179	-1.373***	-0.865***	0.350	0.0757	-0.0140
	(-2.32)	(-6.36)	(-5.95)	(0.18)	(-0.94)	(-5.73)	(-4.75)	(1.95)	(0.42)	(-0.08)
Extension visits	0.0210	-0.432	-0.280	-0.413*	0.453*	-0.0369	-0.351	0.0655	0.213	-0.374
	(0.05)	(-1.62)	(-1.15)	(-1.97)	(2.10)	(-0.13)	(-1.67)	(0.32)	(1.03)	(-1.73)
Training	0.203	0.462	0.799**	0.289	0.00653	-0.337	0.423	0.549**	0.534*	1.238***
	(0.47)	(1.51)	(3.01)	(1.29)	(0.03)	(-1.14)	(1.88)	(2.60)	(2.48)	(5.01)
NGO visits	0.117	-0.428	0.484	0.449	-0.942**	0.743	0.643*	-0.0855	-0.284	-0.305
	(0.24)	(-1.33)	(1.53)	(1.66)	(-3.11)	(1.80)	(2.38)	(-0.33)	(-1.08)	(-1.11)

	Weedicide usage	Row planting	Fertilizer	Minimum tillage	Zero	Sheller	Tarpaulin	Thresher (Multi)	Farm radio	Mono cropping
FBO membership	-0.0995	-0.0803	0.172	-0.00472	0.0990	-0.279*	0.0120	-0.103	0.110	0.0992
	(-0.58)	(-0.67)	(1.73)	(-0.05)	(1.05)	(-2.03)	(0.14)	(-1.23)	(1.26)	(1.10)
Possessing Savings	0.576	0.324	-1.094***	-1.201***	1.427***	-0.433	-1.260***	-0.841***	-1.337***	-1.366***
	(1.73)	(1.40)	(-5.17)	(-6.67)	(7.74)	(-1.92)	(-6.93)	(-4.30)	(-6.51)	(-7.38)
Access to credit	0.293	0.0419	0.133	0.572**	-0.422*	0.0304	0.00796	0.268	0.0279	-0.420*
	(0.87)	(0.18)	(0.62)	(2.97)	(-2.07)	(0.12)	(0.04)	(1.48)	(0.15)	(-2.18)
Average annual farm size	0.0129	-0.146**	-0.265***	-0.0621	0.0502	-0.0610	-0.0354	-0.0348	-0.0388	-0.0855
	(0.17)	(-2.58)	(-4.47)	(-1.39)	(1.12)	(-1.06)	(-0.79)	(-0.73)	(-0.83)	(-1.86)
Average annual labor cost	0.374	1.173*	-1.277**	-0.775*	0.790*	0.815	-0.323	-0.452	-0.0183	-0.0537
	(0.48)	(2.07)	(-3.07)	(-2.38)	(2.35)	(1.43)	(-0.99)	(-1.35)	(-0.06)	(-0.16)
Average annual input cost	0.966	1.605**	5.301***	1.232***	-1.141***	0.731	1.275***	0.753**	0.247	1.294***
	(1.22)	(2.83)	(9.35)	(3.81)	(-3.49)	(1.40)	(3.89)	(2.63)	(0.90)	(3.67)
Average annual yield (MT/HA)	0.206	0.123	0.125	0.214**	-0.110	0.0925	0.0938	0.00201	0.0714	0.208**
	(1.74)	(1.36)	(1.62)	(3.25)	(-1.85)	(1.03)	(1.45)	(0.03)	(1.35)	(3.09)
Average annual gross margin (GHC/HA)	-0.0145	-0.0401	-0.205	-0.127	0.0267	-0.194	-0.104	0.0600	-0.0261	-0.282*
	(-0.25)	(-0.33)	(-1.43)	(-1.06)	(0.36)	(-1.38)	(-0.85)	(0.53)	(-0.89)	(-2.27)
_cons	0.598	-0.355	-1.458	2.953**	-4.705***	-0.213	2.565*	0.176	-1.489	1.987
	(0.38)	(-0.30)	(-1.25)	(2.66)	(-3.92)	(-0.18)	(2.44)	(0.17)	(-1.96)	(1.85)
N	854	854	854	854	854	854	854	854	847	854

Table 21 proffers an explanation for variations in production cost, yields and gross margins in maize production given location, gender, education, type of technology and general technology usage index. The potential large variability in average values of these variables is recognised. This is hinged on the multiple time and practice dependent production systems in maize production as well as multiple location of respondent. Farmers from a common location are more likely to be identical relative to those at difference locations. For instance, comparison of means following the one way ANOVA procedure in SPSS shows that, at 5% significance level, means levels of yields, gross margins vary significantly with location (See Table 20).

Table 21: ANOVA results for test of means of production costs, yields and margins across zone

ANOVA		Sum of Squares	df	Mean Square	F	Sig.
Yield (MT/HA)	Between Groups	148.916	2	74.458	32.412	0.00
	Within Groups	1897.494	826	2.297		
	Total	2046.409	828			
Labor Cost (GHC 1000)	Between Groups	12.782	2	6.391	39.525	0.00
	Within Groups	137.93	853	0.162		
	Total	150.712	855			
Input Cost (GHC 1000)	Between Groups	34.223	2	17.112	101.417	0.00
	Within Groups	142.911	847	0.169		
	Total	177.134	849			
Gross Margin (GHC/HA)	Between Groups	115.969	2	57.985	3.497	0.031
	Within Groups	10163.55	613	16.58		
	Total	10279.51	615			
Area cultivated (HA)	Between Groups	47.844	2	23.922	4.914	0.008
	Within Groups	4035.901	829	4.868		
	Total	4083.744	831			

Accordingly, OLS estimation procedure, which otherwise is appropriate given the nature of the dependent variable, is substituted with the robust regression procedure as the pooled dataset may show wide range (outlying values). The results of this procedure are displayed in Table 22. Gross margin, yields and input costs expressed at average annual levels given the seasonal values in 1000s of Ghana Cedis. Farmer age, household size and composition are reported in unit of tens only for scaling and convenience of interpretation.

The results show that location, gender, education and technology usage explain between 8 to 16 per cent of the variation in the dependent variables under discussion. Yields are the least explained by these explanatory terms and input cost the most explained. The results in Table 22 bring to sharp focus that, location has more pervasive impact on production and farm performance whereas gender affects only gross margins. Being male increases the gross margins that one makes from maize production as 7% from its mean level at 5% significance level. Gender otherwise, explains production cost (labor and input) with no statistical significance. Locating in elsewhere relative to Ejura significantly reduce not only input and labor cost but also the yield of maize. Level of farmers education has significant impacts only on labor cost and yields such that the higher the level of education, the higher the investment in labor and the higher the corresponding production from a unit area.

The technology application index was found to statistically explain only the gross margin of maize production at a 5% level of significance. The application of a unit incremental number of technologies yields a 70% change in the mean gross margins of maize production holding all other things at average level. When attention is turned to the specific technologies in wide usage, weedicide application with 92% prevalence among maize farmers was statistically significant in explaining neither production per unit farm earnings or production cost. This may be explained by the relative low cost of both pre-emergence and post emergence weedicides in use in maize production. Row planting with its labor implications, pushed labor cost 9% higher from mean level when practiced without significantly affecting yields or gross margins. Fertilizers, especially in the production season under review, were relatively expensive but the farmers knew of their productivity enhancing properties. Consistent with expectations, usage of fertilizers increased input cost significantly to a level 12% higher than the mean. It also resulted in a 37% rise in yields significant at 5% alpha level. Zero and Minimum tillage reduced average labor cost by about 10% without significant impacts to yields and input cost. Practice of zero tillage however was associated with a 15% decrease in average gross margins. This observation may be explained by leaching of nutrients as sub-soils fail to be turned-up with continuous practice of zero tillage. The use of multipurpose threshers, tarpaulin and information sources like farm radio had no effect on any of the dependent variables under discussion. Mono cropping, however, was found to be associated with a 5% higher purchased input cost among maize farmers across the ZOI.

Table 22: Robust regression estimates of determinants of cost, yield and gross margin

	Labor cost/HA	Gross margins/HA	Input Cost/HA	Yield (MT/HA)
Gender (Male=1 female=0)	0.0167	0.0697**	0.0277	-0.109
	(0.71)	(2.68)	(1.37)	(-0.90)
Techiman (Ejura=1, Otherwise=0)	-0.0740*	-0.0393	-0.103***	-0.780***
	(-2.12)	(-1.01)	(-3.41)	(-4.32)
Sunyani (Sunyani =1, Otherwise=0)	-0.101*	0.00119	-0.172***	-0.464*
	(-2.22)	(0.02)	(-4.37)	(-1.97)
Education level (Higher education=1, Primary or below=0)	0.0591**	-0.00849	-0.00372	0.213*
	(3.05)	(-0.39)	(-0.22)	(2.12)
General Technology Application Index	0.579	0.696*	0.206	2.242
	(1.83)	(1.98)	(0.75)	(1.37)
Weedicide application (1 if practiced, 0 otherwise)	0.0144	-0.0267	0.0140	0.106
	(0.35)	(-0.58)	(0.39)	(0.49)
Row planting (1 if practiced, 0 otherwise)	0.0855**	0.0368	-0.0114	0.208
	(2.77)	(1.07)	(-0.43)	(1.30)
Fertilizer application (1 if practiced, 0 otherwise)	0.0191	-0.0426	0.122***	0.370*
	(0.65)	(-1.30)	(4.76)	(2.42)
Minimum tillage (1 if practiced, 0 otherwise)	-0.107**	-0.0730	-0.0510	-0.0738
	(-2.60)	(-1.59)	(-1.43)	(-0.34)
Zero tillage (1 if practiced, 0 otherwise)	-0.103*	-0.148**	-0.0215	0.0404
	(-2.36)	(-3.05)	(-0.57)	(0.18)
Sheller usage (1 if practiced, 0 otherwise)	0.0656*	0.0199	0.0401	-0.0600
	(2.21)	(0.60)	(1.56)	(-0.39)
Tarpaulin usage (1 if practiced, 0 otherwise)	0.0183	-0.0300	0.0120	-0.0900
	(0.70)	(-1.03)	(0.53)	(-0.66)
Multi-purpose thresher usage (1 if practiced,	-0.0237	0.0454	-0.0148	-0.00196

0 otherwise)				
	(-0.97)	(1.66)	(-0.70)	(-0.02)
Farm radio usage (1 if practiced, 0 otherwise)	-0.00369	-0.0423	0.00795	-0.230
	(-0.13)	(-1.36)	(0.33)	(-1.59)
Mono-cropping practice (1 if practiced, 0 otherwise)	0.0384	-0.00854	0.0477*	0.0754
	(1.48)	(-0.30)	(2.13)	(0.56)
_cons	0.169**	0.0515	0.211***	1.687***
	(2.64)	(0.73)	(3.83)	(5.11)
N	941	941	941	941
F-Stat df	9.14	1.91	19.61	6.75
p-value	0.000	0.019	0.000	0.000
R-Square	0.09	0.011	0.16	0.082

t statistics in parentheses * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

4.3.5 Gross margin analysis

Gross margin in this survey is defined in the context of Feed the Future Project as the measure of net income from targeted small-holder farmers' production of maize expressed as the difference between the total value of production of maize and the cost of producing maize, divided by the total number of units used in production. For this baseline survey, it is calculated from the under listed data types as captured in the 'Feed The Future Agricultural Indicators Guide', (2014, pp. 53).

1. Total production during reporting period (TP)
2. Value of Sales (USD) during reporting period (VS)
3. Quantity of Sales during reporting period (QS)
4. Purchased recurrent input costs during reporting period (IC) (data required only for those costs that are at least 5 percent of total costs, although all recurrent input costs can be reported).
5. Unit of Production (UP): Hectares planted during the reporting period.

Input costs

Access to agricultural input is basic to improving agriculture productivity. This section provides baseline information in cost of inputs based on farmer recall method. The cost items focus mainly on recurrent cash costs. The estimates for the recurrent cash costs of inputs used by farmers in their production activities constitute one of the five components of gross margin.

Farm input prices, often thought to be a major constraint to higher input use and better crop husbandry practices, varied little in the major and minor seasons of production. This accounted for the low usage of input in the season particularly in the minor season.

Table 23: Average production cost among farmers who incurred them

Production cost item	Major season		Minor season	
	N	Mean	N	Mean
Land rent	356	376.4108	228	371.9991
Seeds	276	57.0982	132	631.34
Basal fertilizer	425	704.8988	358	661.3897
Top dressing	427	622.0515	354	568.9972
Herbicides	890	322.9708	653	296.4617
Insecticides	63	67.127	65	49.9
Sacks	234	78.5299	141	74.5546
Crop insurance	5	248	**	**
Loans Interests payment	23	781.1739	9	1424.444
Total input cost	901	1153.297	697	1086.669
Labor for land preparation	853	378.0258	593	389.1594
Planting	765	210.3203	560	192.6348
1st fertilizer application	297	96.7239	242	90.9256
2nd fertilizer application	291	83.2474	228	75.6535
Total weedicides application	512	190.498	372	165.8172
Manual weed control	106	180.6604	70	158.7143
Insecticide application	22	81.4545	20	1589.9
Harvesting	730	290.7082	531	238.4011
Shelling	862	230.2216	641	180.6039
Bagging (Jute sacks)	118	118.6568	77	115.1558
Transporting	761	178.0696	585	145.0051
Storing	44	59.6705	33	30.3636
Drying and winnowing	35	153.5429	12	153.2083
Total labor input	909	1330.342	698	1129.116
Total production cost	912	2677.317	699	2297.11

Table 23 shows the total cost as presented under production cost among farmers who incurred them. The average production cost relative to total production cost among all farmers is presented in Table 23. Among all farmers, production cost averages GHS 2409.33 and GHS 1751.23 in the major and minor seasons respectively. Average Labor cost among all farmers accounted for 53.94% of total production cost in the major season and 49.84% in the minor season. Farmers invest less in their farms during the minor season than in the major season. Total production cost among farmers who incurred them averages GHS 2677.3171 and GHS 2297.5108 in the major and minor seasons respectively.

Among all inputs, seeds (GHS 57.10) and insecticides (GHS 49.90) recorded the least average costs in the major and minor seasons respectively among farmers who incurred them. Table 23 shows that among all production cost, insecticides, sacks, crops insurance and interest on loans were found to average below 5% of total production cost. Cost of seeds was significant (5.15% of total production cost) in the minor season but not in the major season. Among labor costs, cost of applying insecticides, fertilizers and weedicides as well as manual weed control were all below 5% of the total production cost. Apart from transporting and shelling, all other post shelling activities remained below 5% of total production cost in both seasons.

Table 24: Average production cost among all farmers

Production cost item	Major season		Minor season	
	Mean	% total cost	Mean	% total cost
Land rent	142.4041	5.91	90.13369	5.15
Seeds	16.74718	0.70	88.56111	5.06
Basal fertilizer	318.3656	13.21	251.6233	14.37
Top dressing	282.2699	11.72	214.0542	12.22
Herbicides	305.4665	12.68	205.7274	11.75
Insecticides	4.494155	0.19	3.446865	0.20
Sacks	19.52816	0.81	11.17131	0.64
Crop insurance	1.317747	0.05	**	**
Loans	19.09352	0.79	13.6238	0.78
Total input cost (a)	1109.687	46.06	878.3417	50.16
Labor for land preparation	342.6738	14.22	245.2407	14.00
Planting	170.983	7.10	114.6392	6.55
1st fertilizer application	30.52816	1.27	23.38363	1.34
2nd fertilizer application	25.74389	1.07	18.3305	1.05
Total weedicides application	103.6504	4.30	65.55154	3.74
Manual weed control	20.35069	0.84	11.80659	0.67
Insecticide application	1.904357	0.08	33.79171	1.93
Harvesting	225.5228	9.36	134.5282	7.68
Shelling	210.8937	8.75	123.0256	7.03
Bagging (Jute sacks)	14.87938	0.62	9.422954	0.54
Transporting	144.0074	5.98	90.14665	5.15
Storing	2.790117	0.12	1.064825	0.06
Drying and winnowing	5.710946	0.24	1.953773	0.11
Total labor input (b)	1299.639	53.94	872.8859	49.84
Total production cost (a+b)	2409.326	100	1751.228	100

Table 25 shows the total input cost as presented under production cost. Among smallholders, total production cost (per hectare) averages GHS 705 and GHS 1065 across ZOI in the major and minor seasons respectively season. Labor input cost accounted for a larger proportion (at least 54%) relative to purchase input cost in the major season but was lower (at least 29%)in the minor season. The average cost of insurance for maize was GHS 84 representing 12% of total input cost. Among the production cost items, Loans interests' payment was the highest in both seasons with the highest in the minor season (GHS 343 for the 2014 production season).

Costs of insecticide and fertilizer application as well as cost of insecticides also have average costs below 5% of total production cost. Labor cost of weedicide application featured promptly with 8% of total production cost. Average cost of seed is insignificant in both seasons, forming 3% of total input cost (in major season). It was found that farmers did not have any insurance for their crops in the 2014 minor season. With the exception of transportation, all post shelling activities (bagging, storing, drying and winnowing) remain below 5% of total production cost.

Table 25: Average crop production cost relative to total cost of production

Production cost item (GHS per Hectare)	Major season		Minor season	
	Mean	% total cost	Mean	% total cost
Land rent	117.07	16.60	106.37	9.99
Seed	21.89	3.11	24.80	2.33
Basal fertilizer	200.37	28.42	183.36	17.21
Top Dressing	163.61	23.20	154.36	14.49
Herbicides	98.26	13.93	91.87	8.62
Insecticides	18.74	2.66	14.37	1.35
Sacks	22.10	3.13	22.76	2.14
Crop Insurance	84.00	11.91	**	**
Loans Interests payment	124.77	17.70	342.50	32.15
Total input cost (a)	**327.41**	**46.43**	**754.04**	**70.79**
Labor for land preparation	111.15	15.76	105.00	9.86
Planting	52.92	7.51	53.02	4.98
1st fertilizer application	29.76	4.22	23.81	2.24
2nd fertilizer application	25.09	3.56	22.02	2.07
Total weedicides application	55.39	7.86	50.22	4.71
Manual weed control	60.85	8.63	55.58	5.22
Insecticide application	29.91	4.24	37.17	3.49
Harvesting	74.12	10.51	66.91	6.28
Shelling	65.01	9.22	55.35	5.20
Bagging (Jute sacks)	23.59	3.35	26.30	2.47
Transporting	51.71	7.33	44.45	4.17
Storing	10.09	1.43	9.03	0.85
Drying and winnowing	34.31	4.87	42.67	4.01
Total labor input (b)	**377.71**	**53.57**	**311.15**	**29.21**
Total production cost (a+b)	**705.12**	**100.00**	**1065.19**	**100.00**

Table 26 shows gross margins for smallholder farmers' production of maize in the ZOI with production cost adjusted for insignificant cost lines as outlined above and exclusions consistent with the FTF guidelines. The gross margin analysis is based on these sub-samples of the survey. Following the extraction of smallholder farmers and elimination of insignificant cost items, 816 farmers in the major season (87% of farmers) and 627 farmers (67 % of farmers) in the minor season were obtained. The gross margin analysis is based on these sub-samples of the survey.

The study indicated that allocation of maize for storage was higher (248.52MT) in the minor season whiles quantity of maize allocated for consumption was higher (149.91MT) in the major season. This is in consonance with the use of the maize as the largest food security crop across Ghana. Male farmers across the zone of influence were found to not only cultivate farms but also obtained and sold larger tonnage of produce relative to females.

Sales volume relative to quantum produced was highest in the major season (91.37%) than in the minor season (84.17 %). Females were found to participate effectively in marketing of maize, selling larger proportions of their harvest in both seasons. Average production cost per hectare having been adjusted for conformity, may reach GHS 917.73 and GHS 819.70 in the

major and minor seasons respectively among smallholder maize farmers. Across the ZOI, male farmers were found to not only cultivate large farms but also obtained and sold larger tonnage of produce relative to females in both seasons.

Maize production in the major season recorded the highest average gross margins of GHS 525.27 whiles the average gross margin in the minor season was estimated at GHS 542.68. Gross margins for males were higher than females in both seasons. Male gross margins were estimated at GHS 562.73 and GHS 597.17 whiles that of females were estimated at GHS 487.82 and GHS 488.19 in the major and minor season respectively. The analysis indicated that, yield among males and females did not differ much in both seasons. However, women invest more in maize production than their male counterparts. Women reported they do not have the strength to farm like men; most of the production activities within the season are undertaken with hired labor, increasing their production cost. Thus for a given farm size, maize production cost for females is higher than males in both seasons resulting in the higher gross margins of males than females. Farmers were found to pay less for inputs in the minor season and sell their produce at a higher price, accounting for the higher gross margins in the minor season.

Table 26: Gross margins for maize in the Zone of Influence

Category	Ejura		Techiman		Sunyani		Total (Extrapolated)	
	Male	Female	Male	Female	Male	Female	Male	Female
Major season								
Volume of Production (MT)	618.425	215	658.05	127.46	549	65.55	1331.605	795.1333
Amount of sales (GHS)	469585	160055	585551.5	110730	496840	60295	1130921	673744
Quantity Sold (MT)	558.2	177.45	603.8	120.05	477.95	58.95	1200.729	713.6261
Input Cost* (GHS)	358474	141761	408774	83716	254417.1	34448	760211.5	494766.9
Area (Ha)**	335.2	130.6	458.2	87.2	418	44.2	877.8252	524.6378
Gross Margin (GHS/ha)	482.6229	399.4109	500.6284	388.1735	756.6531	737.5019	562.7276	487.8204
Minor season								
Volume of Production (MT)	456.16	148.6	357.4075	61	263.8	34.7	791.4227	439.1699
Amount of sales (GHS)	395282.5	128950	319925	52835	275235	35560	720761.9	398581.4
Quantity Sold (MT)	384.475	129.25	316.95	52.6	222.68	29.9	680.9935	379.787
Input Cost* (GHS)	297150.6	105782.5	223199.8	45715.5	112475.3	14474.4	474007.9	285703.2
Area (Ha)**	289.08	105	307.2	56.4	233	28	608.9218	358.8753
Gross Margin (GHS/ha)	594.4097	404.5008	447.7944	275.8338	916.6716	956.9367	597.1734	488.191

*Defined to correspond to FTF guidelines: i.e. exclusion of in-kind, unpaid cost land and capital cost as well as cost items falling below 5% of total production cost. It is equivalent but not equal to total cost in Table 25.

**Data from Farm Plots that were above 5ha were excluded from the calculation of the Gross Margin

4.4 General farm management

The major farm management practices deployed by farmers in the various zones and their effect on farm productivity are discussed in this section.

Table 27: Soil fertility maintenance

Practices	Ejura		Techiman		Sunyani		Male		Female		Total	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Land Fallowing	11.8	88.2	16.2	83.8	30.9	69.1	20.6	79.4	15.8	84.2	19.6	80.4
Cover cropping	1.6	98.4	3	97	1.3	98.7	2	98	2	98	2	98
Rotation of crops with nitrogen fixing crops	58.5	41.5	8.2	91.8	12.1	87.9	23.6	76.4	34	66	25.8	74.2
Fertilizer	97.1	2.9	60.1	39.9	14.3	85.7	53.7	46.3	70	30	57.2	42.8
Organic matter	2	98	1.5	98.5	8.8	91.2	4.2	95.8	3.4	96.6	4	96

According to RELC (2005), low soil fertility is one of the core challenges to cereal production in Ghana. Essential nutrients such as Nitrogen, Phosphorus and Potassium (NPK) and organic matter in the soil are depleted due to exposure of bare land/soil to bush fires, wind and water erosion during the respective dry and wet seasons (SARI, 1995). There is therefore the need for farmers to adopt various practices in maintaining the fertility of the soil.

From Table 27 various practices including land fallowing, cover cropping, crop rotation, fertilizer and organic matter application were applied by farmers in the study zones. Generally, fertilizer application remains the commonest practice for maintaining soil fertility as stated by 57.2% of respondents whereas cover cropping remains the least (2%) fertility maintenance practice used. Though not mostly practiced, rotation of crops with nitrogen fixing crops was found mostly among respondents in Ejura (58.5%) due to its boost to productivity, low cost and less risks incurred as revealed by a focus group discussion.

Female farmers in rural communities especially, are known to have less access to productive opportunities and resources (FAO, 2011). As such, they tend to use less farm inputs than men. However, in this study, a greater number of females (70%) declared they apply inorganic fertilizers as against their male counterparts (53.7%) substantiating Hassan and Salayas' (1993) study that women in maize production use more fertilizers than their male counterparts.

Nitrogen, Phosphorus and Potassium are known to be essential nutrients for cereal production. From the study, about 90% of respondents use NPK in their first stage of fertilizer application. This was explained by farmers to enrich the soil and provide the necessary nutrients to crops. However, in the second application, majority of farmers (44.3%) in the zones were found to apply DAP as recommended by the various agricultural officers within the zones. This was commonest in Techiman (47.3%) but lowest among farmers in Sunyani (21.9%).

Table 28: Distribution of type of fertilizer applied

Zones	First Application			Second Application		
	DAP	Urea	NPK	DAP	Urea	NPK

Ejura	6.6	1.6	91.8	45	39.9	15.1
Techiman	8.7	6.4	85	47.3	45.6	7.1
Sunyani	6.1	3	90.9	21.9	18.8	59.4
Male	8	3.5	88.5	41.9	41.9	16.2
Female	5.6	3.2	91.1	51.4	36.9	11.7
Total	7.3	3.5	89.2	44.3	40.7	15

4.4.1 Farm finance, savings and credit

The survey recorded a high savings culture (65.5%) among farmers in the ZOI. This implies that respondent's project for future uncertainties to ensure some form of financial security. Generally, savings culture in Ejura was high. Females in Ejura recorded the highest (86.1%) savings culture across the ZOI. Sunyani recorded the lowest savings culture among females (43.9%) and Techiman, the lowest savings culture for males (52.40%). Among female respondents, 70.9% were found to be saving as compared to 64% of males.

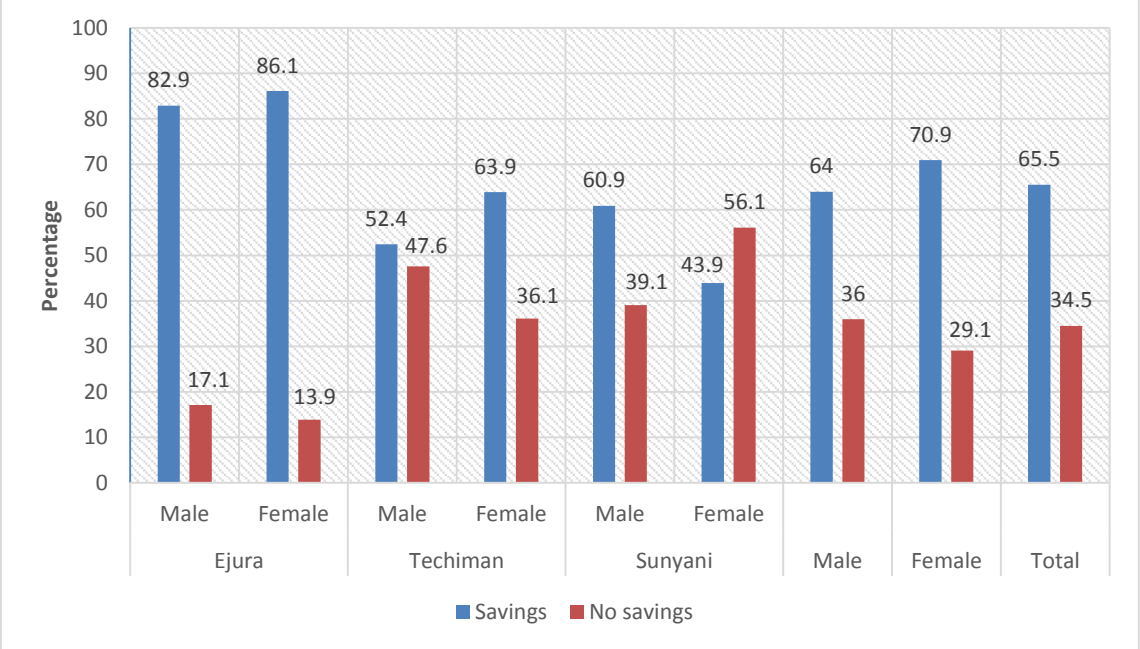


Figure 15: Distribution of saving status by zone and sex

Rural banks are the most common banking institutions in the study communities. From Table 29 it is evident that most people save at rural banks (53.2%). Cooperative society was the least saving institution (4.4%) because such institutions were found to be fading out and most respondents were not members of the institution. Respondents who saved their money at home (17.2% across the ZOI) indicated their disposable income was usually not much to save with financial institutions.

Table 29: Distribution of respondents' place of savings

Gender	Place of savings	N	%
Male	Rural Bank	253	53.6
	Commercial bank	101	21.4

	Savings and loans	28	5.9
	Cooperative society	16	3.4
	Home	74	15.7
Female	Rural Bank	75	52.1
	Commercial bank	17	11.8
	Savings and loans	9	6.2
	Cooperative society	11	7.6
	Home	32	22.2
Total	Rural Bank	328	53.2
	Commercial bank	118	19.2
	Savings and loans	37	6
	Cooperative society	27	4.4
	Home	106	17.2

Credit is a very important resource that allows farmers to expand their operations, improve agricultural productivity and apply new technologies. Generally access to credit in the ZOI was low (27.3%). Females in Techiman had the highest access to credit (32.8%) across the zones. Respondents in the Sunyani recorded the lowest access to credit (22.8%). Further analysis of the data indicated that farmers were not interested in obtaining loans due to the cumbersome procedures involved and the inability to pay back on time.

Table 30: Distribution of credit status by gender and zone

Zone	Total		Male		Female	
	Credit	No credit	Credit	No credit	Credit	No credit
Ejura	30.4	69.6	30.7	69.3	29.7	70.3
Techiman	28.7	71.3	27.7	72.3	32.8	67.2
Sunyani	22.8	77.2	23.7	76.3	17.1	82.9
Total	27.3	72.7	27.1	72.9	28.1	71.9

Sources of credit for respondents included rural banks, commercial bank, savings and loans, cooperative societies and family and friends. Across the ZOI, rural banks serve as the main source of credit for respondents (45.9%) and cooperative societies, the lowest (8.1%). Respondents had rural banks as a major source of credit due to the high saving rate with rural banks. On zonal basis, Sunyani recorded the highest (60%) for credit from rural banks. Family and friends was the highest source of credit for respondents in Techiman (42.6%).

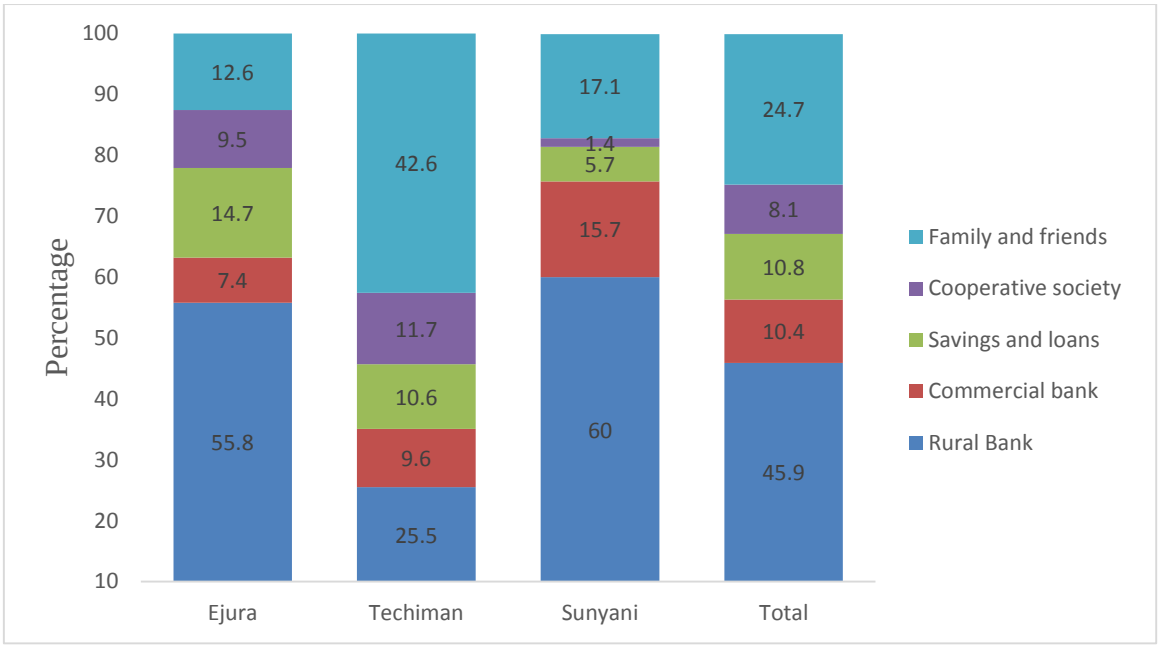


Figure 16: Source of credit

During focus group discussions, farmers mostly spoke about how the formation of Village Savings and Loan Associations (VSLAs) have helped them to be able to save now. Farmers revealed it was easy accessing loans from VSLAs than banks. The banking processes are cumbersome and though go through it, they are not able to assess loans. One farmer noted the following:

'Sometimes we go to banks in Atebubu for loans and they will be asking you to go and come always until you get fed up and stop'

Most VSLA members attested that they were not interested in saving because of their previous experiences with some financial institutions. The situation has changed with the introduction of the VSLA and this depicts the level of trust farmers have in VSLAs.

The loan assessment component associated with being a member of a VSLA was confirmed by respondents to be automatic. Once you are a member you are qualified to get a loan if you need it but the amount will depend on your level of contribution. Members attested that it was easier than going to the banks and it has helped most of them in affording quality education for their wards and in their jobs. Input for farming like fertilizers and tractors were provided by some VSLAs for their members and they pay later or after harvesting. This has been a relief for most farmers especially in the minor season since most of them will still be searching for buyers or are waiting for prices of maize to increase before they sell and do not have money to start farming.

4.4.2 Access to markets

The survey indicates that farmers have ready market for their produce after harvest. Analysis of the data revealed that 99.1% of the farmers in the ZOI had market for their produce as shown in Table 31. This is due to the high demand for maize in the study area. Few respondents (0.9%) indicated they had no ready market for their produce due to poor transportation network and distance to the open markets.

Table 31: Access to ready markets

	Ready		No ready	
Zone	N	%	N	%
Ejura	305	99.7	1	0.3
Techiman	326	99.4	2	0.6
Sunyani	302	98.4	5	1.6
Total	933	99.1	8	0.9

From Table 32, Aggregators were the main source of market for farmers in the Ejura zone as indicated by 79% of respondents. Local market was the major source of market in Techiman (70.9%) and Sunyani (59.9%). This is because the local market aids easy pricing of maize produce since there is a uniform price at the local market. Poultry feed industries as a market source was comparatively high (13.9%) in the Sunyani zone. This is due to the number of large scale poultry farms in the area.

Table 32: Distribution of market by zone

	Ejura		Techiman		Sunyani		Total	
Source of market	N	%	N	%	N	%	N	%
Local Market	59	19.4	231	70.9	181	59.9	471	50.5
Aggregator	241	79	75	23	71	23.5	387	41.5
Nucleus farmer	4	1.3	15	4.6	8	2.7	27	2.9
Poultry feed industry	1	0.3	5	1.5	42	13.9	48	5.1

Figure 17 shows farmers access to market information. In general 96.1% of farmers had access to marketing information. Techiman zone has the highest marketing information (97.9%). Marketing information was readily available to farmers because of several information sources in the ZOI.

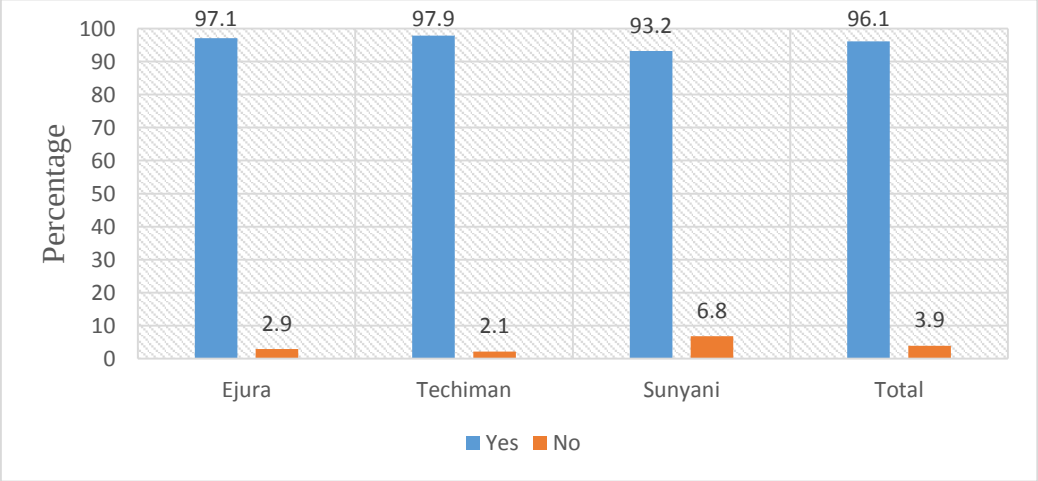


Figure 17: Access to market information

Sources of market information include Esoko, nucleus farmers, other farmers, FBOs, Aggregator, traders and extension officers as shown in Table 33. Across the study area market information was mainly through other farmers (43.6%). FBOs, Esoko and extension officers were the least source of market information in the ZOI recording less than 0.5%. In the Ejura zone, Aggregators recorded the highest percentage (40.1%) as source of market information.

Table 33: Source of market information

Source of information	Ejura		Techiman		Sunyani		Total	
	N	**%**	**N**	**%**	**N**	**%**	**N**	**%**
Other farmers	70	23.6	159	49.5	165	57.7	394	43.6
Aggregators	119	40.1	16	5	45	15.7	180	19.9
Other farmers and Aggregators	64	21.5	56	17.4	19	6.7	139	15.4
Traders	32	10.8	52	16.3	48	16.9	132	14.7
Nucleus farmers	2	0.7	17	5.3	2	0.7	21	2.3
Aggregators and Traders	9	3	7	2.2	0	0	16	1.8
Radio	0	0	7	2.2	3	1	10	1.1
Extension officer	0	0	2	0.6	2	0.7	4	0.4
Other farmers and Nucleus farmers	1	0.3	2	0.6	1	0.3	4	0.4
Esoko	0	0	2	0.6	0	0	2	0.2
FBOs	0	0	1	0.3	1	0.3	2	0.2

4.4.3 Input supply

Inputs farmers used were fertilizers, insecticides, herbicides and improved seeds. The study revealed that access to improved seed was generally difficult and this was mostly in Ejura (83.3%) and Techiman (73.8%). Thus, farmers had difficulty in obtaining improved seeds but there was no significant difference among both sexes. According to farmers, this was due to high price, unavailability of the input and low yield resulting from the usage of the available improved seeds. Access to fertilizer, insecticide and herbicide was however easy in all the zones.

A local input supply shop, Adidwan community

Table 34: Access to inputs

Zones	Fertilizer		Insecticide		Herbicide		Improved seed	
	Easy (%)	Uneasy (%)	Easy (%)	Uneasy (%)	Easy (%)	Uneasy (%)	Easy (%)	Uneasy (%)
Ejura	78.1	21.9	92.5	7.5	92.5	7.5	16.7	83.3
Techiman	78.7	21.3	57	43	83.5	16.5	26.2	73.8
Sunyani	66.4	33.6	63.8	36.2	82.4	17.6	56	44
Male	74.3	25.7	69.6	30.4	86.2	13.8	33.3	66.7
Female	75.4	24.6	74.9	24.6	85.7	14.3	31	69
Total	74.5	25.5	70.8	29.2	86.1	13.9	32.8	67.2

4.4.4 Farmer satisfaction with access to inputs

Satisfaction with access to inputs was assessed on a 5 point scale ranging from satisfied to unsatisfied. The results indicated that respondents in the study area were generally satisfied with access to various farm inputs. With access to fertilizer and insecticide, both male (41.10%) and female (41.40%) respondents indicated they were very satisfied. However, most farmers (54.5%) were very unsatisfied with access to improved seeds as shown in (Annex 20)

Various FGDs revealed that though some of these inputs were available, farmers had inadequate finances to purchase them.

4.4.5 Access to Extension Services and Training

Extension service is available in all surveyed communities. However, in some communities, it is the farmer who seeks them out when they need assistance. In other communities also, the extension officers call out farmers for workshops to educate them on the use of new technologies and improved farming practices. Generally, there were low extension worker visits to respondents' farms in the zones. Farmers in Sunyani had the most interaction with extension officers recording (27%). The zone with the least interaction with extension officers was Techiman (18.3%).

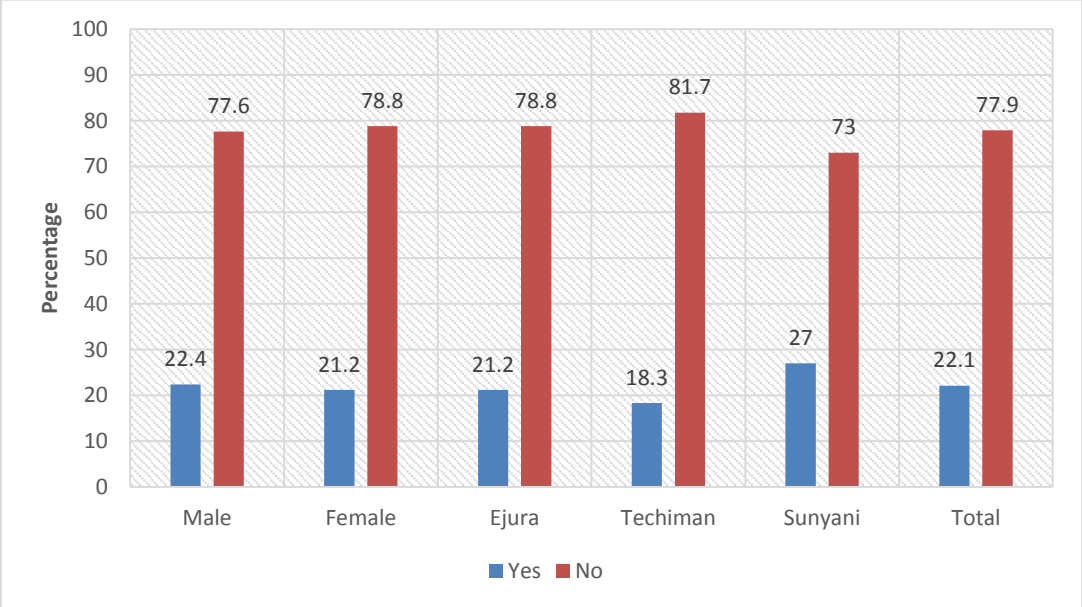


Figure 18: Visits of extension workers to farms

Across the zones, extension officers available were mainly from the Government. Although some nucleus farmers offered extension services, it was meagre (less than 3.5%) as compared to about 38% of government extension workers across the ZOI. Farmers' limited access to extension services was found to have a negative impact on their application of improved varieties and good agronomic practices.

Access to Training

In general, few training was organized for farmers in the last farming season. Majority of farmers (over 70%) in all the zones did not attend any training. The Ejura zone recorded the highest percentage (25.8%) of farmers who had attended trainings in the last farming season whiles only 41farmers (13.4%) in the Sunyani zone had attended such trainings. Across the zones, farmers who attended the training indicated fertilizer application, pest and disease control and cropping practices were the most treated topics. Cropping practices (50%) and fertilizer application (32.9%) were the most treated topics in Sunyani and Ejura respectively. Across the ZOI, other topics discussed at trainings were seed selection (8.1%), post-harvest (4.0%), marketing (3.5%) and weed control (3.5%).

Table 35: Frequency distribution of attending training last farming season

Zone	Yes		No	
	N	%	N	%
Ejura	79	25.8	227	74.2
Techiman	53	16.2	275	83.8
Sunyani	41	13.4	266	86.6
Male	135	18.3	603	81.7
Female	38	18.7	165	81.3
Total	173	18.4	768	81.6

4.4.6 Farmer Organizations and Networking

Membership of farmer organizations was low in the study communities. Across the zones, most respondents (78.8%) did not belong to any farmer group. Farmer group membership was high among female respondents (26.2%) in Techiman. Membership to cooperative societies was least (5.9%) in the ZOI with no female being a member in Sunyani.

Majority of farmer groups (60.6%) have savings account of which 79.6% are with formal financial institutions. This enables farmers to have easy access to credit facilities because financial institutions have more confidence in farmer groups than individuals and a lower risk of loans not recovered.

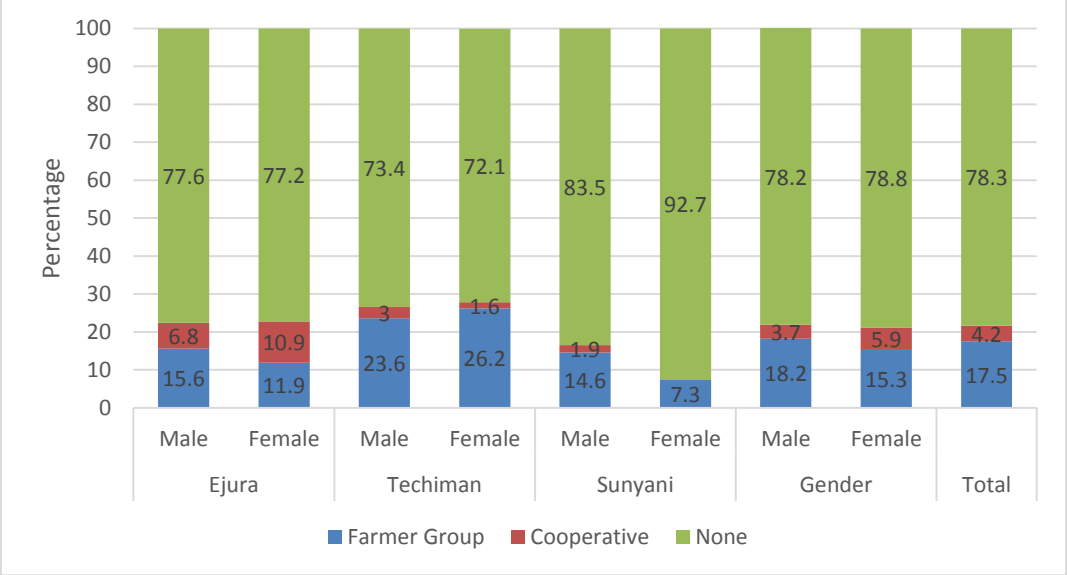


Figure 19: Membership of farmer group

The FBOs were mainly focused on integrated crop management, integrated pest management, soil fertility farmers' production and irrigation. A significant number (92%) of the FBOs across the regions had formal savings accounts with commercial banks and micro-finance institutions. FBOs in the ZOI were less structured and in a number of cases were formed primarily to access credit, particularly from donor/NGOs which usually ceased to function actively and eventually collapsed after program/project closure.

4.5 Multiple regression analysis of some key variables

The following variables: access to extension services; access to training; level of education; inputs usage and land size, were examined to assess their influence on maize yield in the major and minor seasons within the Zone of Influence.

The results indicated that variables contributed 3.9% to maize yield per hectare in the major season and 3.9% in the minor season. In the major season, inputs usage was the highest contributor to yield per hectare (16.1%, p=0.000) and this was followed by land size (7.7%, p=0.019). Access to extension, trainings and level of education were not significant contributors. However, in the minor season, variables contributed 7.6% to yield per hectare. Land size had the highest contribution to yield per hectare (16.5%, p=0.000) followed by inputs usage (15.8%, p=0.000) whiles access to trainings recorded the least (9.4%, p=0.016) to yield per hectare in the minor season.

Furthermore, the following variables; hectares planted, volume of production, gender and zone were tested to assess their influence on maize gross margins per hectare within the Zone of Influence.

The results indicated that gender was not a contributing variable to gross margins per hectare in both seasons. The Variables contributed 8.1% to maize gross margins per hectare in the major season and 2.8% in the minor season. Among the individual variables, Total volume of production was found to be the highest contributor to maize gross margins in both seasons. Volume of production contributed 46% (p=0.000) in the major season and this was followed by land size (36.7%, p= 0.000) whiles zone contributed the least (15.6%, p=0.000) to maize gross margins per hectare. In the minor season, volume of production contributed 17.1%

(p=0.003) followed by land size (12.8% p=0.027) whiles zone was the least contributor to gross margins per hectare in the minor season (10.2% p=0.009).

4.6. Value Chain

This section focuses mainly on the key actors in the chain of maize production; input suppliers, producers (farmers), aggregators/ marketers, processors and consumers across the ZOI.

Input suppliers

The survey indicated that, value chain of maize in the zones starts with input suppliers. They serve as the source of inputs supply; herbicides and improved seeds, pesticides and fertilizers to farmers. The input dealers and farmers in the ZOI are linked through demand and supply of farm inputs. Farmers get easy access to inputs within the zones. Input dealers within the communities were linked with suppliers at the district level and outside the district. During the survey it was observed that, the input dealers within these zones are well decentralized and are able to meet the demand of farmers. This makes it possible for farmers to reach input dealers, except for improved seeds which were not readily available.

Producers/Farmers

The producers of maize in the ZOI were basically smallholder farmers. However, there were few large scale farmers. Smallholder farmers are key actors within the chain in terms of output.. They also sell directly to the aggregators or at the main markets. The nucleus farmers were found to provide support services to out-growers and were also engaged in large scale production. Some nucleus farmers also served as aggregators and market outlets for smallholder farmers. The linkage between farmers and the market in the ZOI was very strong i.e. the farmers were found to be well connected with traders.

Market

The survey revealed four main market sources for maize in the ZOI. The market sources included; local markets, nucleus farmers and aggregators and poultry industries. The survey further proved that more than 50% of maize in the ZOI gets to the local market after harvest. Farmers bag the produce and take them directly to the local market for sale. Local market has strong link with nucleus farmers, aggregators, processors and consumers. The nucleus farmers and aggregators buy the produce from farmers and sell to the local market. They also sell to traders who come from outside the ZOI; these traders normally come from bigger towns and cities. Aggregators connected to the value chain in the three zones did not add any significant value to the commodity.

Abofour maize market, a burgeoning market for maize produce

Processors

In the ZOI, processors were mainly women who are into food processing and are directly linked to the local market. Maize for processing was usually purchased from middlemen in the local markets. Processors buy the commodities from the market and turn it into corn dough, corn flour among others.

Processors in the ZOI also act as buyers and marketers. Thus the processors take the commodity from the market, process them, and send the processed commodity back to the market for sale. This establishes strong nexus between processors and marketers in the chain.

Consumers

Consumers are the final users of the commodities and are connected to the markets. Consumers buy both processed and unprocessed maize for consumption. Consumers of the commodity are not only in the ZOI but across the country and beyond. Some aggregators sell the commodity to other regions and sometimes outside the country to the sub-region. Due to this, there is a strong link between consumers and the market.

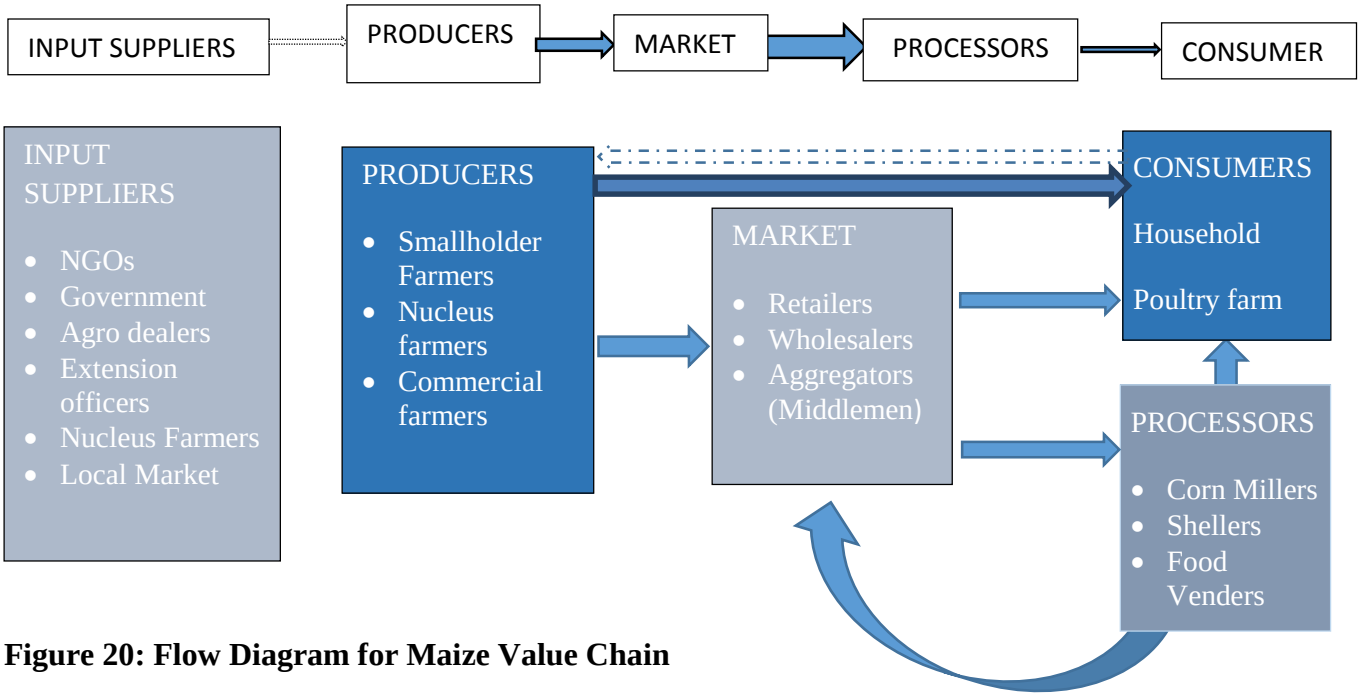


Figure 20: Flow Diagram for Maize Value Chain

Figure 20 shows the relationship between actors of maize value chain in the ZOI. Producers in the ZOI are directly linked to markets and poultry farms. Marketers sell directly to the consumers and some processors. These processors in turn sell the processed maize back to the market and some consumers. The poultry farmers on the other hand receive maize from farmers to feed their poultry. They also supply manure to farmers to improve soil fertility.

4.7 Private sector investment

Private sector investments are important drivers of agricultural productivity and income growth. Any use of private sector resources intended to increase future production output or income, to improve the sustainable use of agriculture-related natural resources (soil, water, etc.), to improve water or land management, etc. is termed as investment as per the FtF indicator

handbook. "Private sector" includes any privately-led agricultural activity managed by a for-profit formal company. CBOs or NGOs that are engaged in for-profit agricultural activities are also included.

In the study area, private investments were mainly concentrated in tractor services, inventory credit, post-harvest services (shellers/threshers drying and bagging, warehousing, tarpaulins), input credits, transporting goods and processing (grinding mills). However, there was an FBO that was engaged in extension and soil management services. Investment threshold within the study area is said to be medium per the MOFA standard, i.e. investments are in the threshold of GHS 100,000.

It was mentioned by MoFA Directorate in Techiman that a local organization provided investment support to about 500 farmers. The investment package included weedicide, hybrid seed and fertilizer (5 bags per farmer). The total cost of investment per acre of land was GHS750 and farmers were to pay back after harvesting. The farmers were generally happy about this investment package as it yielded positive results. Another organization (Concerned Universal) is also providing some support by providing input credits and also linking farmers up to financial institutions such as the Opportunity International savings and loans. Similar services were provided by Sekyeredomase Rural bank. Abunu Organic farming project is an FBO that train members on soil management practices and also provides community based extension services to farmers. They train members who are to pass on the acquired knowledge to other farmers. Other organizations that could be mentioned are the Practical Care International, Peasant Farmers Association of Ghana and Sahel grains that provide dryers and warehousing facilities.

Kwadwo Kyere Johnson in Nsuatre (in the Sunyani zone) indicated his investments in the maize value chain was about GHS 100,000, providing credit, inputs, shellers and warehousing services to farmers. He owns three tractors and provided about GHS 7000 credit facility to farmers within the area in the last farming season. Individuals with similar investments include Ibrahim Abdul Rahman in Dromamkoma (in the Ejura zone), a nucleus farmer and an input dealer, who provides input credits, warehousing services and also linking up farmers to markets outside the district.

4.8 Major constraints

Farmers encounter several challenges which affect production. Quite a number of these challenges outlined by farmers across the zones are:

- High cost and unavailability of farm Inputs. A number of farmers who have access to farm inputs complained of the high cost of the chemicals, improved seeds and fertilizers they purchase, as such not able to get the desired quantity. Improved seeds were mostly not available.
- Inadequate and lack of proper storage facilities.
- Difficulty in gaining access to agricultural credits.
- Women invest more in all production stages resulting in high production cost and low profit margins.
- Unfavorable weather condition is a challenge to the production of crops in these communities and this leads to poor performance of crops. The irregular rainfall pattern delays the start of the season and this affects the production of farmers.

- Poor fertility status of most agricultural lands. This has made fertilizer application a key component in the cultivation of crops in the zones, affecting farmers' production cost.
- Limited knowledge about good agricultural practices that enhance production.
- Limited access to farm machinery. Most farmers did not have easy access to tractors for ploughing due to its limited quantity and the high charges involved.
- Inadequate technical support and extension services to farmers.

5.0 KEY OBSERVATIONS AND LESSONS LEARNT

The under listed are the key observations from the study:

- Gross margins were higher in the minor season than in the major season. On the basis of gender, males had high gross margins than females in both seasons.
- The average farm size for males and females in the ZOI were 2.86 ha and 1.70 ha respectively in the major season. In the minor season, land sizes were estimated at 2.78 ha for males and 1.67 ha for females. Average farm size in the Techiman zone reduced whiles average land size in the Ejura increased in the minor season. However, in the Sunyani zone, average land size in the minor season remained the same.
- Land ownership was high among both males and females.
- Market was readily available for the commodity and the local market was the major source of market for farmers in the ZOI. The role of Aggregators in the purchase of maize was significant in the Ejura zone.
- From the data set, 45.1% of the respondents fall within the range of less than 30 to 40 years (<30=15%, 31-40=30.10%). However, the minimum age from the study is 17 years.
- Houses were mostly owned by respondents (59.6%) across the study area. About 32% of respondents in the Ejura zone were however living in family houses. Houses were mainly constructed with concrete/Brick. Boreholes were the commonest source of drinking water while the improved pit latrine was the predominant place of convenience. Source of energy for cooking was primarily firewood.
- Among all technologies, weedicide application was the most practiced technology among surveyed farmers, with 890 farmers (94.58%) practicing the technology. Row planting, fertilizer application and minimum tillage are other technologies with relatively high usage. Row planting was practiced by 803 farmers (85.33%), 538 farmers (57.17%) practiced fertilizer application whiles 529 farmers (56.2%) practiced minimum tillage. However, among users of these technologies, the percentage of new users across the ZOI did not exceed 5%.
- The use of hybrid seed was low among farmers in the study area and this was mostly among farmers in Ejura zone; as users of all hybrid seeds did not exceed 20%.
- Savings culture among respondents was high across the ZOI. Most farmers had their savings with rural banks.
- Most farmers regardless of gender and zone, used between six (6) and ten (10) technologies out of a possible forty four (44). About 70% of males use this number whereas 76% of females used similar. At the zonal level, a least 82% of the farmers in Ejura and Techiman and 45% of those in Sunyani also used between Six (6) and ten (10) improved technologies.
- Generally, there were low extension worker visits to respondents' farms in the zones. Extension services was mostly provided by the government, although some nucleus farmers provided extension services to farmers but this was below 3.5% of respondents. Major constraints to the effectiveness of agriculture extension services included the

declining number of visits per farmer per year, inability to incorporate indigenous knowledge and poor targeting.

- Farmer groupings or corporative were not popular in the ZOI as majority of farmers (about 79%) were not members of any farmer group or cooperative society. Majority of farmer groups have savings account of which 79.6% are with formal financial institutions.

6.0 SUMMARY OF INDICATOR FRAMEWORK

A summary of the ADVANCE impact areas and shared indicators is presented in the matrix below. In this section, we provide the baseline situation of each of the performance indicators. The essence of this is to ensure effective performance monitoring over time and to track the impact of the ADVANCE maize intervention program below the 8th parallel in future.

Type	Indicator	Baseline 2015					
		Regional	Zone			Sex	
			Ejura	Techiman	Sunyani	Male	Female
Outcome	Yield per hectare for major season (MT/ha)	1.52	1.79	1.44	1.33	1.52	1.52
	Yield per hectare for minor season (MT/ha)	1.27	1.53	1.15	1.14	1.30	1.22
Outcome	Gross margins of maize for major season (GHS)*	525.27	441.02	444.40	747.08	562.73	487.82
	Gross margins of maize for minor season (GHS)*	542.68	499.46	361.81	936.80	597.17	488.19
Outcome	• Number of targeted farmers and others who have applied new technologies or management practices	933	306	324	303	733	200
	• New application of technology	218	69	89	60	169	49
	• Continuing application of technology	715	237	235	243	564	155
Outcome	Value of sales of maize for major season (GHS)	1,804,665.04	508,414.05	822,581.54	473,669.45	1,130,921.05	673,743.99
	Value of sales of maize for minor season (GHS)	1,119,343.35	421,925.50	427,983.01	269,434.84	720,761.94	398,581.41
Output	Number of hectares under hybrid maize, and other new technologies or management practices	2405.8	771.2	841.8	792.8	2081.8	324
Output	Percentage of farmers who applied Pioneer (both yellow and white)	6.7	5.6	11.6	2.6	5.9	9.4
Output	Number of hectares applying pioneer hybrid seed (both yellow and white)	99	23.4	66.4	9.2	77	22
Output	Percentage of farmers with access to agricultural training	18.4	25.8	16.2	13.4	18.3	18.7
Output	Percentage of farmers with access to credit	27.3	30.4	28.7	22.8	27.1	28.1

* The Regional Gross Margin figures are averages from extrapolated values

1USD=GHS 4.1

7.0 CONCLUSIONS

The study aimed at estimating and presenting baseline information for performance indicators for the ADVANCE maize program in the Ashanti and Brong Ahafo regions. Indicators such as yield per hectare, gross margins per hectare, application of technology, farm management practices among others are relevant in tracking the performance and assessment of maize production. These indicators were disaggregated by gender and zones.

Results obtained were estimates derived from a farmer household survey complemented with institutional survey, conducted in the ZOI. Data collection instruments such as structured questionnaire, key informant interview guides and focus group discussion guides were used. Collection of data was carried out in March 2015 with a farmer household sample of 941 comprising 78.4% males and 21.6% females.

Females were found to participate effectively in marketing of maize, selling larger proportions of their harvest in both seasons and were found to invest more in maize production than their male counterparts. Savings culture was higher among female respondents than males.

From the study, males had the highest gross margins in both seasons. However, gross margins increased in the minor season in the zones, except Techiman, which decreased from GHS 444.40 to GHS 361.81. Most farmers in the Techiman zone did not cultivate in the minor season, hence, low production and its resulting decrease in gross margins.

Most farmers used between six (6) and ten (10) technologies out of a possible forty four (44). At the zonal level, a least 82% of the farmers in Ejura and Techiman and 45% of those in Sunyani also used between Six (6) and ten (10) improved technologies. The number of farmers and technologies that are in new usage was found to be very small across all zones. For instance, a typical farmer was found to use only 2 technologies at most, for the first time. Application of crop genetic technologies was low among farmers. For instance, farmers in the Ejura zone who planted hybrid maize seeds in the previous season did not exceed 20%.

Also, the study shows a strong interaction between the key actors in the chain of maize production. Thus, farmers had easy access to inputs, market and consumers; consumers had easy access to the market, processors and poultry farms, particularly, in Sunyani; and processors had easy access to consumers, farmers and the market.

Traditional granary (Crib) is the storage facility that is mostly used by majority of farmers (44.1%). The study recorded only five respondents (0.5%) who were users of certified warehouses across the ZOI.

The ADVANCE project will equip beneficiaries in south Ghana, with better agronomic practices and improve the value chain of maize. This will enhance productivity and profitability of maize production in the beneficiary regions. The project when implemented will increase the incomes of more than 13,000 small-holder farmers in the maize zone below the 8th parallel. Therefore, if the activities of ADVANCE are implemented as anticipated in the project design, it will reduce poverty among small holder farmers, increase the efficiency of work, enhance food security and improve the quality of lives in the study area.

8.0 RECOMMENDATIONS

From the observations and lessons learnt, the under listed are recommended:

8.1 Productivity

- Improve access to hybrid seeds to producers in the value chain to increase farmers' margins.
- Training should be targeted at women to help improve their efficiency in maize production.
- Train farmers on Good Agronomic Practices (GAPs) to improve their production
- Easy access to farm inputs and support services such as credit, tractor services, improved seed and fertilizer should be improved to enhance productivity.
- Provision of adequate and well-structured post-harvest facilities.
- Farmers should be trained on appropriate post-harvest handling of maize to reduce post-harvest losses.

8.2 Market access and trade linkages

- To enhance income generation marketing strategies, storage facilities such as silos, credit and technical know-how should be readily available to farmers.
- Nucleus farmers should be supported to enhance the provision of services to the out-growers particularly marketing and storage facilities.
- Facilities such as tractors, harvesters, shellers, tarpaulins and dryers be readily available in communities either for rent or hiring.
- Improve accessibility and linkages between out-growers and nucleus farmers/Aggregators.
- Market systems should be improved to curtail exploitation of farmers by buyers.
- Trainings by MOFA and other organizations should incorporates marketing programs
- Farmers should be exposed to available marketing platforms such as ESOKO.
- The Ministry of Food and Agriculture (MoFA) as part of its responsibilities should ensure standardization of market prices of farm produce to control the regular fluctuation of prices.

8.3 Local capacity

- The link between farmers and credit institutions must be enhanced to streamline and help farmers acquire credit.
- Strengthen the capacity of financial institutions providing credit services to farmers.
- More women should be encouraged to go into maize production
- Farmer based organizations should be encouraged among farmers to enable easy access to credit facilities and enhance experience sharing among members.
- Strengthen leadership capacity of already existing FBOs.
- Encourage the use of group savings to help investment in agriculture.eg VSLA
- Increase extension services and training.
- Individual farmers should be encouraged to have better savings culture.
- Farmers should be trained in record keeping and other relevant management practices to enable them know how well or not their business is doing.

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ANNEXES

Annex 1: Baseline scope of work

I. BASELINE STUDY OBJECTIVES

The ADVANCE baseline study aims to provide knowledge to test the project causal pathways as outlined in the above Theory of Change; confirm the targets of key indicators; and lay the groundwork for impact assessment. Results will also be used to set targets to track output, outcome and impact indicators and will provide the basis of comparison for mid-term review and the final evaluation. Finally, the baseline will capture the current climate for business development, growth, investment and innovation.

2. BASELINE METHODOLOGY

The baseline study will adopt mixed methods and will be conducted through 1) desk reviews, 2) quantitative survey, and 3) individual and focus group interviews. The questionnaires for all indicators will be gender sensitive to ensure that the impact of interventions on both men and women can be captured throughout the program.

A. DESK REVIEWS

The Offeror will start the baseline activities with a desk review of key documents on ADVANCE/ADVANCE that will help understand the project's context and data needs. Practical knowledge will also be gathered through this means to help identify the successful and less successful approaches/measures that were based on similar development assumptions. Finally, desk reviews will allow the Offeror to collect secondary data on the current climate for business development, growth, investment and innovation.

Documents to review will include but are not limited to:

1. The ADVANCE/ADVANCE project documents;
2. The ADVANCE performance Management Plans;
3. Feed the Future (FTF) indicators handbooks;
4. FTF M&E Guidance Series Volume 8: Population-Based Survey Instrument for Feed the Future Zone of Influence Indicators;
5. The USAID Feed the Future strategy in Ghana;
6. USAID Feed the Future population based survey compiled by Monitoring Evaluation and Technical Support Services (METSS – Ghana) in 2012;
7. The 2011-2015 Medium Term Agricultural Sector Investment Plan (METASIP) of Ghana;
8. The Country Development Cooperation Strategy (CDCS) 2013-2017 (Published 2012)
9. Other relevant resources on the agriculture sector in Ghana and on the targeted commodities value chains.

All documents for review will be provided by ACDI/VOCA.

B. QUANTITATIVE SURVEY

SURVEY OBJECTIVES

The quantitative survey has as a main objective the collection of the baseline values of the impact and outcome indicators for the ADVANCE project.

i. Study Population

The study population will be composed of the potential farmers and other value chain beneficiaries, meaning smallholders, aggregators, members of farmer based organizations, production and business development service providers in the targeted regions. These will include both ADVANCE I beneficiaries in the ADVANCE implementation areas and ADVANCE potential beneficiaries.

ii. Survey Design

This project will utilize a non-experimental pre-post-test design survey. This survey will be farmer based in the targeted districts of Ashanti and Brong Ahafo regions. The survey data will be collected in two phases.

Phase 1: Data at this phase include but are not limited to: Technologies and management practices applied, input cost, size of farm, commodity, setting crop cut area and other qualitative information.

Phase 2: Data in this phase (harvest period) will be yield from crop cut area, and other relevant information for the yield estimated.

Information from the second phase of this survey will complete the data needs to calculate Gross Margin of the hybrid maize seed.

iii. Sampling Approach

Though the final sampling approach will be provided by the Offeror, it will ideally be random based and will use the beneficiary focus regions and potential beneficiary population. A random selection of farmers from each district in the communities and the sample must include not less than 40% females. A database of farmers can be obtained from the Ministry of Food and Agriculture at the District/Regional Offices. A multi-stage sampling will be used to select districts, communities and ultimately farmers for this survey. To determine yield and calculate gross margin, the Offeror will use crop cut method for maize for determination of yield. However, a proposed method for maize can be found in Appendix B.

SAMPLE SIZE DETERMINATION

The sample will be statistically representative, at least at 95% confidence level and 5% error margin, of all the potential beneficiaries in the two regions, of target districts, of all sexes, of all the maize commodity farmers, and if the available maize farmers population figures allow, of all potential beneficiary types. Provision for non-response will be 10%. We suggest a minimum sample size of 860 maize farmers; however, Offerors will be responsible for submitting a final sample size that may otherwise represent the true population, and this sample size must be approved by the ACDI/VOCA M&E Specialist.

Indicators Baseline Values to Collect	Indicator	Definition	Disaggregated by
Outcome	Gross margins per hectare for hybrid maize	Difference between the total value of production of the agricultural product (maize) and the cost of producing that item, divided by the total number of units in production. Gross revenue = average price x total production Net revenue = gross revenue - purchased input cost Gross margin = net revenue divided by area planted Unit of measurement: US dollar/ha	Sex of farmers
Outcome	Number of beneficiary farmers and others who have applied new technologies or management practices	Number of farmers, and other primary sector producers, individual processors (not firms), rural entrepreneurs, traders, etc. that applied new technologies or management practices	Sex of farmers
Outcome	Percentage of farmers who applied Pioneer	Percentage of farmers that applied Pioneer hybrid maize seed	Sex of farmers
Output	Number of hectares applying pioneer hybrid seed	This indicator measures the area (in hectares) cultivated	Sex of farmers

		using Pioneer Hybrid Seed.	
Outcome	Value of sales	This indicator will collect both volume (in metric tons) and value (in US dollars) of purchases from smallholders of targeted commodities for its calculation: the value (in USD) of the total amount of agricultural products sold by farm households. Unit of measurement: Value of sales (USD)	Maize value chains
Output	Number of hectares under hybrid maize, and other new technologies or management practices	This indicator measures the area (in hectares) cultivated using USG-promoted improved technology (ies) or management practice(s) during the reporting year. Technologies to be counted are agriculture related, land based technology and innovations including climate change adaptation and mitigation. Crop Genetics: Certified high yielding seed, pest management, Disease management, irrigation, soil related fertility and conservation, water management etc.	Sex of farmers

Output	Value of new private sector investment in agriculture sector or value chain	Investment is defined as any use of private sector resources intended to increase future production output or income, to improve the sustainable use of agriculture-related natural resources (soil, water, etc.), to improve water or land management, etc. "Private sector" includes any privately-led agricultural activity managed by a for-profit formal company. A CBO or NGO's resources may be included if they engage in for-profit agricultural activity. "Investments reported should not include funds received by the investor from USG as part of any grant or other award. Unit of measurement: U.S. dollars	None

In addition to the indicators above, the quantitative survey will collect data on the training and support received by the surveyed farmer from various projects percentage of farmers who continue to use Pioneer hybrid seeds; their agricultural and business practices, networking, partnerships and collaborations among them; and any other data that will help answer the survey's objectives.

A. QUALITATIVE SURVEY

The qualitative survey will consist of focus group discussions of a representative sample of potential beneficiaries and key informant interviews of key resource persons/subject matter experts in the areas concerned by the baseline survey. Those include the project causal pathways or development assumptions as outlined in the above Theory of Change, and the current climate for business development, growth, investment and innovation. Moreover,

some qualitative questions such as farmers' continued use of Pioneer hybrid seeds information will be used to interpret and explain the quantitative results.

IMPORTANT NOTES ON THE SURVEY METHODOLOGY AND TASKS

SURVEY INSTRUMENTS

The Offeror's team will have a Lead Consultant. S/he is the one who should design the quantitative and qualitative data collection instruments in coordination with the study team (organized by ACDI/VOCA). The questionnaires and interview guides will be developed using the results of the desk reviews and based on the project's data needs outlined above. Also, the design of the questionnaires will follow the definitions in the FTF handbook (as referenced above) and will answer the requirements of the project's (Concept Document) Performance Monitoring Plan (PMP). Prior to implementation, questionnaires and interview guides must be approved by ACDI/VOCA ADVANCE II DCOP.

Pilot testing of all instruments will include practice sessions in a community similar to those that are part of the target population, but will not be part of the target group. Pilot testing will be done during the week of training of the enumerators.

II. DATA ENTRY

DESIGN OF ELECTRONIC DATA ENTRY FORMS:

The Lead Consultant of the Offeror will design all the electronic data entry templates, procedures and systems. The Lead Consultant will also train all of the data entry clerks in the use of the templates as well as oversee the overall management and supervise the overall post fieldwork data entry and management process.

Survey questionnaires will be completed electronically both online and offline, where data validation and controls will be observed. Certified data will be stored in a central storage system in real time for further analysis by Offeror. Statistical software for quantitative data such as (SPSS, Stata, EpiInfo, EpiData) and qualitative data (NVIVO, MaxQDA, ATLasTi) or any effective and efficient software will be used for data analysis. The methodology adapted by Offeror should be agreed by both parties. As most of the data collection will occur out in enumeration areas, the data will be initially checked in the field by supervisors, and errors corrected on-site.

ADVANCE requires that data are completely labeled (both variables and values labeled in English). Each data record should include the following identification fields:

1. Questionnaire or interview serial number (If possible on electronic system)
2. Date of interview (MM/DD/YYYY format)
3. Start and end time of each interview
4. Interviewer ID number (must be unique in data file)
5. Supervisor's certification

In order to minimize data entry errors, all enumerators will be required to attend enumerators training so that they will be conversant with the electronic data capturing procedure using any device suitable (Mobile Phones, Tablets or Laptop computers).

III. CAPTURING OPEN ENDED RESPONSES:

All responses from open ended items will be typed in English on the electronic questionnaire during the interview for the qualitative survey. Appropriate qualitative data management mechanisms will be used to analyze every response by the Offeror.

IV. QUALITY CONTROL

The Offeror's team will include supervisors. Their primary role will be to:

1. Ensure that the enumerators follow all the survey implementation procedures and complete their allocated interviews within the allocated times;
2. Carry out and follow quality control measures (as developed by ACDI/VOCA) on a daily basis through the entire course of the fieldwork days;
3. Manage team logistics;
4. Review questionnaires for completeness before leaving the surveyed communities;
5. Monitor the movement of the teams particularly in reaching all pre-selected sampling points within the prescribed timeframe;
6. Conduct call backs on respondents;
7. Provide technical advice regarding the implementation of the sampling plan; and
8. Interpret the code difficult field responses

The Offeror's team will implement quality control measures to ensure a high level of interviewer performance. A full description of these measures and the results of the quality control must be included in the final technical report. The Offeror shall ensure that every respondent can be matched to a questionnaire and an enumerator. The time and duration of the interview must be recorded and included in the final dataset. At least 15% of the total number of interviews will be verified. Quality control should be spread throughout the survey area and the distribution of controls should be proportional to the sample distribution in terms of village residence and districts. It is recommended that at least 10% of the work of each interviewer will be witnessed by his/her supervisor. At a minimum, quality control measures will include verification of the:

1. fact that the interview took place;
2. proper application of the sampling plan in selecting the respondent;
3. the approximate duration of the interview;
4. the proper administration of the various sections of the questionnaire;
5. Interviewer's general adherence to professional standards.

In addition, the supervisors will check all field enumerators' collected data while still in the enumeration area the survey has been conducted before moving to the next selected enumeration area. The purpose of this spot check is to minimize the return of incomplete survey questionnaires because the team had already moved on and the affected interviewer could not go back to a particular respondent to get responses to question items that were accidentally missed or skipped. Since such mistakes will be captured while still in the site, the affected interviewer will then be sent back by the supervisor to correct such error. One hundred percent (100%) of the interviews will be back checked. For every verification conducted, a brief verification form must be completed. Enumerators should, at all times carry a field log in which they record relevant information on what happens in the field. The enumerators' logs must supply enough information for an

independent observer to locate the selected household and to identify the respondent interviewed.

Call backs: It is always a possibility that an enumerator may decide to ignore some aspects of the sampling procedure such as the household selection or even decide to conduct the interview and instead falsify responses. A call back by the supervisor done at random is intended to minimize this risk. A call back involves the supervisor retracing the steps of the interviewer to the actual respondent to verify the responses recorded on a questionnaire. Call backs will also be conducted by the quality controllers/fieldwork auditors. A short form with select questions from the main questionnaire will be used to conduct call backs to the respondent.

V. DATA ANALYSIS

Data will be analyzed following the guidance of USAID/Feed the Future and the ADVANCE PMP. Quantitative data analysis will be conducted using SPSS or any suitable software. The analysis should follow the sample design and presents a comparison of results by region and by sex when appropriate. In addition, the Offeror should also disaggregate the results by other key variables as appropriate and as required by the Feed the Future indicators handbooks and the ADVANCE PMP. All processing and analysis steps will be recorded under syntaxes that the Offeror will hand over to, among the deliverables, ACDI/VOCA.

In addition to the data needs laid out in the above sections, it is expected that correlations, chi-squares and other regression analysis will be utilized to assist ACDI/VOCA management in learning what factors may be most associated with the indicators of interest. This will help management in better designing approaches to, specifically address related factors.

Qualitative data may be analyzed using software or not. Outputs should clearly answer the different questions and needs mentioned above.

VI. PROGRESS UPDATES

It is expected that the Offeror will provide regular updates on the implementation of the baseline activities weekly. These could be done by short meetings at the ACDI/VOCA office in Accra/Kumasi or any agreed location or communication medium suitable and also supported by emails.

VII. REPORT WRITING

The report writing will be led by the Lead Consultant of the Offeror. Progress reports will be submitted at the end of each phase of the survey. Once the ACDI/VOCA Management receives the draft report, it will be circulated to the staff and headquarters staff for technical review. Comments will be collated by ACDI/VOCA and passed on to the Offeror.

Offeror's revisions should take approximately less than two (2) weeks. It is anticipated that the final report will be completed by 15th January 2015.

The final baseline report will include at a minimum the following elements:

1. Executive Summary
2. Acknowledgements
3. List of Acronyms and abbreviations
4. Table of Contents
5. Executive Summary

6. Background/Brief program description, context and rationale
7. Purpose and expected use of the survey
8. Objectives of the survey
9. Survey methodology and data collection techniques
10. Main findings
11. Key observations
12. Conclusions
13. Lessons Learned and Recommendations

Annexes to the final baseline report:

1. Baseline scope of work
2. Time table
3. List of documents, references and data sets used
4. Survey instruments: questionnaire, interview guide (s), etc. as appropriate
5. Field work documentation
6. Description of sampling procedures
7. Data analysis procedures and syntaxes

B. DELIVERABLES

The following are the deliverables resulting from the implementation of phase 1 and 2 of the baseline survey

1. Electronic copy of the final baseline report; Gross Margin Production report; and Harvesting Period report
2. Clean data set with variable and value labels;
3. Syntaxes used for the analysis. The program files should clearly identify section or module names used in the questionnaire and should follow the same order as the survey questionnaire so that the project staff could generate the same results;
4. Supervisors and enumerators training manual(s);
5. Log files by the supervisors during data quality control/verification;
6. Field visit timeframe/field work plan

Documents to review will include but are not limited to:
1. The ADVANCE/ADVANCE project documents;
2. The ADVANCE performance Management Plans;
3. Feed the Future (FTF) indicators handbooks;
4. FTF M&E Guidance Series Volume 8: Population-Based Survey Instrument for Feed the Future Zone of Influence Indicators;
5. The USAID Feed the Future strategy in Ghana;
6. USAID Feed the Future population based survey compiled by Monitoring Evaluation and Technical Support Services (METSS – Ghana) in 2012;
7. The 2011-2015 Medium Term Agricultural Sector Investment Plan (METASIP) of Ghana;
8. The Country Development Cooperation Strategy (CDCS) 2013-2017 (Published 2012)

9. Other relevant resources on the agriculture sector in Ghana and on the targeted commodities value chains.
10. All documents for review will be provided by ACDI/VOCA.

Annex 2: Timetable

Itinerary: Baseline Studies of ADVANCE in the Ashanti and Brong Ahafo regions.					
Date	Activity	Time Frame			Facilitator (S)
		Morning	Afternoon	Evening	
12/03/15	Pretesting of Questionnaires in Ejura zone	do	do	do	YAS, EOA, PSM
13/03/15	Revision of Questionnaires	do	do		PSM, YAS, EOA

16/03/15	Training of Enumerators, BIRD office		do	do	PSM, YAS, EOA, EFA, RA
16/03/15	Travel from Kumasi to Mampong, Techiman, Sunyani				
17/03/15	Debriefing at ADVANCE Office, Tamale	do			PSM, RA
17/03/15	Commencement of Data gathering in Ejura, Techiman and Sunyani zones	do	do	do	BIRD staff, ADVANCE Support Team
24/03/15	Completion of and wrap-up on data gathering exercise in NR, UER, UWR	do	do	do	BIRD staff, ADVANCE Support Team
24/03/15	Debriefing with Technical Director, ADVANCE, Tamale	do			PSM, RA
24/03/15	Departure of BIRD Staff		do	do	
BIRD Staff					
PSM	Dr. Paul Sarfo-Mensah				
RA	Dr. Robert Aidoo				
EFA	Dr. (Mrs.) Ernestina Fredua Antoh				
EOA	Ebenezer Owusu-Addo				
YAS	Yaw Amo Sarpong				
ADVANCE Team	DCOP, Project Director, Zonal Coordinators				

Annex 3: Data gathering instruments

Bureau of Integrated Rural Development, KNUST

GAMPSAP BASELINE STUDIES: FARM HOUSEHOLD QUESTIONNAIRE

ADVANCE BASELINE SURVEY – BRONG AHAFO AND ASHANTI REGIONS

SECTION A: HOUSEHOLD FARM MANAGER IDENTIFICATION

Part A-1: Location (To be filled in by Enumerator before HH Visit)

A.1.1	Name of Region	Use Regional Code List	R----------
A.1.2	Name of District	Use District Code List	D----------
A.1.3	Name of community	Use Community Code List	C----------
A.1.4a	House Number		|__|__|__|__|
A.1.4b	Provide name of the house (if house number is not available)	…… …… ……	
A.1.5	List the closest landmarks to the house		

Part A-2: Verification

A.2.1	Name of Enumerator		Code	|__|__|__|	Date |__|__|/
A.2.2	Initials of Supervisor		Code	|__|__|__|	Date |__|__|/
A.2.3	Initials of Editor		Code	|__|__|__|	Date |__|__|/
A.2.4	Initials of Back Checker		Code	|__|__|__|	Date |__|__|/
A.2.5	Initials of Data Entry Operator 1		Code	|__|__|__|	Date |__|__|/
A.2.6	Initials of Data Entry Operator 2		Code	|__|__|__|	Date |__|__|/

Part A-3: Introduction and Consent

Hello. My name is _____ and I am working with the Bureau of Integrated Rural Development (BIRD), KNUST. We are conducting a baseline survey on the ADVANCE, a USAID agriculture funded Program in Ghana. The purpose of the survey is to gather information on maize production to help inform program decisions and assess program impacts in the future. We would very much appreciate your participation in this survey. The survey usually takes between 1 hr and 1 hr 30 minutes to complete. As part of the survey we would first like to ask some questions about your household. All of the answers you give will be confidential. There are no risks to you or your family in answering these

questions. Participation in the survey is completely voluntary. If we should come to any question you don't want to answer, just let me know and I will go on to the next question, or you can stop the interview at any time. However, we hope you will participate in the survey since your views are important. If you have any questions about the study or the survey at a later date, you may contact Dr. Paul Sarfo-Mensah, the Team Leader for ADVANCE Baseline Survey at 0243140500, or the Chief of Party for the ADVANCE Program, Dr. Emmanuel Dormon at 0244374926. .At this time, do you want to ask me anything about the survey? May I begin the interview now?

A.3.1	Do you agree to participate?	1 = Yes 2 = No	|__|	If "2" --> STOP SURVEY
A.3.2	Have you benefited from ADVANCE I?	1 = Yes 2 = No	|__|	Either '1' or '2' CONTINUE
A.3.3	Date of First Visit	Day/Month/Year	|__|__|/|__|__|/2014	
A.3.4	Start Time of Interview 1	Use 24 Hour Clock	|__|__|:|__|__	
A.3.5	End Time of Interview 1	Use 24 Hour Clock	|__|__|:|__|__	
A.3.6	Date of Second Visit	Day/Month/Year	|__|__|/|__|__|/2014	
A.3.7	Start Time of Interview 2	Use 24 Hour Clock	|__|__|:|__|__	
A.3.8	End Time of Interview 2	Use 24 Hour Clock	|__|__|:|__|__	

Section B:

Part 1: Target Respondent

ENUMERATOR INSTRUCTIONS: Identify target respondent. You need to interview the household member who is primarily responsible for making decisions about the HH farm. This is most likely the head of the household, but if the head of the household works off the farm, it will be another household member who is responsible for the household farm. The crop of interest in this survey is **Maize**

B.1.1	**Name of HH Head** Write Name used on official documents, with nickname in parentheses			
B.1.2	Sex of HH Head			
		1= Male		
		2 = Female	|__|	

B.1.3	HH Head's Religion	1= Muslim 2=Christian 3=Traditionalist 4=Other	|__|	
B.1.4	Household Type			
		1. Male no Female		
		2. Male & Female		
		3. Female no Male	|__|	
		4. Child no Adult		
B.1.5	Is Respondent the HH Head?	1 = Yes 2 = No	|__|	If 1 -->B.1.7
B.1.6	Respondent Name			
	Write name used on official documents, with nickname in parentheses			
B.1.7	Sex of Respondent			
		1 = Male		
		2 = Female	|__|	
B.1.8	Relationship of Respondent to HH Head	1= Spouse 2=Son/Daughter 3=Son/Daughter in-law 4= Parent 5=Bother/Sister 6= Other relative 7= No relation	|__|	
B.1.9	Mobile Numbers of HH Members (for follow-up)	Mobile Owners		
		a.		|__|__|__|__|__|__|__|__|__|__|__|

		b.		|__|__|__|__|__|__|__|__|__|__|__|
B.1.10	Age class of Respondent	1= <30		
		2=31-40		
		3=41-50		
		4=51-60		
		5=Above 60	|__|	
		6. Don't Know		
B.1.11		Full age	|__|__|	
B.1.12	Marital Status	1=Married		
		2=Single		
		3=Divorced		
		4=Separated		
		5=Widowed	|__|	
B.1.13	Highest level of Education	1=None		
		2=Primary		
		3=JSS/JHS		
		4=SSS/SHS/Voc/Tech		
		5=Tertiary	|__|	
B.1.14	Household Size	Indicate number	|__|__|	
B.1.15	Number of children under 18	0-5	|__|__|	
B.1.16		6-17	|__|__|	
B.1.17	Male Adults	Over 18	|__|__|	
B.1.18	Female Adults	Over 18	|__|__|	
Land Ownership				

B.1.19	Does your Household Own Agricultural Land?	1= Yes 2=No	|__|	
B.1.20	How did you obtain the use of the land for faming?	1=Family land		
		2= Purchase		
		3=Gift		
		4= Inheritance		
		5=Renting		
		6=Sharecropping	|__|	
B.1.21	What is the Size of all Agricultural Land (acres)?		|__|__||__|	

SECTION C-1: MAIZE FARMER INFORMATION

FARM AREA UNDER MAJOR CROP (Acres) for the production period	C.1.1 Farmer estimation of total area for **ALL** maize cultivated on farm (acres)				**C.1.2 Actual (GPS) Area for major (largest) maize plot** **(when crop cut measure is done)**
C.1.3 Plant Population Density (*# of plants in crop cut area * 1000*)					
C.1.4 Type of Seed Used	Local Hybrid |__| Pioneer Hybrid |__|			Local open pollinated varieties |__|	

SECTION C 2: PURCHASED INPUT COST OF PRODUCTION

Instruction: ***Kindly Tell the Farmer that you will like to ask her/him questions about the Cost she/he incurred in producing Maize in this particular Crop Season Record responses appropriately. If the farmer made payment with cash, record the actual amount paid but if she/he made repayment with produce, use the price of the produce at the time of payment to establish the cost.***

Tell the Farmer that this is to help the project know his/her cost of production.

C.2.1 Input Cost Section			**C.2.2 Labour Cost Section**	
Farm Activity	**Purchased Input Cost (GH¢)**		**Labour Charges**	**Paid Amount (GH¢)**
A. Land rent (per season for entire acreage of MAIZE largest farm)			**A. Labour Charges for Land Preparation [**Clearing and Ploughing (including harrowing)] *Probe for 1st& 2nd ploughing cost and sum* **B. Mode of payment** Cash: ( ) In-kind Repayment: ( )	
Seeds: B. Pioneer 30Y87 (*Yellow Maize*) Indicate quantity purchased ( )			C. Quantity of seed planted Bag (Number) or other local unit eg. Olonka etc. (specification ….Number ……..) Total Weight (KG) …… Remark:	
C. Pioneer 30F32 (White Maize) ( ) Indicate quantity purchased ( )			D. i. Method of Planting (tick option below): 1=Manual |__| 2=Mechanized planting |__|	C2.2D.ii ……..
D. Pan 53 (White) ( ) Indicate quantity purchased ( )				
E Pan 12 (Yellow) ( ) Indicate quantity purchased ( )				
F. Etubi ( ) Indicate quantity purchased ( )				
G. Mamaba ( ) Indicate quantity purchased ( )				
H. Obatampa( ) Indicate quantity purchased ( )				

I. Farmer's saved seeds ( ) Indicate quantity purchased ( )				
J. Others ( ) Specify---------- Indicate quantity purchased ( )--				
Fertilizer			E. Fertilizer Application:	
NPK (Basal) K. 15-15-15 ( ) L. 23.10.10 ( ) M. 21.10.5 ( ) N. 31.10.10.3S ( ) O. 23.10.5+2S ( ) Other Specify ……			5. 1st Application 6. 2nd Application	
Qi. Top Dressing				
Sulphate of Ammonia/Sulphate ( ) NPK 23.10.10 ( ) Urea: ( ) Others Specify……	**C.2.1Qii** **…….**		F. Weedicides Application	
R. Weedicides			Broad Spectrum *(Condemn)*	
R1: Weedicides 1: *Applied before ploughing*			Pre-emergence	
R 2Weedicides 2: *pre-emergence*			Post-emergence *(selective)*	
R3.Weedicides 3: *Post-emergence*			G. Manual Weed control ( ) *Probe for multiple times of weeding*	
R**4.Weedicides total Cost:**				

(sum 1,2 & 3)				
S. Insecticides :			H. Cost of insecticide application	
			I.i. Mode of Harvesting: 1=Manual |__| 2=Mechanized|__| **J. Mode of payment** Cash ( ) In-kind ( ) Bags (kg)----------|	C.2.2.Iii ……
			K.iMode of Shelling 1=Manual |__| 2=Mechanized|__| **L. Mode of payment** Cash ( ) In-kind ( ) Bags (kg)----------	C.2.2.Kii ……
			M. Processing (Drying and winnowing)	
T. Sacks (Jute sacks):			N. Bagging	
U. Crop Insurance			O. Transporting:	
V. Interest Payment on Loan			P. Storing:	
W. Total Input Cost: *Sum all cost under this section*			**Q. Total labour Cost** *Sum all cost under this section*	

SECTION C 3: PRODUCTION AND SALES

Instruction: ***Tell the farmer that, now you will like to ask him/her questions about total volume produced, volume sold, volume consumed and total value of sales to help the project to have an idea on his/her performance and advise him or her appropriately.***

C.3.1	C.3.2	C.3.3	C.3.4	C.3.5	C.3.6	C.3.7	C.3.8
Total volume Produced (100kg bags)	Total Vol. produced(kg)	No. of 100kg bags sold	Total Volume Sales(kg)	Price per Kg	Total Sales(1GH¢)	Volume consumed(Kg)	Volume Stored(Kg)

Section C4:TECHNOLOGY and MANAGEMENT PRACTICES

Instruction: ***Kindly Tell the Farmer that you will like to ask her/him questions about the technologies and management practices she/he applied or practiced producing Maize in this particular Crop Season. Record responses appropriately.***

Tell the Farmer that this is to help the project know the technology and management practice.

Technology	**Area under Tech. (Acre)**	**Cont./New C/N**	**Technology**	**Yes/No**	**Cont./New C/N**		**Management Practice**	YES/ NO	Cont./New C/N
Crop Genetics			**Post-Harvest Handling**				**C.4.28 Book/Record keeping**		
C.4.1Pioneer 30Y87 (*Yellow Maize*)			C.4.15 Sheller				**C.4.29 Sales/Purchase Receipt**		
C.4.2 Pioneer 30F32 (White Maize)			C.4.16 Tarpaulin				**C.4.30 Pricing and costing**		
C.4.3Other Hybrid Seeds			C.4.17 Weighing Scale				**C.4.31 SMS**		
C.4.4 Pan 53			C.4.18 Moisture Meter				**C.4.32 Warehouse Receipt**		
C.4.5 Pan 12			C.4.19 Warehouse				**C.4.33 Farm/Crop Budgeting**		
C.4.6 Etubi			C.4.20 Silo						
C.4.7Mamaba			C.4.21 Power Tiller				**C.4.34 Sustainability Plan**		

1 We will convert GHS to the prevailing USD exchange rate (at the time of reporting)

C.4.8Obatanpa			C.4.22 Multi-Purpose Thresher			**C.4.35 Others(specify)**		
Pest Management			**Climate Mitigation or Adoption**					
C.4.9 Weedicide			C.4.23 Igntia Weather Update					
C.4.10 Insecticide			C.4.24 Weather Crop Insurance Index					
Soil Related			**Water Management**					
C.4.11 Planting in rows			C.4.25 Mulching					
C.4.12 Fertilizer			C. C.4.26 Irrigation of maize grown area					
C.4.13 Minimum Tillage ( ) C.4.14 Zero Tillage ( )			**ICT**					
			C.4.27 Esoko Market Price updates					
			C.4.28 Farm Radio					
Disease Management								
			C.29 Integrated Pest Management					
			Cultural practices					
			C. 30 Rotation of crops with Nitrogen fixing crops (legumes)					
			C. 31 Land fallowing					
			C.32 Inter-cropping					
			C.33 Cover cropping					
			C. 34 Mono-cropping					
			C.35 Use of other erosion control methods in the farm					

Has farmer applied any new technology this farming season? Yes |__| **No** |__|(Enumerators Only)

4 Technologies applied within the cropping calendar (that is before, during and after cropping)

SECTION C 4: SUMMARY DATA

Instruction: ***Do not Complete Section C4. The Supervisor will complete Section C 4 and authenticate the quality of the data that you have collected***

(For use by Supervisor only for authentication)

CATEGORIES	**TOTAL**
10. Total hectares planted (Ha) =	
11. Total volume (production in Kg) =	
12. Total volume sold (sale in Kg) =	
13. Total value of sales(GH¢) =	
14. Average price(GH¢) =	
15. Total purchased input cost (GH¢)=	
16. Gross revenue (GH¢)=	
17. Net revenue (GH¢) =	
18. Gross margin per ha (GH¢/Ha)=	

REMARKS/NOTES:

19. **Average price** = value of sales divided by quantity of sale
20. **Gross revenue** = average price x total production
21. **Net revenue** = gross revenue – Total purchased input cost
22. **Gross margin per ha** = net revenue divided by area planted

SECTION D 1: FARMING PRACTICES

Instruction: ***Kindly tell the farmer that you want to collect information about his/her general farming practices in order for the project to understand the current farming practices for appropriate interventions to be made.***

D.1.1	D.1.2	D.1.3	D.1.4	D.1.5	D.1.6	D.1.7
Did you apply fertilizer last farming season?	Type of fertilizer applied	Did you use organic matter last farming season?	Type of organic manure applied	Did you apply any pesticides last farming season?	*Type of pesticides applied	What is your source of inputs (fertilizer, pesticides, insecticides)?
1 = Yes *2 = No* If '2'► D.1.3	1=DAP 2=Urea 3=NPK	1 = Yes 2 = No If '2'go to D.1.11	1=Manure 2=Compost 3=Biomass transfer 4=Others (specify)	1 = Yes 2 = No If '2'►D.1.13	1=Fungicide |__| 2=Herbicide |__| 3=Insecticide |__| 4= Insecticide and Herbicide|__| 5=Others (specify)	1=Agro dealer 2=Local markets 3=Nucleus farmer 4=Government 5=NGO 6=ADVANCE 1 7=Other farmer
|__|	|__|	|__|	|__|	|__|	|__|	|__|

***Note to Enumerators**

Check the use of unregistered, rejected, or banned pesticides, the source of such pesticides and reason for usage

……
……
……
……
……
……
……
……

SECTION D2: POST-HARVEST HANDLING

Post-harvest handling

Type of storage structure	D.2.1.Do you use this type of storage structures?**1= Yes2=No** **If not used skip to next structure**	D.2.2.What is the estimated capacity of this storage structure (in kg)?	D.2.3. Is structure adequate for your maize storage purposes? **1=Yes2=No**	D.2.4.[II]What is the **major** problem with usage of this storage structure?	D.2.5.Provide an estimate of **seasonal** storage losses incurred in using this structure (in kg)?
23. Traditional granaries					
24. Indoors- in baskets/bags					
25. Indoors-open storage					
26. Outside-open storage					
5.Certifiedwarehouse (receipt indicating quality and quantity)					
5.Other warehouses					

[II] **Codes for storage problems: 1=Attack by rodents, 2=Weevil infestation, 3=Moisture, 4=Theft, 5=Others (specify…….)**

Availability of post-harvest facilities and services

Post-harvest facilities and services	D.2.6.Is this post-harvest service or facility available for usage in your locality? **If yes skip to next service of facility**	D.2.7.[II] Who provides this service or facility?	D.2.8.[IIII] What are the terms of usage?
Transporting goods to buyers	1.Yes|__| 2.No|__|		
Drying for long term storage	1.Yes|__| 2.No|__|		
Cleaning (foreign matter removal)	1.Yes|__| 2.No|__|		
Removing broken/small grains	1.Yes|__| 2.No|__|		
Removing discoloured grains	1.Yes|__| 2.No|__|		

Weighing & bagging	1.Yes|__| 2.No|__|		
Small scale food processing	1.Yes|__| 2.No|__|		
Threshing/shelling of maize	1.Yes|__| 2.No|__|		
Drying facilities/equipment	1.Yes|__| 2.No|__|		
Cleaning facilities/equipment	1.Yes|__| 2.No|__|		
Fumigation or other treatment	1.Yes|__| 2.No|__|		
Storage facilities	1.Yes|__| 2.No|__|		
Milling (grinding mills)	1.Yes|__| 2.No|__|		

[II]**Codes for providers: 1=Buyers, 2=Private individuals or businesses, 3=International development agencies (UN, USAID, GTZ), 4=NGOs (Local/foreign), 5=Government 6=FBOs, 7=Others (specify……..), 8=Don't know**

[III]**Codes for terms of use: 1=Rents entire facility, 2=Pays user fee for using part of facility, 3=Not owned but not paid for**

Indicate key problems you face in selling maize by ranking the constraints in the table below using 1as most important.

D.2.10 Key constraint to farmers' maize marketing	**Ranking of constraint**
27. High cost of transport to market	
28. Low prices in accessible market	
29. High market fees/taxes	
30. Poor transportation infrastructure	
31. Lack of price information	
32. Unpredictable prices	
33. Difficult/unable to find buyer	
34. Late or slow payment from buyers	
35. inability to meet quality requirements of buyers	
36. Ineffective farmers' organization in marketing	
37. Trade restrictions (e.g. restrictions on cross-border trade)	
38. Others (Specify……)	

SECTION E:

PART E-1: ACCESS TO MARKET

E.1.1	E.1.2		E.1.3	E.1.4	E.1.5	
Do you have market for your produce? *1 = Yes* *2 = No* If '2'► E.1.3	Source of market		Do you have access to marketing information? *1 = Yes* *2 = No*	What type of information do you normally receive? [tick all types applicable]	What is your source of marketing information? [tick all sources applicable]	
	1=Local market			1=Prices |__|	1= Other farmers|__|	6=Aggregators|__|
	2=Aggregators			2=Availability of buyers|__|	2:=SMS|__|	7=Traders |__|
	3=Nucleus farmer			3=Availability of commodity|__|	3=Esoko|__|	8=TV|__|
|__|	4=Poultry feed industry	|__|	|__|	4=Availability of sellers|__|	4=Nucleus farmers|__|	9=Radio|__|
				5=Other (specify)_____	5=FBOs|__|	10=Extension officer |__|
						11=Other (specify)_____

PART E-2: SATISFACTION WITH ACCESS TO INPUTS

Do you have access to the following in your village? Fill in

	E.2.1	E.2.2	E.2.3
Opportunities	Easy access Yes= 1, No=2	If No, what is the distance to the nearest dealer/outlet (in kilometres)	Level of satisfaction (score: 1-5)

			1=Satisfied 5=Not satisfied
Fertilizer dealer/outlet			
Insecticide dealer/outlet			
Herbicide dealer			
Improved seed dealer			

SECTION F: ACCESS TO EXTENSION & TRAINING

F.1.1	Did an extension worker visit your HH farm last farming season to provide advice about farming?	1 = Yes 2 = No			if '2' ►F1.5
F.1.2	Was this extension worker from government or nucleus farmer?	1=government 2= nucleolus farmer 3= government and nucleus farmer		|__|	
F.1.3	How many times did the government extension worker visit to provide advice about farming?	Number of Visits			
F.1.4	Who met with this extension worker? Multiple responses possible	A = a female HH member B = a male HH member C= a non-HH member D=Both male and female HH Members		|__|	
F.1.5	What topics were discussed during these visits? ***[Multiple Responses Possible]***	A = seeds selection |__| B = fertilizer application |__| C = pests and diseases|__| D = cropping practices|__|	E = Site selection/soil type|__| F = Weed control |__| G = Marketing |__| H = irrigation|__| I = Postharvest |__| J = other (specify)		
F.1.6	Have you or anyone else in your household attended a Department of Agriculture Extension training in the last six months **(six months from the day of the interview)**?	1 = Yes 2 = No		|__|	If 2 ► F.1.7
F.1.7	What topics were discussed in this most recent training?	A = seeds|__|	F = soil type|__|		

	Multiple Responses Possible	B = fertilizer|___| C = pests and diseases|___| D = pesticide use|___| E = cropping practices|___|	G = compost|___| H = irrigation|___| I = previous year crop on your land|___| J = other (specify)		
F.1.8	Did anyone from an NGO visit your HH farm last farming season to provide advice about farming?	1 = Yes 2 = No		|___|	if 2 ►F.1.11
F.1.9	How many times did the person from the NGO visit to provide advice about farming?	Number of Visits			
F.1.10	What topics were discussed during these visits? Multiple Responses Possible	A = seeds|___| B = fertilizer|___| C = pests and diseases|___| D = pesticide use|___| E = cropping practices|___|	F = soil type|___| G = compost|___| H = irrigation|___| I = previous year crop on your land|___| J = other (specify)		
F.1.11	Did you benefit from any training last farming season?	1 = Yes 2 = No		|___|	
F.1.12	Who provided the training? ***[Multiple Responses Possible]***	1 = Government Agency |___| 2 = NGO |___| 3 = Nucleus Farmer |___| 4 = Other (specify) |___|			
F.1.13	What was the content of the training? ***[Multiple Responses Possible]***	1= Agronomic practices |___| 2 = Marketing |___| 3 = Group formation |___| 4 = Business management |___| 5 = Post harvest handling |___| 6 = Record keeping |___| 7 = Other (specify) |___|			

SECTION I: FARMER GROUPS

G.1.1	Are you a member of a Farmer Group or Cooperative?	1 = Farmer Group 2 = Cooperative 3 = None	|__|	if "3" --> Section J
G.1.2	For how long have you been a member of the above group?	1 = <5 2 = 5-9 3=10-14 4=15+	|__|	
G.1.2	What is the current number of male group members in the Farmer Group or Cooperative?	Number of male members	|__||__|	
G.1.3	What is the current number of female group members in the Farmer Group or Cooperative?	Number of female members	|__||__|	
G.1.9	Does your farmer group have a savings account?***[for farmer groups only]***	1 = Yes 2 = No	|__|	If 2 *skip* G.1.10
G.1.10	Is this a formal account (in a microfinance institution or bank) or informal (savings kept by the group)?	1 = formal 2 = informal	|__|	

SECTION J: SAVINGS & ACCESS TO CREDIT

H.1.1	Does your household currently [date of interview] have any savings (formal or informal)?	1 = Yes 2 = No	|__|	If 2 ►H.1.3
H.1.2	If yes, where do you save?	1=Rural bank 2=Commercial bank 3=Savings & Loans Inst 4=Cooperative society 5=Home		
H.1.3	Do you have access to credit	1 = Yes 2 = No	|__|	
H.1.4	If yes, what is the source of the credit?	1=Rural bank 2=Commercial bank 3=Savings & Loans Inst 4=Cooperative society	|__|	

		5=Family & Friends		
H.1.5	If no, give reasons	1=Lack of collateral 2=High interest 3=Not interested 4=others (specify)…….	|__|	

SECTION I: HOUSING

Background and Status of Housing Occupancy				
I.1.1	What is your current occupancy status?	1 = Own 2 = Renting 3 = Dwelling provided for free	4 = Temporary Shelter 5 = Family house 6 = Other (Specify)	|__|
Physical Characteristics of the House				
I.1.2	What is the main construction material of the walls of your main dwelling?	1 = Concrete/Brick 2 = Wood 3 = Mud 4 = Bamboo 5 = Jute Straw	6= swish 7 = Grass/Straw 8 = Other (specify)	|__|
I.1.3	What is the main material used for roofing your main dwelling?	1=Aluminium sheets 2=Thatch 3=Bamboo 4=Others (specify)	|__|	
Water & Sanitation				
I.1.5	What is the primary source of drinking water?	1 = Supply Water (piped) 2=Borehole 3 = Own tube well 4 = Neighbor's tube well	5 = Community tube well 6 = Rainwater 7=Stream/River/Pond 9 = Sachet/Bottled Water	|__|

			10= Other (specify)	
I.1.6	What type of toilet facility does your household use?	1 = None (open field) 2 = Traditional pit latrine 3 = Improved pit latrine	4 = Septic tank 5= WC linked sewer	|__|
Electricity				
I.1.7	What is the main source of lighting?	1 =Electricity (government provided) 2 = Private Generator 3 = Solar Electricity 4 = Kerosene	5 = Candles 6 = Lantern 7 = Charger Light (torch flashlight) 8 = Others (specify)	|__|
I.1.8	What is your primary source of energy for cooking?	1 = Electricity 2 = LPG 3 = Kerosene 4 = Firewood 5 = Dried cow dung	6 = Coal 7 = Rice bran/saw dust 8 = Dried leaves/straw 9= charcoal 10 = Other (specify)	|__|

Interview guide for Maize farmers

A: General Information

1. Note the region, district, community and number of farmers interviewed

B: Cropping Systems

2. What are the main crops grown in this area? Which one of them are food/cash crops? (focus on maize)
3. Which crops are mainly grown by males, which by females and which equally by both sexes?
4. What is the cropping calendar of maize, rice and soybean? (from planting to marketing)
5. What is the trend in production of these crops and how can it be explained?
6. What are the smallest, average and the largest farmers for these crops?
7. How do you obtain inputs you use in production of these crops? (probe land, labour, seed, machinery/ox-ploughs/hoes, chemicals/drugs, fertilizers, extension services)
8. What problems do you face in accessing farm inputs?
9. Which crop varieties are being grown here? Does anyone of them outperform the others? (Probe yields, pest & disease resistance, consumption attributes etc.)
10. Do you produce these crops individually or collectively and why? (Probe acreage for block farms)
11. Do you follow recommended agronomic practices in the production of these crops? Why or why not? (Probe seed selection, row planting, crop rotation, pest and disease control, manuring/fertilizing etc.)
12. What postharvest technologies are commonly practiced in regard to these crops? What are their advantages and disadvantages? (Probe drying and storage facilities used)

C. Resource Allocation

Land

13. Who are the land owners?
14. Is land readily available for farming?
15. Are the lands suitable for maize, rice and soybean cultivation?
16. Is it equally easy for men and women to acquire land for farming purposes?
17. For how many years to you fallow your land?

Cash

18. What is your source of finance for production?
19. When is it most difficult for you to get cash?

20. What are the particular reasons for the difficulties?

D. Insects, Pest and Diseases

21. What are the major insect, pests and diseases or maize?
22. How do you detect these pests and diseases?
23. What control measures to you use?
24. What are key constraints to producing these crops?
25. In case there is any natural disaster in your area, what control measures do you always take to minimize damage to your crops?
26. Harvesting and Postharvest handling
27. How is maize harvested in this area?
28. What storage facilities are commonly used by maize farmers in this area?
29. What proportion of the harvest is stored as seed?
30. What post-harvest facilities and services are available in this area?
31. What are the storage problems?
32. How do you tackle the observed storage problems?

E. Marketing

33. Who is involved in the marketing of these crops?
34. How do you market these crops?
35. In what form do you market you produce?
36. Which varieties attract higher prices and why?
37. What are the average marketing costs you incur? (probe transport cost, local taxes, bribes etc.)
38. What is the average market price and what influences it?
39. List the main marketing problems
40. What should be done to enhance the production of these crops? What roles can and can't you play to achieve the above goal?

F. Nucleus Farmer &Out-grower systems

41. Are you a member of any out-grower group? If yes, since when and if no why?
42. How did you become a member of an out-grower group?
43. What support do you received from the group?
44. What challenges do you face as a member of the group?
45. What is your view on the use of nucleus farmers?
46. What benefits do you/will you derive from nucleus farmer system?
47. What are the challenges in dealing with nucleus farmers
48. How can the out-grower-nucleus farmer linkage be improved?

G. Value of new private sector investment

49. Have you benefited from any private sector investment?
50. What organisation provided the support
51. What investment package did you receive? (e.g. input, hybrid seed, financial support, training, post-harvest handling etc.)
52. Was the investment package beneficial in any way?

Interview guide for Nucleus Farmers

1. When did you start your organization/business?
2. What is the size of your organization and in which areas are your operating ?
3. Is your organization a registered entity?

4. What types of crops do you deal with?
5. How many out-grower farmers do you have?
6. How do you select the out-growers?
7. What kind of support do you give to the out-growers? (probe*: machinery, equipment, seeds, chemicals, market linkages, etc.*).
8. What kind of arrangement do you have with the out-growers? (probe*: Memorandum of Understanding, Signed contract, etc.*)
9. Do you provide training to the farmers? (probe*: type of training, content of training, who the participants are, etc.*).
10. Do you provided market and credit linkage services to out-growers?
11. Have you received any training? (probe*: type of training, by whom, when, where, etc.*)
12. Have you receive any support services from ADVANCE? (probe*: type of service received, accrued benefits, etc.*).
13. What is your relationship with input supplies, traders, processors, transporters and other any other actor in the value chain?
14. What problems/challenges do you face as a nucleus farmer and how can these problems be best addressed?

Interview guide for input dealers

1. When did you start your organization/business?

2. What is the size of your organization and in which areas are your operating in the region?
3. What kind of inputs are you dealing in and how do you procure them? Which of these inputs are related to the soybean/maize/rice value chains? (probe*: machinery, equipment, seeds, chemicals etc.*).

4. What are their selling prices and how do you determine these prices? (*probe: buying prices, transport costs, etc.*)
5. Who are your customers and who among them are the most important and why? (*probe: individuals, government and non-government organizations, CSOs*).
6. Do you provide any augmented services or after-sales services to your customers besides selling those inputs and which are these services? (probe*: credit, production and marketing formation, transport, training, demonstrations, repair, spares*).

7. Do you charge your customers for any these services and what are the rates looking like?
8. What challenges are you facing in this business?
9. What can be done to mitigate these challenges and by whom?
10. Do you know of any input dealer operating in this area? Which are they and what do they deal in?

Thank you for your time. Do you have additional observations or comments that we have not discussed?

Interview guide for traders

Questions about Clients/Buyers

1. Which crop commodities do you trade in and what are volumes traded annually?

2. Who are your main clients (buyers)?
3. Whom are you currently selling to? If different from the past, what are the reasons for the change?
4. Where and how did you find your clients for the first time?
5. How do you learn about your clients' preferences? (*probes:* order quantities, types of product preferred, standards, quality requirements, delivery dates)
6. What type of storage do you have currently? What is your storage capacity?
7. If you desired a different form of storage, what would that be and why?
8. How is power wielded amongst value chain actors? Who holds it and who benefits from it? Do actors in the chain enjoy equal or fair bargaining power? What are their individual and collective capacities to negotiate? Can value chain intervention redress any imbalance?

9. How would you characterize your relationships with your principal clients? (*probe:* independent, close, collaborative, difficult, lots of information passes between you, client is in charge, they direct you)
10. Would you say that in your relations with your clients there is a lot of trust, there is some trust, or there is no trust? Why?
11. Does your firm receive any assistance/help or collaboration from your clients? (*probes:* Advances, credit, information, inputs, technical assistance, recommendations)

12. What are the steps you usually take to ensure that you meet your clients' specifications, including delivery date and quality? (Normally, how difficult is it to comply with your clients' requirements? What do you have to do?)

13. What challenges do you face in your business arising out of the operating environment (corruption, bureaucracy, transparency)?
14. Are there policies related to the value chain business economic environment that cause conflict among chain actors or with others. Are there policies benefiting one group of actors at the expense of another?
15. What is the government's role in your industry? Do you view their activities positively or negatively?
16. What are the challenges exporting crop commodities?

17. How do you arrive at the sale price? What are the factors influencing this price?
18. What prices are you currently trading crop commodities?

Questions about Suppliers/Producers

19. What are all the ways you source the products you sell, how do you find your products? Who are your main suppliers?
20. Do you buy your products from individual producers, from associations (groups) of producers or brokers?
21. What is the purchase price?
22. What determines the price you purchase at?
23. How many producers do you work with?
24. Do you have preferred areas to buy from?
25. If you have different types of suppliers, how would you characterize them? (In other words, what are the characteristics of each type of supplier?)
26. How do you communicate information to your suppliers regarding your requirements in terms of quality of produce, size, chemical use, delivery dates, etc.?
27. How do you demand that your suppliers meet the requirements? What difficulties do your suppliers have in meeting your demands? Do you help them? How?
28. How do you work with your suppliers to ensure that they satisfy your requirements for quality? What do you do to encourage them? What pressures do you apply?
29. What changes would you like to see your suppliers make?
30. Have you communicated this to them? How do they respond?
31. What are the difficulties suppliers have in making these changes?
32. What can you (yourself) do to facilitate or demand these changes?

Other questions

33. What are the three most serious risks for your enterprise?
34. Do you have additional observations or comments that we have not discussed?

Thank you for your time. Are there other players in this value chain that you think we should talk to?

Could you give me referrals?

Interview guide for processors

Questions about Buyers/Clients

1. What are the main products that you sell?

2. What are all the ways that you sell your products (market outlets)? To whom do you sell your products?
3. What are the differences between your clients? To whom do you prefer to sell? (*probes*: frequency, price, bargaining/negotiating costs, volume, quality, consistency)
4. How do you learn about the new products that buyers want? How do you learn about market taste and quality requirements?
5. How did you first meet your clients/buyers?
6. Do you receive any form of assistance/help from your clients/buyers? (*probe*: cash advances, advances in materials, training, transport, record keeping)

7. What steps to you take to meet your client/buyers specifications, including delivery date and quality?
8. What challenges do you face when it comes to your buyers?

Value Addition

9. How much are you currently paying for raw materials?
10. What are your processing costs?
11. What is your current sales price for finished product? Do you sell to everyone at the same price? If no what causes price variance?
12. What is your current sales price for by-products? Do you sell to everyone at the same price? If no, what causes price variance?
13. How do you arrive at an agreed sales price for products and by-products?
14. Have you identified any needs for technological upgrades? If yes what are the likely efficiencies that this technology update will deliver?
15. Are there hindrances or enablers for this technology upgrade?

Questions about Suppliers/Producers

16. What are all the ways you obtain the products to process? Who are your suppliers?
17. What are the differences between the suppliers you work with? (*probe*: quality, price, punctuality, standards, volume, costs of collecting raw materials, risks)
18. Which type of supplier do you prefer to buy from?
19. Do you buy directly from farmers? If so, do you buy from individual farmers or from groups of farmers? What is the typical landholding of the farmers you buy from?
20. How many suppliers (of each type) do you buy from?
21. How do you first find your suppliers? (*probe:* people you know, contacts, family, neighbours, language groups)

22. What kinds of help or services do you provide to your suppliers? (*probe:* inputs, seeds, credit, market information, irrigation techniques, technical assistance in better farming practices, help with certification)

23. How do you communicate your product requirements to your suppliers?

24. What are the difficulties suppliers have in meeting their requirements?

25. In what ways are suppliers reluctant to make these changes?

26. What type of storage do you have currently? What is your current storage capacity?

27. Would you desire a different type of storage? If yes, what benefits would this deliver e.g. cost efficiencies etc.?

28. How do you handle produce that does not meet the expected requirement e.g. cleanliness or moisture content? Do you accept or reject this type of produce?

29. If you accept this type of produce do you have any drying or cleaning facilities? If yes what are the costs involved?

30. How much do you pay if you contract an outside firm to perform these services?

Interview guide for leaders of producer/traders/processors associations

Questions about Members and Services

1. How and when did this association form and how has it evolved over time?
2. What was the initial objective of this association? Has the objective changed through time?
3. How many members do you have?
4. How many are women?
5. How does one become a member of your association?
6. Do you have special considerations for women and men to become members?
7. Which gender is predominant in the group and why?
8. Which types of crops are your members involved in?
9. Do your members specialize in certain stages of production?
10. What services do you provide to your members?
11. What are the advantages of being a member of this association?

Questions about Sales and Markets

12. Does the association coordinate the sales of their members' products? If so, how does this work?
13. Does the organization negotiate the sales price? Do they charge a commission on this?
14. Where does the association sell their products? (*probes:* local markets, farm gate, millers, export)
15. How do you locate new buyers?
16. Are individual members allowed to sell their products outside the association?
17. How is the role of the association different from the role of traders?

Questions about Upgrading

18. How do members of the association learn about product requirements and quality standards that buyers want? How do they learn about the changes customers want?
19. What are the difficulties producers have in making these changes?

20. Why are producers reluctant to make these changes?
21. Are there any costs or risks to members in making changes? Do they earn more or less if they make changes?
22. How does being a member of this association help them to learn about the changes buyers want and make these changes?
23. Does the association have any storage facilities? If yes what type and capacity? Is this storage suitable for your purpose?
24. If no, what type of storage do you need and why?

Other Questions

25. How do producing selected crops fit in with the other activities of the households of members (i.e., the household economic portfolio)?
26. Is production of these crops usually a full-time or a part-time activity for your members? How does the part-time status of producers affect their ability to respond to orders? (*probes:* seasonality, type of income needed)
27. Can some farmers produce more efficiently than others? If so, why?
28. Would you say that it is sometimes hard for members to trust the leaders of the association? Why or why not?
29. What do you think about the future for smallholders who grow these crops?
30. Do you have additional observations or comments that we have not discussed?

Thank you for your time. Are there other players in this value chain that you think we should talk to?

Could you give me referrals?

Interview guide for government officials

1. To start with, can you please provide general information about this area in terms of geographical/political units, population, and major economic activities
2. What is the importance of the agricultural sector to the economy of this area? (Probe: food security, incomes, exports especially to neighboring countries)
3. What role does government currently play in the agricultural sector in this area? Has this role changed overtime and why? (probe: research, extension, input distribution, credit, production, transportation, processing, marketing)
4. In particular, what is the capacity of your agriculture department? How many staff are available, which roles do they serve and how are they facilitated?
5. How about the private sector, what role does it currently play in the agricultural sector in this area? Has this role changed overtime and why? (probe: research, extension, input distribution, credit, production and market information, production, transportation, processing, marketing)
6. Do you know of any CBOs/NGOs operating in this area with focus to the agricultural sector (particularly maize, rice and soya)? Which are they and what do they do?
7. What do you see as being constraints to increased performance of the agricultural sector in this area?
8. Which strategic interventions has government so far put in place to boost agricultural production in this area?
9. What more does government need to do to increase agricultural production in this area?

Thank you for your time. Do you have additional observations or comments that we have not discussed?

Interview guide for financial institutions

1. When did you start this business and from where? How big is your organization? Do you have any branches elsewhere in other parts of Ghana?

2. When did you begin your operations in this area?
3. What motivated you to come to do business in this area?
4. Which financial products do you have in general? Which of these products are targeted to farmers and agribusinesses? What proportion of total loan portfolio is dedicated to agriculture?

5. How many farmers and agribusinesses have over time obtained credit from your organization? What are the loan sizes offered – smallest, average, largest?
6. What conditions do you set for them to access loans from your organization? Do you require them to save with your organization? What interest rate do you charge at the moment?

7. What proportion of applicants meets these conditions? Do you extend any waiver to those who do not meet credit conditions?

8. How do you monitor those farmers and agribusinesses who obtain loans from your organization?
9. What are the repayment rates for farmers and agribusinesses overtime looking like?
10. Are there any institutional problems that impede your operations in serving farmers and agribusinesses?
11. What should be done to remove these impediments and who should do what?

Thank you for your time. Do you know of other financial institutions lending to farmers and agribusinesses in this area that I should talk to?

Interview guide for Private Sector Investors/NGOs

1. For how long have you operated in the region Ghana and in which districts are you?

2. Which activities, both humanitarian and developmental, have your organization been engaged in?

3. Have your organization ever been involved in the development of maize/rice value chains? (*If No, skip to question 8*).

4. If yes, how were your organization involved (or still involved), where and for what period of time?

5. What were some of the challenges your organization faced in the development of maize value chain?

6. What has been the impact of your organization's involvement on the development of maize value chains?

7. What still needs to be done to further develop the maize value chain and by whom?

8. Do you know of any organization operating in this area with focus on maize value chains? Which are they and what do they do?

Thank you for your time. Do you have additional observations or comments that we have not discussed?

Annex 4: List of some persons contacted

Zone	Community	Participants	
EJURA	**DROMANKOMA**	1. Abdulai	6. Asana suwalisu
		2. NabraNankwada	7. Asana Karim
		3. Ibrahim Abdul Rahman	8. Juliana wombi
		4. Ibrahim Hamid	9. Abena Bento
		5. Alhassan Adam	
	ADIDWAN	1. AbdulaiManprusi	8. NuhuFuseini
		2. kadiriAlhassan	9. Ibrahim Sissala
		3. Damani Salam	10. KarimYakubu
		4. Razack Karim	11. Kwadjo Kuma
		5. BukariFuseini	12. SumailaMusah
	New Konkompe	1. AlhassanAmoako	7. HarunaSumaila
		2. Yaw Vincent	8. Kofi Amoako
		3. Ibrahim Kwasi	9. Moro Yaw
		4. FuseiniAwudu	10. Musah Kofi
		5. Akwasi Boateng	11. Asoma Yaw
		6. Mensah Otoo	
SUNYANI		Hawa Halidu	Linda Amankwah
		Asala Innusah	
	Nsuhia	Kofi Moore	Acquah Emmanuel
		Gyabaah Isaac	
	Nkrankwanta	Osei Solomon	Kabiru Haruna
		Salam Sam	Ali Moro
		Mohamed Issaka	Moro Mamudu
		Yakubu Kwalan	Nasuru Musah
		Salifu Sumaila	Baba Amando
		Ahmed Kalif	Fusieni Adams
		Ibrahim Seidu	Fusseini Kusman
	Awuah Dumase (Awuah Dumase Maize market Association)	Florence Gyamaah	Yaw Yeboah
		Anthony Baah	Esther Amankwah
TECHIMAN	**Akomadan**	Dickson Bonsu	Dora Konadu
		Tereto Derre	Stephen Acheampong
		Yaw Samuel	Kwaku Kumah
		James Y. Badu	Kwaku Mensah
		Moses Sabla	Philip Donkor
		Opanin Akwasi Fobi	Margaret Adusah
		Kofi Owusu Ansah	Boa Wilson
		David Owusu Ankra	Akwasi Boadu Ayeboafoh
	Anyima	Alfred Taah	Dikorogu Danaa
		Mary Asamoah	Alhassan Abukari
		Cecilia Asamoah	Adam Yakubu
		Haruna Bomba	Baba Seidu
		Bukari Mohammed	

Annex 5: Sample size of the Survey

Gender Against zone Strata	Proportionate Commodity Frame	Comment/Assumptions	Sample Size based on Gender
Males in Maize Farming in Ejura zone	16,666	It was assumed that male maize farmers have equal chance of getting enrolled on ADVANCE in future as female maize farmers	144
Females in Maize Farming in Ejura zone	16,666	It was assumed that female maize farmers have equal chance of getting enrolled on ADVANCE in future as maize male farmers	144
Males in Maize farming in Techiman zone	16,666	It was assumed that male maize farmers have equal chance of getting enrolled on ADVANCE in future as female maize farmers	144
Females in Maize farming in Techiman	16,666	It was assumed that female maize farmers have equal chance of getting enrolled on ADVANCE in future as maize male farmers	144
Males in maize farming in Sunyani zone	16,666	It was assumed that male male farmers have equal chance of getting enrolled on ADVANCE in future as female maize farmers	144
Females in maize farming in Sunyani zone	16,666	It was assumed that female maize farmers have equal chance of getting enrolled on ADVANCE in future as maize male farmers	144
Total of sample size (addition of all 6 sample sizes)			**864**
10% of sample size for Non-Response		%age based on total sample size	86
TOTAL SAMPLE SIZE			**950**

Annex 6: Distribution of female Education by zone

Zone	None		Primary		JSS/JHS/MSLC		SSS/SHS/Voc/Tech	
	N	%	N	%	N	%	N	%
Ejura	41	40.60	18	17.80	34	33.70	8	7.90
Techiman	40	65.60	9	14.80	10	16.40	2	3.30
Sunyani	9	22.00	9	22.00	18	43.90	5	12.20
Total	90	44.3	36	17.7	62	30.5	15	7.4

Annex 7a: Distribution of farmers' criteria for sorting after harvesting.

Criteria	Ejura		Techiman		Sunyani		Total
	N	**%**	**N**	**%**	**N**	**%**	%
Colour	42	19.4	49	19.7	13	6.2	15.5
Cob Size	12	5.6	23	9.2	13	6.2	7.1
Grain size	22	10.2	9	3.6	35	16.8	9.8
Damage	128	59.3	160	64.3	83	39.9	55.1
Colour and Damage	12	5.6	8	3.2	64	30.8	12.5

Annex 8b: Site of sorting maize after harvesting

Site for sorting	Ejura		Techiman		Sunyani		Total
	N	**%**	**N**	**%**	**N**	**%**	%
On farm	75	33.9	190	75.7	111	53.4	55.3
At the village	57	25.8	51	20.3	55	26.4	24
At the site of storage facility	89	40.3	10	4	42	20.2	20.7

Annex 9: Distribution of state in which maize is stored

State of storage	Ejura		Techiman		Sunyani		Total
	N	**%**	**N**	**%**	**N**	**%**	%
Husked	36	12	63	20	98	33.6	21.7
Dehusked	69	22.9	126	40	125	42.8	35.2
Shelled	196	65.1	126	40	69	23.6	43.1

Annex 10: Distribution of method of treatment of maize before storage

	Ejura		Techiman		Sunyani		Total
Method of treatment	**N**	**%**	**N**	**%**	**N**	**%**	**%**
Insecticide/pesticides	213	99.5	151	94.4	260	99.6	98.3
Manure	0	0	3	1.9	0	0	0.5
Smoke	1	0.5	2	1.2	0	0	0.5
Ash	0	0	4	2.5	1	0.4	0.8

Annex 11: Distribution of type of storage facility used by farmers.

Storage facilities	Ejura				Techiman				Sunyani				Total			
	Yes		No		Yes		No		Yes		No		Yes		No	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Traditional granaries (Crib)	81	26.5	225	73.5	122	37.2	206	62.8	186	60.6	121	39.4	389	41.3	552	58.7
Indoors-in baskets/bags	70	22.9	236	77.1	69	21	259	79	10	3.3	297	96.7	149	15.8	792	84.2
Indoors- Open storage	124	40.5	182	59.5	46	14	282	86	66	21.5	241	78.5	236	25.1	705	74.9
Outside- Open storage	23	7.5	283	92.5	51	15.5	277	84.5	31	10.1	276	89.9	105	11.2	836	88.8
certified warehouse	1	0.3	305	99.7	2	0.6	326	99.4	2	0.7	305	99.3	5	0.5	936	99.5

Annex 12: Estimated capacity of storage structure (Kg)

Type of storage structure	Ejura			Techiman			Sunyani		
	N	Mean	SD	N	Mean	SD	N	Mean	SD
Traditional granaries	80	8268.1	11162.76	120	5020	5572.93	191	4701	3896.83
Indoors- in baskets/bags	70	9858.6	10282.04	69	4827.5	6114.06	10	4220	3863.73
Indoors-open storage	124	8517.4	8550.44	46	4623.9	2864.12	59	6381.4	10829.53
Outside open storage	23	13804	13926.54	51	4133.3	3001.24	31	4354.8	5775.23
Certified warehouse	1	80000		2	80000	0.00	2	24000	7071.068

Annex 13: Adequacy of storage facility

Type of storage structure	Ejura				Techiman				Sunyani			
	Yes		No		Yes		No		Yes		No	
	N	%	N	%	N	%	N	%	N	%	N	%
Traditional granaries	61	76.2	19	23.8	107	62.6	64	37.4	149	61.6	93	38.4
Indoors- in baskets/bags	64	91.4	6	8.6	60	87	9	13	5	50	5	50
Indoors-open storage	103	81.1	24	18.9	41	89.1	5	10.9	52	84.8	10	16.2
Outside open storage	15	65.2	8	34.8	48	94.1	3	5.9	23	74.2	8	25.8
Certified warehouse	1	100			2	100			2	100		

Annex 14: Estimated seasonal loses

Storage facility	Ejura			Techiman			Sunyani		
	N	Mean	S.D	N	Mean	S.D	N	Mean	S.D
Traditional granaries (crib)	73	40.34	24.11	116	89.91	85.37	190	74.53	75.77

Indoors-in baskets/bags	88	26.3	34.57	21	66.19	79.79	45	72.51	127.87
Indoors- Open storage	59	41.74	56.27	64	86.72	103.84	10	19	28.75
Outside- Open storage	23	13.87	14.95	51	40.73	59.14	31	34.29	52.01

Annex 15: Major problems in using storage facilities

	Ejura		Techiman		Sunyani		Total
Storage facility/Problems	**N**	**%**	**N**	**%**	**N**	**%**	**%**
Traditional granaries							
Attack by rodents	56	81.2	36	43.4	29	25.4	45.5
Weevil infestation	4	5.8	16	19.3	81	71.1	38
Moisture	9	13	6	7.2	1	0.9	6
Theft	0	0	1	1.2	0	0	0.4
Others	0	0	24	28.9	3	2.6	10.1
Indoors-in baskets/bags							
Attack by rodents	51	86.4	35	51.5	5	50	66.4
Weevil infestation	3	5.1	30	44.1	5	50	27.7
Moisture	5	8.5	3	4.4	0	0	5.9
Indoors- Open storage							
Attack by rodents	95	91.3	12	60	6	16.7	70.6
Weevil infestation	3	2.9	8	40	18	50	18.2
Moisture	6	5.8	0	0	12	33.3	11.2
Outside- Open storage							
Attack by rodents	11	68.8	17	50	1	5	41.4
Weevil infestation	1	6.2	3	8.8	16	80	28.6
Moisture	3	18.8	9	26.5	3	15	21.4
Theft	1	6.2	5	14.7	0	0	8.6

Annex 16: Percentage new users of crop genetic and improved agronomic practices across zone and gender

	Ejura (N=306)				Techiman (N=328)				Sunyani (N=307)					
	Male (N=205)		Female (N=101)		Male (N=267)		Female (N=61)		Male (N=266)		Female (N=41)		Total new users	% of farmers (N=941)
	New users	% New users	New users	% New users	New users	% New users	New users	% New users	New users	% New users	New users	% New users		
Pioneer 30Y87 (Yellow Maize)	3	50.00	1	33.33	8	61.54	3	100.00	2	100.00	0	0.00	17	1.81
Pioneer 30F32 (White Maize)	0	0.00	0	0.00	3	23.08	1	11.11	0	0.00	0	0.00	4	0.43
Other Hybrid Seeds	0	0.00	0	0.00	5	8.47	1	6.25	1	50.00	0	0.00	7	0.74
Pan 53	1	100.00	0	0.00	2	20.00	0	0.00	0	0.00	0	0.00	3	0.32
Pan 12	0	0.00	0	0.00	1	7.14	0	0.00	0	0.00	1	100.00	2	0.21
Etubi	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Mamaba	0	0.00	0	0.00	0	0.00	1	100.00	0	0.00	0	0.00	1	0.11
Obatanpa	3	13.64	1	6.25	7	25.93	1	16.67	9	5.39	1	3.85	22	2.34
weedicide	0	0.00	0	0.00	15	5.73	4	7.02	4	1.69	0	0.00	23	2.44
insecticide	1	1.59	0	0.00	3	25.00	2	28.57	3	15.00	1	50.00	10	1.06
Planting in rows	0	0.00	1	0.99	12	5.15	4	7.69	21	11.54	2	7.69	40	4.25
Fertilizer	1	0.50	0	0.00	9	5.52	2	5.41	10	27.78	1	33.33	23	2.44
Minimum Tillage	0	0.00	0	0.00	8	6.78	4	10.26	3	5.36	0	0.00	15	1.59
Zero Tillage	0	0.00	0	0.00	5	3.82	0	0.00	2	1.10	0	0.00	7	0.74

Annex 14: Distribution of application of post-harvest, weather mitigating, ICT and water management technologies at gender and ZOI level

	Gender								Zone of Influence (N=941)			
	Male users (N=738)	% Male Users	New users male	% New Male Users	Female Users (N=203)	% Female users	New female users	% New female users	Users	% Users	New Users	% New users
Post-Harvest technology												
Sheller	627	84.96	24	3.83	172	84.73	3	1.74	799	84.91	27	3.38
Tarpaulin	380	51.49	31	8.16	133	65.52	5	3.76	513	54.52	36	7.02
Weighing Scale	83	11.25	4	4.82	12	5.91	1	8.33	95	10.10	5	5.26
Moisture Meter	75	10.16	2	2.67	9	4.43	0	0.00	84	8.93	2	2.38
Warehouse	14	1.90	0	0.00	2	0.99	0	0.00	16	1.70	0	0.00
Silo	1	0.14	0	0.00	1	0.49	0	0.00	2	0.21	0	0.00
Power Tiller	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Multi-Purpose Thresher	221	29.95	7	3.17	63	31.03	0	0.00	284	30.18	7	2.46
Climate mitigation												
Igntia Weather Update	2	0.27	0	0.00	0	0.00	0	0.00	2	0.21	0	0.00
Weather Crop Insurance Index	2	0.27	0	0.00	0	0.00	0	0.00	2	0.21	0	0.00
Water management												
Mulching	7	0.95	1	14.29	1	0.49	0	0.00	8	0.85	1	12.50
Irrigation of maize grown area	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ICT												
Esoko Market Price updates	10	1.36	4	40.00	1	0.49	1	100.00	11	1.17	5	45.45
Farm Radio	236	31.98	19	8.05	76	37.44	9	11.84	312	33.16	28	8.97

Annex 15: Distribution of application of post-harvest, weather mitigating, ICT and water management technologies at zonal level

	Ejura (N=306)				Techiman (N=328)				Sunyani (N=307)			
	Users	% Users	New users	% New users	Users	% Users	New users	% New users	Users	% Users	New users	% New users
Post-Harvest technology												
Sheller	303	99.02	2	0.66	298	90.85	13	4.36	198	64.50	12	6.06
Tarpaulin	292	95.42	12	4.11	154	46.95	14	9.09	67	21.82	10	14.93
Weighing Scale	4	1.31	4	100.00	87	26.52	1	1.15	4	1.30	0	0.00
Moisture Meter	0	0.00	0	0.00	84	25.61	2	2.38	0	0.00	0	0.00
Warehouse	0	0.00	0	0.00	7	2.13	0	0.00	9	2.93	0	0.00
Silo	0	0.00	0	0.00	2	0.61	0	0.00	0	0.00	0	0.00
Power Tiller	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Multi-Purpose Thresher	120	39.22	0	0.00	113	34.45	7	6.19	51	16.61	0	0.00
Climate mitigation												
Igntia Weather Update	0	0.00	0	0.00	2	0.61	0	0.00	0	0.00	0	0.00
Weather Crop Insurance Index	0	0.00	0	0.00	1	0.30	0	0.00	1	0.33	0	0.00
Water management												
Mulching	0	0.00	0	0.00	1	0.30	0	0.00	7	2.28	1	14.29
Irrigation of maize grown area	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
ICT												
Esoko Market Price updates	0	0.00	0	0.00	10	3.05	4	40.00	1	0.33	1	100.00
Farm Radio	185	60.46	12	6.49	51	15.55	13	25.49	76	24.76	3	3.95

Annex 16: Distribution of application of cultural practices, management practices and disease management technologies at gender and ZOI level

	Gender								Zone of Influence (N=941)			
	Male users (N=738)	% Male Users	New users male	% New Male Users	Female Users (N=203)	% Female users	New female users	% New female users	Users	% Users	New Users	% New users
Management practices												
Book/Record keeping	69	9.35	7	10.14	9	4.43	0	0.00	78	8.29	7	8.97
Sales/Purchase Receipt	30	4.07	1	3.33	4	1.97	0	0.00	34	3.61	1	2.94
Pricing and costing	16	2.17	0	0.00	6	2.96	0	0.00	22	2.34	0	0.00
SMS	4	0.54	2	50.00	0	0.00	0	0.00	4	0.43	2	50.00
Warehouse Receipt	5	0.68	1	20.00	0	0.00	0	0.00	5	0.53	1	20.00
Farm/Crop Budgeting	52	7.05	1	1.92	8	3.94	1	12.50	60	6.38	2	3.33
Sustainability Plan	67	9.08	3	4.48	17	8.37	3	17.65	84	8.93	6	7.14
Disease Management												
Integrated Pest Management	30	4.07	2	6.67	5	2.46	1	20.00	35	3.72	3	8.57
Cultural practices												
Rotation of crops with Nitrogen fixing crops (legumes)	174	23.58	24	13.79	69	33.99	14	20.29	243	25.82	38	15.64
Land fallowing	152	20.60	20	13.16	32	15.76	10	31.25	184	19.55	30	16.30
Inter-cropping	88	11.92	12	13.64	17	8.37	2	11.76	105	11.16	14	13.33
Cover cropping	15	2.03	2	13.33	4	1.97	2	50.00	19	2.02	4	21.05
Mono-cropping	404	54.74	6	1.49	145	71.43	3	2.07	549	58.34	9	1.64

Use of other erosion control methods in the farm	11	1.49	2	18.18	3	1.48	1	33.33	14	1.49	3	21.43

Annex 17: Distribution of application of cultural practices, management practices and disease management technologies at zonal level

	Ejura (N=306)				Techiman (N=328)				Sunyani (N=307)			
	Users	% Users	New users	% New users	Users	% Users	New users	% New users	Users	% Users	New users	% New users
Management practices												
Book/Record keeping	17	5.56	1	5.88	22	6.71	3	13.64	39	12.70	3	7.69
Sales/Purchase Receipt	12	3.92	0	0.00	1	0.30	0	0.00	21	6.84	1	4.76
Pricing and costing	5	1.63	0	0.00	5	1.52	0	0.00	12	3.91	0	0.00
SMS	0	0.00	0	0.00	3	0.91	1	33.33	1	0.33	1	100.00
Warehouse Receipt	0	0.00	0	0.00	2	0.61	1	50.00	3	0.98	0	0.00
Farm/Crop Budgeting	3	0.98	1	33.33	8	2.44	1	12.50	49	15.96	0	0.00
Sustainability Plan	33	10.78	5	15.15	5	1.52	1	20.00	46	14.98	0	0.00
Disease Management												
Integrated Pest Management	17	5.56	0	0.00	14	4.27	2	14.29	4	1.30	1	25.00
Cultural practices												
Rotation of crops with Nitrogen fixing crops (legumes)	179	58.50	29	16.20	27	8.23	7	25.93	37	12.05	2	5.41
Land fallowing	36	11.76	11	30.56	53	16.16	19	35.85	95	30.94	0	0.00
Inter-cropping	9	2.94	1	11.11	38	11.59	8	21.05	58	18.89	5	8.62
Cover cropping	5	1.63	1	20.00	10	3.05	0	0.00	4	1.30	3	75.00
Mono-cropping	300	98.04	1	0.33	137	41.77	8	5.84	112	36.48	0	0.00
Use of other erosion control methods in the farm	7	2.29	0	0.00	6	1.83	3	50.00	1	0.33	0	0.00

Annex 18: Area allocated to land based technologies among males and females across the ZOI

Gender	Male				Female				Total			
Technology	N	Mean	Sum	SD	N	Mean	Sum	SD	N	Mean	Sum	SD
Pioneer 30Y87 (Yellow Maize)	21	1.29	27.00	0.85	6	1.27	7.6	0.85	27	1.28	34.6	0.83
Pioneer 30F32 (White Maize)	23	2.17	50.00	1.66	13	1.11	14.4	0.57	36	1.79	64.4	1.45
Other Hybrid Seeds	64	2.73	174.60	2.53	17	1.55	26.4	1.23	81	2.48	201	2.36
Pan 53	14	1.69	23.60	1.31	2	2	4	0	16	1.73	27.6	1.23
Pan 12	18	1.71	30.80	0.92	1	1.6	1.6	0	19	1.71	32.4	0.89
Etubi	0	0	0	0	0	0	0	0	0	0	0	0
Mamaba	14	2.97	41.6	1.41	1	4	4	0	15	3.04	45.6	1.38
Obatanpa	248	3.00	743.60	5.08	48	1.83	87.6	2.4	296	2.81	831.2	4.76
weedicide	699	2.99	2089	4.42	191	1.63	311.4	1.53	890	2.7	2400.4	4.02
insecticide	95	3.03	287.6	2.87	36	2.05	73.8	2.39	131	2.76	361.4	2.77
Planting in rows	624	2.79	1740.8	4.03	179	1.66	297.6	1.96	803	2.54	2038.4	3.7
Fertilizer	398	3.19	1270	4.71	140	1.73	242.8	1.65	538	2.81	1512.8	4.19
Minimum Tillage	379	2.75	1042.8	2.69	150	1.57	235.8	1.54	529	2.42	1278.6	2.47
Zero Tillage	312	2.93	913.2	4.94	43	1.4	60	1.13	355	2.74	973.2	4.67

Annex 19: Land allocation to technology by zone

Zone	Ejura				Techiman				Sunyani				Total			
Technology	N	Mean	Sum	SD	N	Mean	Sum	SD	N	Mean	Sum	SD	N	Mean	Sum	SD
Pioneer 30Y87 (Yellow Maize)	9	1.04	9.4	0.82	16	1.43	22.8	0.89	2	1.2	2.4	0	27	1.28	34.6	0.83
Pioneer 30F32 (White Maize)	8	1.75	14	1.25	22	1.98	43.6	1.64	6	2	6.8	1.13	36	1.92	64.4	1.45
Other Hybrid Seeds	4	1.35	5.4	0.91	75	2.57	192.4	2.42	2	1.6	3.2	1.13	81	2.48	201	2.36
Pan 53	1	0.2	0.2	.	12	2.05	24.6	1.24	3	0.93	2.8	0.23	16	1.73	27.6	1.23
Pan 12	0	0	0	0	14	1.71	24	0.89	5	1.68	8.4	1	19	1.71	32.4	0.89
Etubi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mamaba	0	0	0	0	14	2.8	39.2	1.06	1	6.4	6.4	.	15	3.04	45.6	1.38
Obatanpa	38	3.52	133.8	3.26	65	2.99	194.4	2.30	193	2.61	503	5.56	296	2.81	831.2	4.76
Weedicide	301	2.53	761.4	2.55	319	2.62	834.4	2.29	270	2.98	804.6	6.32	890	2.7	2400.4	4.02
Insecticide	90	2.76	248.4	2.85	19	3.92	74.4	3.20	22	1.75	38.6	1.39	131	2.76	361.4	2.77
Planting in rows	304	2.52	765.4	2.54	285	2.37	676.4	2.66	214	2.79	596.6	5.74	803	2.54	2038.4	3.7
Fertilizer	299	2.46	736	2.42	200	2.82	564.6	2.80	39	5.44	212.2	12.36	538	2.81	1512.8	4.19
Minimum Tillage	306	2.52	772	2.53	157	2.29	359.4	2.43	66	2.23	147.2	2.31	529	2.42	1278.6	2.47
Zero Tillage	0	0	0	0	149	2.67	397.4	2.08	206	2.8	575.8	5.88	355	2.74	973.2	4.67

Annex 20: Percentage of all farmers (N=941) expressing levels of satisfaction with access to input by zone

Zones	Input outlet	Very Satisfied		Satisfied		Not too satisfied		Unsatisfied		Very unsatisfied	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Ejura	Fertilizer	35.60	18.60	4.90	3.90	10.10	3.40	5.20	1.00	11.10	6.20
	Insecticide	50.70	27.10	3.90	2.70	6.90	1.60	1.60	0.30	3.90	1.30
	Herbicide	50.30	27.50	4.90	2.30	6.20	1.30	2.00	0.30	3.60	1.60
	Improved seed	6.50	4.20	2.30	0.00	3.90	1.60	3.30	2.00	51.00	25.20
Techiman	Fertilizer	47.60	8.80	6.40	2.70	4.00	1.20	2.70	0.30	20.80	5.50
	Insecticide	36.00	6.40	3.00	0.30	6.10	1.80	5.80	1.20	30.60	8.80
	Herbicide	48.20	8.50	10.10	4.90	4.30	0.30	1.50	0.00	17.40	4.80
	Improved seed	14.60	5.20	0.90	0.30	4.60	2.10	6.40	1.50	54.90	9.50
Sunyani	Fertilizer	39.70	3.90	13.70	2.60	19.90	2.90	0.70	0.00	12.70	3.90
	Insecticide	38.10	4.60	9.40	2.00	20.50	2.60	1.00	0.70	17.60	3.50
	Herbicide	51.80	4.80	17.50	3.30	2.00	0.70	0.70	0.70	14.70	3.80
	Improved seed	40.70	5.20	5.20	1.30	20.20	2.60	2.00	0.30	18.60	3.90
Total	Fertilizer	41.10	10.40	8.30	3.10	11.20	2.40	2.90	0.40	15.00	5.20
	Insecticide	41.40	12.50	5.40	1.60	11.10	2.00	2.90	0.70	17.70	4.70
	Herbicide	50.10	13.50	10.80	3.50	4.10	0.70	1.50	0.30	12.00	3.50
	Improved seed	20.50	4.90	2.80	0.50	9.50	2.10	3.90	1.30	41.80	12.70