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Expanding Opportunities Worldwide

FINAL REPORT

ADVANCE II BASELINE STUDIES FOR NORTHERN GHANA

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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
AGRA	Alliance for Green Revolution in Africa
AgSSIP	Agricultural Services Sub-sector Investment Project
APSP	Agriculture Policy Support Project
ATTP	Agriculture Technological Transfer Project
BIRD	Bureau of Integrated Rural Development
CAADP	Comprehensive Africa Agriculture Development Programme
CFSVA	Comprehensive Food Security and Vulnerability Analysis
CIP	Country Investment Plan
DEPI	Department of Environment and Primary Industries
DO2	Development Objective Two
EAs	Enumeration Areas
EDIF	Export Development and Investment Fund
F2F	Farmer to Farmer
FAO	Food and Agriculture Organization
FASDEP	Food and Agriculture Sector Development Policy
FBOs	Farmer Based Organizations
FGD	Focus Group Discussions
FinGAP	Financing Ghana's Agriculture Project
FTF	Feed The Future
GDP	Gross Domestic Product
GOG	Government of Ghana
GPS	Global positioning system
GSGDA	Ghana Shared Growth and Development Agenda
GSS	Ghana Statistical Service
HDD	Household Dietary diversity
ICOUR	Irrigation Company of Upper Regions
ICT	Information and Communication Technology
IFDC	International Fertilizer Development Sector
IRs	Intermediate Results
ISSER	Institute of Statistical Social and Economic Research
KII	Key Informant Interviews
M&E	Monitoring and Evaluation
MEL	Monitoring, Evaluation and Learning
METASIP	Medium Term Agriculture Sector Investment Plan
MiDA	Millennium Development Authority
MIHFP	Months of Inadequate Household Food Provisioning
MoFA	Ministry of Food and Agriculture
MoU	memorandum of Understanding
NBSSI	National Board for Small Scale Industry
NGOs	Non-Government Organizations
NRGP	Northern Rural Growth Project
PMP	Performance Management Plan
PPME	Policy, Planning, Monitoring and Evaluation
PPMED	Policy Planning, Monitoring and Evaluation Department

RING	Resiliency In Northern Ghana
SARI	Savannah Agriculture Research Institute
SD	Standard Deviation
SOW	Scope of Work
SPSS	Statistical Package for Service Solutions
TOC	Theory of Change
UER	Upper East Region
UNDP	United Nations Developments Program
UNIDO	United Nations Industrial Development Organization
USAID	United State Agency for International Development
UWR	Upper West Region
VC	Value Chain
VSD	Veterinary Science Division
WFP	World Food Program
ZOI	Zone Of Influence

EXECUTIVE SUMMARY

The Ghana Agricultural Development and Value Chain Enhancement (ADVANCE) project is one of the several donor interventions in the three Northern regions. 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 project's first phase (ADVANCE I) commenced on 14th July 2009 and ended on 13th March 2014. ADVANCE I adopted a long-term sustainable and comprehensive value chain approach by working through commercial actors as conduits for reaching out to large number of smallholders, ensuring that improved practices remain in the market system after the end of the project. The next phase of the project, ADVANCE II, is being implemented for five years. The second phase of the project began on 5th February 2014 and will end on 30th September 2018. In ADVANCE II, emphasis is being laid on the intermediate results of USAID's FTF Strategic Objective 3 i.e. improved nutritional status, especially of women and children; and Strategic Objective 4 i.e. inclusive agriculture sector growth.

In order for ADVANCE II to obtain information to test the Project's causal pathway as outlined in its Theory of Change, confirm the targets of key indicators and lay the groundwork for impact assessment, BIRD was contracted to undertake a Baseline Study for ADVANCE II. The purpose of the baseline study was to estimate and present baseline information of the required indicators of ADVANCE II. The study covered the three Northern regions (Zone of Influence); Upper East, Upper West and Northern. The target commodities were maize, rice and soya. The data collection instruments used included structured questionnaire and interview checklist. Focus group discussions, household and key informant interviews, were conducted in addition to field observations. Data collection was carried out between November and December 2014 with a farmer household sample size of 2,657 comprising 61.4% males and 38.6% females. Both quantitative and qualitative methods were used in data gathering and analysis.

The key findings are outlined as follows:

- The TOC of ADVANCE II is consistent with the national development agenda of reducing poverty and improving the living conditions of citizens. 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 II TOC. An important common link is enhancing competiveness of the private sector, in this case, value chain actors in the three commodities (rice, soya and maize) which is the focus of ADVANCE II.
- 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 three northern regions of Ghana, 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 ADVANCE II. All too often, farmers produce in response to interventions such as those proposed in ADVANCE II 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 access road to markets.

Regardless of this gap, an assessment of the Theory of Change of ADVANCE II indicated that it will impact positively on the livelihoods of the farmer households in the three Northern regions. Responses of farmers during the survey showed that the use of improved technologies, farmer access to credit and markets, extension services and training, enhancement of value chain actors among others have positive correlation with farmers' productivity and improvement in the quality of life of farmers.

The baseline values for key project indicators are summarized in the matrix below (see Section 6.0 for detailed discussion).

Type	Indicator	Baseline 2014					
			Region			Sex	
		Regional	Northern	Upper East	Upper West	Male	Female
Outcome	Yield per hectare of maize (MT/ha)	1.38	1.34	1.45	1.74	1.39	1.31
	Yield per hectare of rice (MT/ha)	1.61	1.48	1.71	1.76	1.71	1.39
	Yield per hectare of soya (MT/ha)	0.89	0.90	0.75	1.11	0.94	0.71
Outcome	Gross margins for maize (GHS)*	752.00	744.87	823.78	615.46	735.36	768.64
	Gross margins for rice (GHS)*	675.61	407.62	915.11	1081.85	688.11	663.11
	Gross margins for soya (GHS)*	701.48	745.67	567.19	934.04	838.31	564.65
Outcome	• Number of targeted farmers and others who have applied new technologies or management practices	2432	1106	519	807	1475	957
	• New application of technology	513	275	112	126	353	160
	• Continuing application of technology	1919	831	407	681	1122	797
Outcome	Value of sales of maize (GHS)	1,236,937.29	590,001	243,392	389,490	1,053,361.90	183,575.39
	Value of sales of rice (GHS)	980,781.12	230,490	281,879	183,296	713,207.25	267,573.87
	Value of sales of soya (GHS)	847,784.05	428,929	116,470	140,710	692,929.25	154,854.81
Output	Number of hectares under hybrid maize, and other new technologies or management practices	3290.66	1452.4	759.26	1079	2386.3	904.36
Output	Percentage of farmers with access to agricultural training	18.1	22.1	26.2	8.4	19.1	16.5
Output	Percentage of farmers with access to credit	2.9	2.1	5.8	2.4	3.4	2.1

* The Regional Gross Margin figures are averages from extrapolated values (see section 4.2.4)

Among all surveyed farmers, maize production remains the single farm activity with the highest average gross margin of GHS 752.00. Gross margins for maize were estimated at GHS 735.36 and GHS 768.64 for males and females respectively. Similarly, Gross margins for rice were estimated at GHS 688.11 (males) and GHS 663.11 (females), and that of soya were GHS 838.31 (males) and GHS 564.65 (females).

Male farmers were dominant in terms of numbers in all three crops in the three regions; they also had larger farm sizes and more farm plots. Females dominated (in terms of numbers) in the cultivation of soya bean in the Northern Region

Most farm sizes were small. Women were disadvantaged in terms of land allocation and access in the three northern regions. The average farm size for males and females in the ZOI were 1.61 ha and 1.06 ha respectively. Across the regions, the allocated average hectares for maize, rice and soya was estimated at 1.83ha, 1.14ha and 1.18ha respectively. Among the regions, Upper West region recorded the largest average farm size for maize (1.85ha) followed by the Upper East (1.83ha). Among the three commodities, rice recorded the least average farm size (1.14ha) across all the regions.

The local practices that farmers adopted to improve on soil fertility in the study area were: land fallow to replenish soil fertility; cover crop to decrease soil erosion; irrigation to retain soil water; mulching and manure as organic fertilizer; and chemical fertilizer to maintain or improve soil fertility.

The survey found out that there was a poor savings culture and low access to loan among respondents. Apart from Upper East region where about 5% of respondents used loans to purchase farm inputs, the rest of the regions recorded less than 3%.

Among the three commodities surveyed, labor input cost accounted for a larger proportion (at least 52%) relative to other farm inputs costs across the three regions.

With the exception of row planting of soya bean and use of weedicides in rice production, usage rate of improved technologies are below 50% of male and female farmers across the 3 regions. The study suggested that technology application is generally low across the ZOI.

Among the technologies that have been introduced to farmers, fertilizer, weedicides and row planting, showed relatively higher percentage usage. Fertilizer application was practiced by 650 farmers (49.9%), 281 farmers (44.1%) and 172 famers (23.9%) in maize, rice and soya production respectively across the ZOI. Weedicides were applied by 49.8%, 58.8% and 49.7% in maize, rice and soya production respectively. Across the 3 northern regions, the practice of row planting was most common among soya producers (73.7%). There were more farmers using row planting in maize (41.6%) than rice (26.1%).

On the whole, there are more farmers applying at least one technology than there are new users. For instance, a minimum of 74% of all farmers adopted at least 1 technology regardless of time. Among maize farmers, 95% adopt at least one technology whereas 30% are new users of at least one technology. Regardless of time of commencement, majority of farmers use two (2) to five (5) technologies. About 50%, 48% and 72% respectively for maize, rice and soya were found doing so. Even within continuous and new users, use of 2-5 technologies emerges the norm among all 3 food crop farmers.

Extension services had concentrated on agronomic practices relegating agriculture business management skills to the background.

The following variables: assess to extension services; assess to training; level of education; land size; and whether a beneficiary of ADVANCE I or not, were examined to assess their influence on maize, rice and soya bean outputs within the Zone of Influence.

The results indicated that all variables contributed 3.3% to maize yield per hectare. Among the selected variables, 'beneficiaries of ADVANCE I', had the highest contribution to maize yield (11.2%, p=0.000) followed by 'agricultural land size' (10.2%, p=0.000).

For Rice, results indicated that all variables contributed 10.2% to yield. Among the selected variables 'beneficiaries of ADVANCE I' had the highest contribution to rice yield (16.2%, p=0.000) followed by 'extension services' (13.6%, p=0.005).

For soya bean, in the ZOI all variables contributed 2.5% to yield. Among the selected variables 'land size' had the highest contribution to soya yield (14.3%, p=0.000).

Regarding access to marketing information, the study revealed that about 72% of respondents had access to marketing information across the ZOI. Marketing information for maize was readily available to the cultivators within the three regions. In terms of volume, maize comparatively had the highest market, followed by rice and soya. Apart from feeding households with maize, the market for maize is readily available and has a diverse use as compared to soya and rice

The study revealed a weak linkage between input suppliers and producers for the three study commodities (maize, rice and soya bean). Rice had the best developed value chain linkage.

Recommendations:

Productivity of target commodities:

- Improve access to input supply to producers in the value chain.
- Train farmers on Good Agronomic Practices (GAPs) to improve their production
- Farmers should be educated on value addition of the commodities, especially soya to increase their profit margins.
- Women access to farm inputs and support services such as credit, tractor services, improved seed and fertilizer should be improved to encourage more women to go into agricultural production especially rice. Interventions in the areas of awareness creation targeting women's specific needs in credit, tractor services and agricultural inputs must be given the requisite attention. Operational rules, such as guarantee for access to credit and other services must be varied in terms of collateral requirements and flexible payment schedules for women farmers.

Market access and trade linkages

- The nucleus farmers should be supported to enhance the provision of services to the out-growers particularly marketing, storage facilities such as silos, credit and technical know-how.
- Transporters should be identified and mainstreamed into the value chain process.
- Improve accessibility and linkages between out-growers and nucleus farmers.
- Collaboration between ADVANCE, local radio stations and MoFA should be enhanced to improve market information to farmers.

- Improve the link between nucleus farmers, aggregators and other farmer platforms, example ESOKO.
- Standardization of market prices of farm produce would boost productivity. For example, minimum prices for accepted standard weights for the three commodities should be promoted

Local capacity

- The link between farmers and credit institutions must be enhanced to streamline and help farmers acquire credit.
- Strengthen leadership capacity of women.
- Encourage the use of group savings to help investment in agriculture.
- Improve extension services and training.
- Individual farmers should be encouraged to have better savings culture.
- It will be prudent that for similar future assignments, field visits should be done around harvesting period to ensure that the crop cut activity could be executed.

It considered that ADVANCE II will make the required impact on the livelihoods of the farmer households in the three Northern regions if the productivity levels of the targeted commodities, market access and trade linkages as well as local capacity of the beneficiaries are improved.

1.0 INTRODUCTION

1.1 Brief Project Background

Agriculture development in Ghana has since independence received massive boost from her development partners. In the three northern regions there have been concerted efforts by the government in partnership with her development partners to ensure food security due to the regions' comparatively worse poverty situation. The three regions have the potential to become food self-sufficient because of their comparative advantage in cereal and legume production. Several donor funded projects have taken advantage of this and the impacts are very encouraging. The Ghana Agricultural Development and Value Chain Enhancement (ADVANCE) project is one of such donor interventions. ADVANCE is funded by USAID's Ghana Mission under the global Feed The Future (FTF) program. The project's first phase (ADVANCE I) was awarded through the Farmer-to-Farmer (F2F) Leader with Associates Award under an Associate Cooperative Agreement and implemented by ACDI/VOCA in partnership with Technoserve, Winrock International, ACDEP and PAB Consult. The agreement was signed on 14th July 2009 and implementation was completed on 13th March 2014.

The overall goal of the FTF 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 I adopted a long-term sustainable and comprehensive value chain approach by working through commercial actors as conduits for reaching out to large number of smallholders, ensuring that improved practices remain in the market system after the end of the project.

The project reached over 31,706 rural households directly impacting 34,121 (38% female) producers. Prior to the start of the FTF program and the move to the north in September 2011, the project had worked with 19,449 producers in the south.

Under FTF, over 32,478 beneficiaries (45% women) were trained to acquire new skills and knowledge in production technologies, management practices, 'farming as a business', and numeracy skills, all of which enabled them to operate their farms in a more business-like manner leading to improvements in yields and gross margins. For technical training of smallholder farmers, the project set up 326 demonstration sites in collaboration with private sector firms to showcase good agricultural practices in maize, rice and soybean between 2011 and 2013, and another 437 on citrus in the south prior to 2011. Over 84% of all beneficiaries in northern Ghana applied at least one new technology or management practice contributing to substantial yield increases and gross margins.

The next phase of the project, ADVANCE II, is being implemented for five years. The project was awarded to ACDI/VOCA and three consortium partners (Technoserve, ACDEP and PAB Consult) on 5th February 2014 and will end on 30th September 2018. ADVANCE II contributes to the intermediate results of USAID's FTF Strategic Objective 3 i.e. improved nutritional status, especially of women and children; and Strategic Objective 4 i.e. inclusive agriculture sector growth.

1.2 Program Description, context and rationale

The overall goal of ADVANCE II is to increase competitiveness of the maize, rice and soybean value chains. Its intermediate results are; (i) increased productivity in targeted commodities, (ii) increased market access and trade, and (iii) strengthened local capacity. The ADVANCE II will achieve the stated goal of improving value chain competitiveness in the three commodities and directly benefit 100,000 value chain actors, mostly smallholder farmers 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 over the last two years in northern Ghana implementing ADVANCE I.

ADVANCE II 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)

The ADVANCE II has also been designed in tandem with other USAID's economic growth office projects under the FTF initiative, including the Agricultural Technology Transfer Project (ATT), Financing Ghana's Agriculture Project (FinGAP), Agricultural Policy Support Project, the Ghana Commercial Agriculture Policy Program (GCAP), and Resiliency in Northern Ghana (RING) Project. However, ADVANCE II is one of the activities under USAID Ghana FTF Intermediate Result (IR) 1: increased competitiveness of agricultural value chains and it focuses on maize, rice and soybean in the north of Ghana. And indeed, ADVANCE II has been planned to take advantage of the other USAID activities, their overlap with its specific activities, and potential challenges. ADVANCE II 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 the poorest in the country but have enormous potential in agriculture, especially cereals, grains and legumes. Enhancing livelihoods of over four million people in the three northern regions will in greater part hinge on developing value chains that will improve farmers' productivity in cereals, grains and legumes. The project's purpose, which in part, is scaling-up of strategic investments in targeted value chains that

incentivize innovation and investment, while mitigating risks, will lead to improved competiveness of the value chains and increased incomes for male and female smallholders, is rationally sound. Also, the part of the hypothesis which is increased spending and investment on the part of male and female farmers and other value chain actors will multiply new opportunities. It will offer the poor expanded opportunities in the rural non-farm sector and lead to reductions in poverty levels, is justifiable within the socio-economic context of the national and regional development strategies.

1.3 Objectives of the Assignment

The assignment is a baseline study of the Feed the Future (FTF) Program in the three northern regions of Ghana. The assignment responds directly to DO2 of the FTF program which encompasses the following:

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

The contract to execute the assignment was signed by the Offeror on 29th of August, 2014 for work to effectively begin on the 1st of October, 2014. The timing of the baseline study for ADVANCE II is appropriate as FTF projects move into a new phase. This will not only help in getting very good performance management plans for the project but ensure the achievement of evidence based results needed to inform policy.

The specific objectives of the baseline study were to:

- provide knowledge to test causal pathways as outlined in the Theory of Change of the ADVANCE II Project (see Figure 4)
- confirm the targets of key indicators of ADVANCE II
- 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 II 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 the FTF interventions. Specific interim outputs included the following:

- Inception Report
- Development of data gathering instruments
- Enumerators' Training Manual
- Progress reports
- Field related outputs (including clean data set with variable and value labels, Syntaxes used for the analysis.
- 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. The next section, section two, reviews the literature and presents the conceptual frameworks on food security in northern Ghana, value chain, theory of change of the ADVANCE II 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 Project Final Completion Report, Agricultural Development and Value Chain Enhancement Feed the Future Activity (ADVANCE II), USAID Feed The Future Initiative: Monitoring, Evaluation and Learning (MEL) Plan and other literature which have 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 II. 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 three commodities 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 8°-11° N latitude and 0°-3° W longitude (see Figure 1). It comprises Upper East Region (UER), Upper West Region (UWR) and Northern Region (NR) with Bolgatanga, Wa and Tamale as the administrative capitals respectively. It occupies total land area of 97,702 square kilometers (sq. km), making up 40.9% of total land area of Ghana within the ZOI, the Regional land areas are as follows: UER 8,842sq. Km: 9.0%., UWR 18476sq. km: 19.0% and NR 70,384 sq. km: 72.0%.

The terrain is low lying and slightly undulating with gentle slopes and heights between 120 – 150m and plateaus of average height of 400m with isolated peaks of 430m above sea level. The area is drained by major rivers such as Nasia, Daka, Oti, Black Volta and White Volta.

The climate is relatively dry; with semi-arid guinea/Sahel and Sudan savannah in the UER and UWR to the sub-humid or tropical savannah around NR (Benneh and Gyasi, 1993).

The area experiences a uni-modal rainfall between May and November (750mm and 1050mm per annum). It also experiences prolonged dry harmattan winds from November to April with characteristic annual bushfires. The vegetation is Guinea and Sudan and Sahel savannah (in the extreme north east) characterized by vast areas of grassland with scattered common trees such as baobab, shea, dawadawa, mango, neem and acacia trees. The soils are low in organic matter.

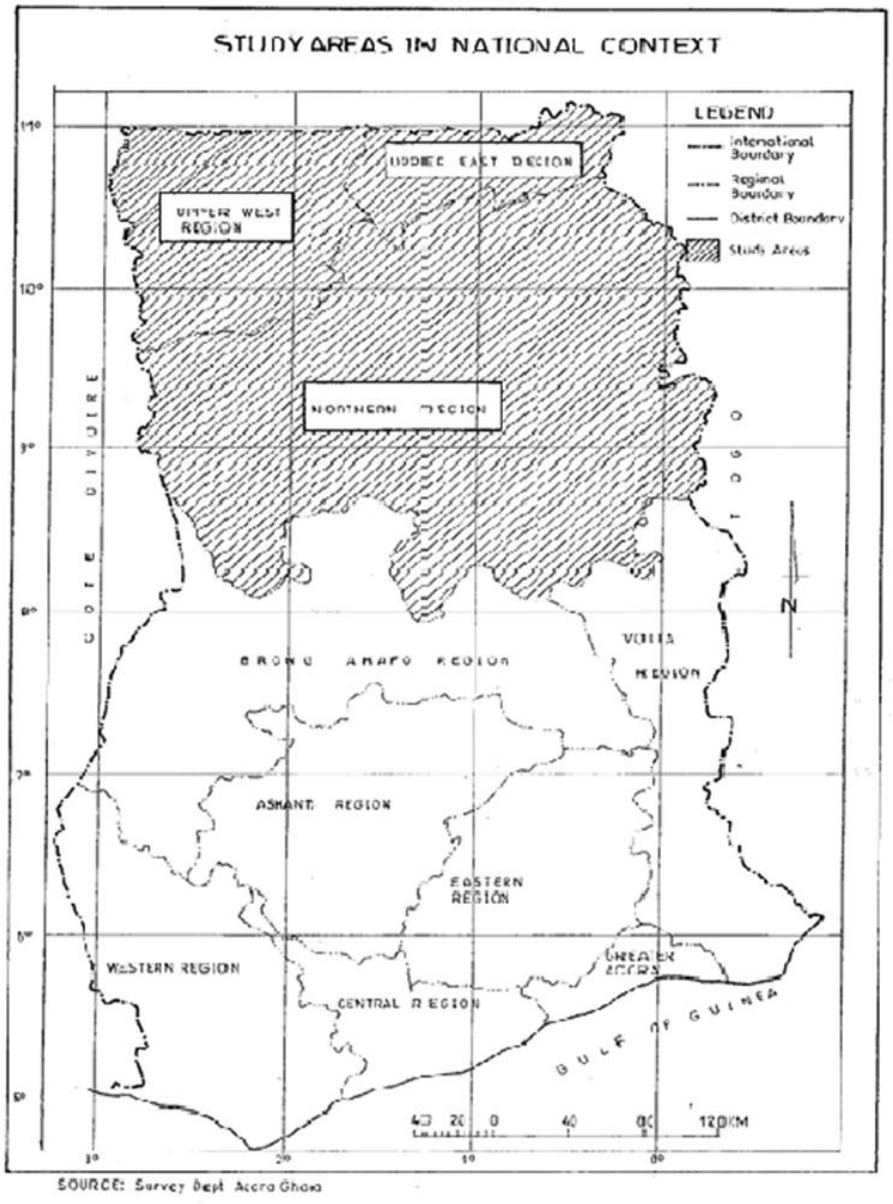


Figure 1: Map of the Zone of Influence

Demographic characteristics

The total population of the Northern region is 2,479,461 (GSS, 2012). Out of this number, the rural population is 1,898,400 and the population density is 35.2 per sq. km. The total number of farm households is 16,580 and total number of farmers is estimated at 324,551 comprising 202,457 males and 122,094 females.

The total population of Upper East Region is 1,046,545 comprising 48% males and 52% females. The region's population density of 118 persons per square kilometer (GSS, 2012) is

higher than the national density of 103.4 persons per square kilometer, ranking fifth in the country. The Upper East Region records the least population growth rate of 1.2% per annum, which is slightly below one-half the national growth rate of 2.5 per cent and is the lowest regional growth rate in Ghana.

The population is primarily rural (84.3%) and scattered in dispersed settlements. With only 15.7 per cent of the population living in urban areas, the region is the least urbanized in the country. There are 144,382 households in Upper East occupying 88,401 houses.

The total population of the Upper West region is 702,110 representing 2.8 percent of the national population. There are 80,599 households in the region, which is about 2.2 per cent of the total households in the country. The total number of houses in the region is 51,898; which gives the average number of 1.6 households per house.

2.2 Agriculture

Indeed about 80% of the total population is directly or indirectly supported by agriculture and related activities. The bulk of production is by smallholders who constitute about 80 to 90% of the farming population (PPMED, 1991). The cultivation of cereals, legumes, vegetables and tree crops is common in Northern Ghana Crop production is mainly rain-fed. Large-scale mechanized farming is not common in the study area.

Some level of irrigation systems are found in the study area. According to Blench and Dendo (2007) dams, particularly by Irrigation Company of Upper Region (ICOUR) and dugouts, are used during the dry season cultivation. Natural floodplain cultivation and flood-retreat systems exist but are still very low-level. The use of small pumps along river systems for dry-season gardens is becoming more common but still remains sporadic.

The focus crops, maize, rice and soya bean, production is dominated by smallholder farmers who depend mainly on rainfall. The cultivation of these crops 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. The regions are also noted to be the leading producer of sorghum, millet, yam, groundnut, cowpea and tomatoes.

The Northern regions are noted for their livestock production. Livestock is kept as a minor occupation for diverse purposes and is common throughout the area. Among the animals kept are cattle, small ruminants (sheep, goat), guinea fowls, rabbits and pigs. The impact of increasing population is gradually leading to increased pressure on land and this has, therefore, resulted in a higher level of interaction between crop and livestock activities. In spite of livestock farming being on a lower level, the study area produce more than 25% of the country's poultry, 30% of sheep, 35% of goats, 40% of pigs, and 70% of cattle. The Northern region has the largest livestock population and is ranked number one in terms of cattle, sheep, goat, and pig production in the entire country.

Fishing is not a key economic activity in Northern Ghana in spite of the presence of major rivers such as Black and White Voltas. However, significant fishing has been recorded along these rivers particularly the White Volta River in the Upper East Region, and at dam sites of other permanent water bodies.

2.3 Conceptual framework of Food Security in Northern Ghana

The 2009 World Food Program (WFP) report on food security and vulnerability in Ghana uses the following definition of food (in) security which was defined at the World Food Summit in 1996: "All people, at all times, have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life" (WFP, 2009).

A study conducted by the WFP in Ghana in 2009 revealed that at a regional level, 34 per cent of the population in the Upper West Region is food insecure, followed by 15 per cent in Upper East and 10 per cent in the Northern Region. This means that approximately 453,000 people are food insecure in northern Ghana. A report presented in 2009 by WFP indicated that the northern regions are the most vulnerable in terms of food security; the report estimated that 507,000 (40%) people are vulnerable of becoming food insecure in the rural areas of the ZOI (WFP, 2009).

ADVANCE II intervention regions are considered among the poorest in the country in spite of the existence of enormous potential to achieve food security due their comparative advantage in cereals, grains and legume production. Poverty in the Northern Regions has both short and long term aspects which are inter linked with seasonal food insecurity. The underlying factors of food security or food insecurity in the Northern Regions is the general low yields of produce which are due to unfavorable weather, lack of agricultural inputs, storage and processing facilities, good market links and poor road networks. Thus chronic food insufficiency is a trend and it compels individuals and households to store their produce for the lean seasons and majority will sell only when they need some cash to meet family needs such as expenditure on education and health (Field Survey, 2014). Such expectations affect the food security of the farm household in the Northern Regions in terms of acquisition and consumption of food.

In the three northern regions various concepts have been proposed for food security. These are focused on access, availability, utilization and stability as used by institutions and agencies such as FAO, USAID for their respective programs. However, in this study due to the centrality of value chain enhancement, the conceptual framework for analysis of food security in the regions focused on improving accessibility and adequacy of:

- agricultural inputs and good roads
- technologies and practices
- value chain mechanisms
- maintenance of acquirement and consumption

The model (Figure 2) shows the parameters within which to situate and analyse the determinants of food security in the study area. It further explicates how food security can address poverty in the Northern Regions of Ghana from a development perspective.

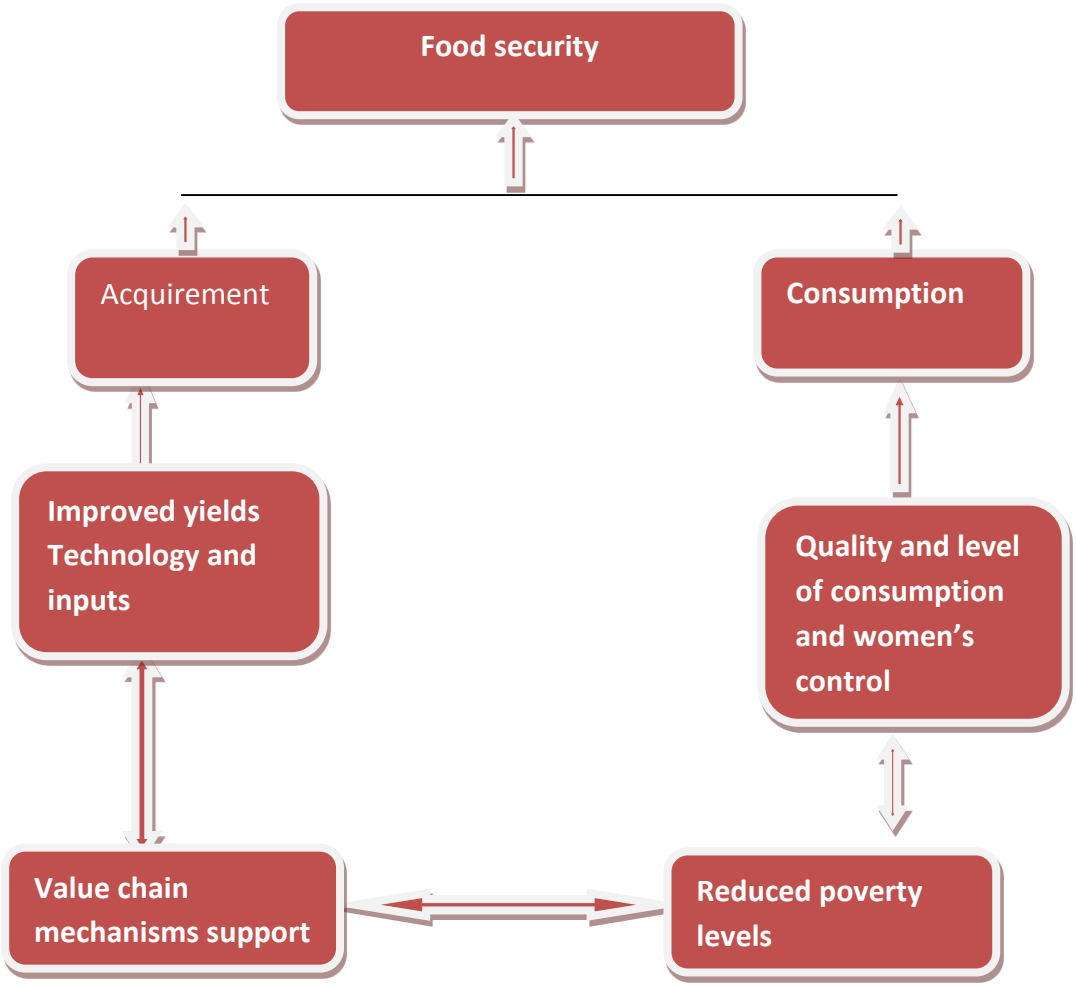


Figure 2: Food security and poverty reduction

Source: Author's Construct, 2014

The framework emphasizes the availability and accessibility to farm inputs, existence of value chain mechanisms, enhanced and sustained consumption smoothening and accumulation of socio economic assets to reduce poverty. With acquirement, farmer households can have adequate surplus to market and make extra income for both basic and strategic needs whilst meeting their consumption needs. Women who bear the brunt of household deficiencies would get some relief. The key assumption underlying the Conceptual Framework corroborates with the theory of change of the project.

The regions can achieve an enhanced food security and better standard of living for majority of the populace who are farmers and reduce poverty if agriculture receives the requisite support, particularly in input supply and improved value chain linkages. This will correspond to the ADVANCE strategic objectives of reducing poverty levels of the people especially of women and children through a comprehensive value chain approach for targeted agricultural commodities driven by commercial actors as conduits for reaching out to large numbers of smallholders

2.4 Value Chain and agricultural productivity in Northern Ghana

2.4.1 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 3 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:

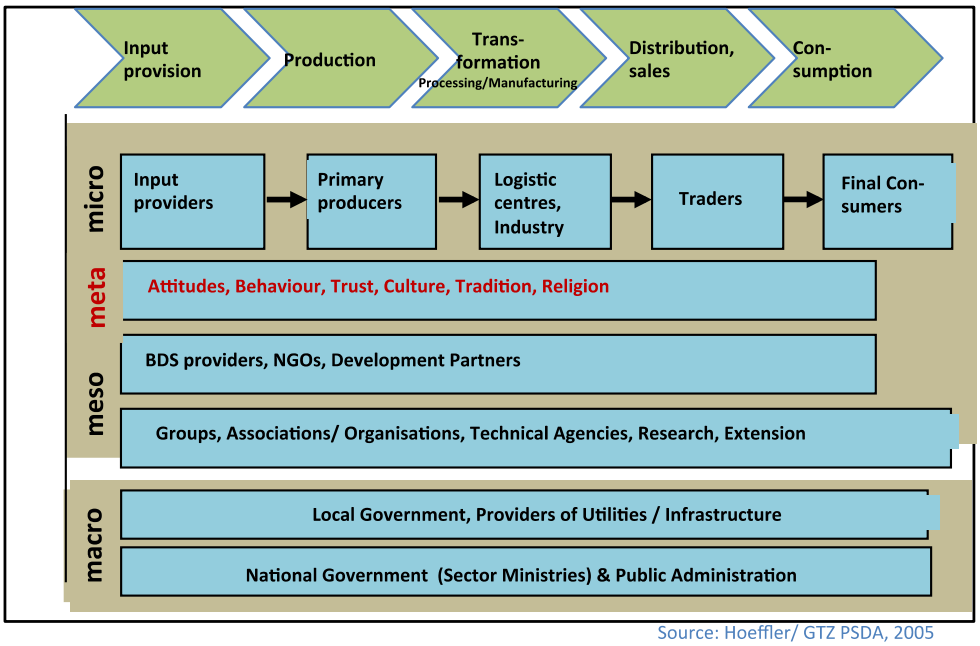
i. improved market access (marketing)
ii. improved/ wider product offer (value addition).

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
v. healthier food at affordable prices



Source: Hoeffler/ GTZ PSDA, 2005

Figure 3: 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 operating under capacity (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 II

2.5.1 Consistency with national development Agenda

The general theory of change of ADVANCE II, is summarized as follows: that there are three functions of value chain competitiveness - agricultural productivity, market access and trade and enabling environment - that are catalyzed through three dimensions of competitiveness - clear incentives for investment, strong local capacity and mutually beneficial relationships (Figure 4). Within this multidimensional framework, ADVANCE II intends to channel resources through eight specific outcomes intermediate results (IRs) summarized below:

Outcomes IR 1.1

- Strengthened systems for service provision and input distribution
- Strengthened incentives for smallholder investment in new technology, services and practices
- Increased application of improved productivity-enhancing technologies, services and practices by women and men

Outcomes IR 1.2

- Increased availability and use of affordable/sustainable services
- Improved capacity of women and men to participate in markets
- Increased private investment to support value chain development expanded benefits from market participation for women and men

Outcomes IR 1.3

- Strengthened advocacy capacity of value chain (VC) actors to address enabling environment constraints
- Strengthened capacity to Implement VC development and become eligible for USAID funding

ADVANCE will also utilize four main implementation principles that impact both the functions and dimensions of value chain competitiveness as follows:

- Coordination with USAID and Non-USAID Programs
- Supportive Enabling Environment
- Market Demand
- Farmers, Private sector, GoG and other stakeholders as Facilitators of Change

Underpinning the theory of change (TOC) is that private sector actors, including men and women farmers, are the drivers of competitiveness, while the GoG and local stakeholders are empowered to lead as facilitators, catalyzed through the project's capacity building, learning and investment, and innovation promotion. It is within this strategic framework that the ADVANCE II technical approach has been designed.

The TOC of ADVANCE II 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 II TOC. An important common link is enhancing competiveness of the private sector, in this case, value chain actors in the three commodities (rice, soya and maize) which is the focus of ADVANCE II.

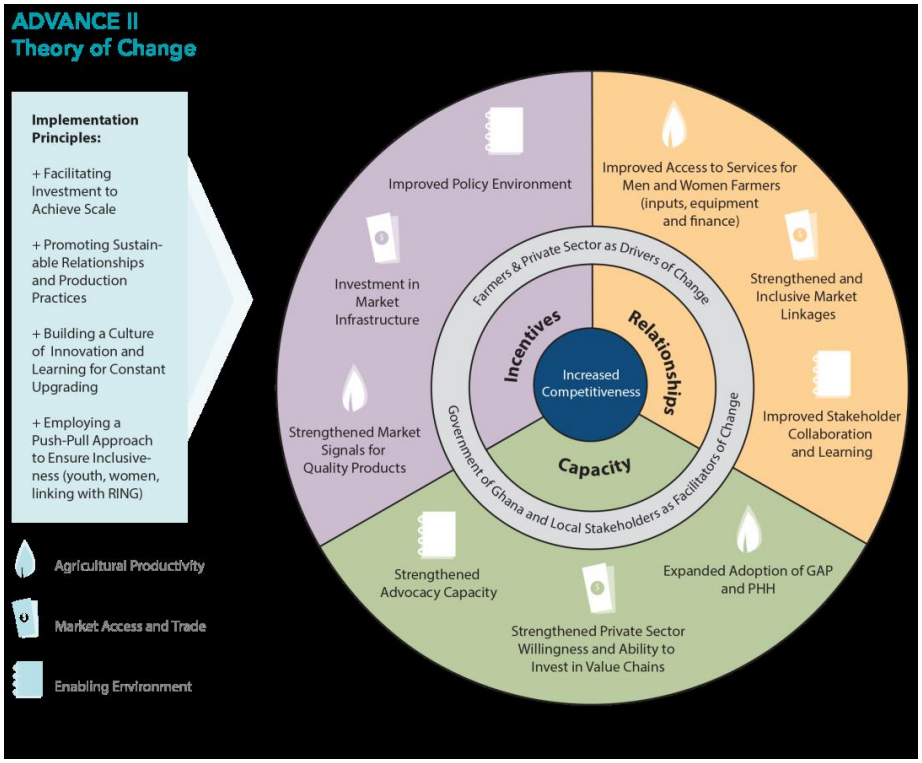


Figure 4: Advance II Theory of Change

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 three northern regions of Ghana, 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 ADVANCE II. All too often, farmers produce in response to interventions such as those proposed in ADVANCE II 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 access road 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).

On the focus crops, Dogbe, et al., (2013) in an economic analysis of soya production in the eastern enclave of the Northern Region (NR) reported that only males in Saboba made profits. The authors did not discount opportunity cost of own land or family labor. The report also includes evidence of low fertilizer and pesticide usage (by at most 7%) and technology application for social and economic reasons. Non-use of improved technologies was explained by low awareness of technologies, perception of irrelevance of use of soil amendments for the crop and the fact that the crop is not staple and hence less usable. Under such conditions production cost per hectare ranged between GH¢470 and GH¢650 with labor accounting for between GH¢230 and GH¢335 in 2012 production season. Unfavorable land tenure arrangement and incidence of credit sales emerged most important constraints. IFDC's 1000+s project in collaboration with SARI and SEND-Ghana, in Salaga, Kpandai and Chamba has raised profit per acre of soya production from GH¢35 to about GH¢165 between 2007 and 2009.

Akramov & Malek (2012) found that maize production is profitable with or without accounting for family labor in variable input stream but negative returns are reported for rice with inclusion

of family labor. And that soya is profitable only with a deliberate plan to maximize profits but not at observed average production scheme of resource allocation.

3.0 STUDY METHODOLOGY

The approach and methods that were used by the Consultant to carry out the fieldwork (from 18th November, 2014 to 10th December, 2014) 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 (Annex 2) 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).

Both quantitative and qualitative data were collected for the study. The Consultant worked in close collaboration with the three M&E Coordinators, Regional Coordinators and their M&E support staff (ADVANCE II task team). Indeed, the two-stage data gathering approach were adequately supported by the ADVANCE II task team.

3.1 Sampling methods and procedures

The sampling frame for the quantitative survey included both current and potential out-grower farmer households. Current beneficiaries included ADVANCE II beneficiaries who have not been influenced yet, and potential beneficiaries included any farmer in the ZOI who was not a beneficiary yet and cultivating < or = 5 hectares of land of maize, soya or rice. The Consultant worked within this sampling frame matrix which was agreed upon with the Regional 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 Regional Coordinators and the Technical 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 ADVANCE II potential beneficiary population must include 26% of ADVANCE I and 74% new beneficiaries. The proportion remained the same in the Baseline survey sample.

To determine yield and calculate gross margin of the three commodities, the Consultant, as proposed by the Client, used the same Crop Cut procedure applied by ADVANCE. A task team set up by the ADVANCE II Regional M&E coordinators ensured that the procedure for crop cut for maize, rice and soya conformed to the FTF processes. In all, a total of 122 farmer fields were used for the crop cuts representing 4.6 percent of respondents.

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, all three targeted commodities, and as permitted by available population figures, of all potential beneficiary types. Provision for non-response was set at 10%.

Looking at the targeted beneficiaries provided by the client in the ToR (26,000 for ADVANCE I beneficiaries who were not yet on ADVANCE II and 74,000 of new 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 as the total commodity target frame. With this target beneficiaries or frame in mind and dealing with 3 commodities (maize, soya bean and rice), there was an equal probability that a farmer could be selected out of the 100,000 dealing in at least one of the commodities. So each commodity was given a proportionate sample frame of 33,333 for both male and female farmers. Since there was no data given to show either there were more male farmers in a particular commodity than females and vice-versa, each of the sexes was apportioned 50% of the commodity frames, so males were 16,666 and females were 16,666 for each commodity. But in reality getting the 50% apportioned to female respondents proved difficult for all three commodities. After the sample sizes based on gender and commodities had been determined, 26% of the respondents were selected from ADVANCE I beneficiaries and 74% allocated to Non-ADVANCE beneficiaries.

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 4. The total sample used in the study was 2704; this was arrived at by adding the ten percent non responsive to actual calculated sample size. After data cleaning, the correct data set amounted to 2657 respondents. This was because some respondents failed to give accurate information and others were non responsive to over 50% of the questions.

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 FTF projects (see SoW, Annex 1). Smallholder farmers cultivating at least one of the three commodity value chains (Maize, Rice or Soya) in the ZOI were surveyed.

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, crop cut area 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 three value chain commodities (Maize, Rice and Soya). The calculation of the gross margins was based on figures that were recalled by farmers. However, some crop cut (see above) was done to triangulate the recall figures provided by farmers. This approach was adopted because at the time of the survey majority of farmers had harvested their crops. We employed efficient and effective supervision of the enumerators and their supervisors which ensured high level of quality and enhanced data cleaning exercise.

Plate 1: Household interview

Plate 2: Participants at a focus group discussion

Pretesting of Questionnaires

Draft questionnaires were carefully prepared and pretested in 25 households comprising beneficiaries of ADVANCE I and potential beneficiaries of ADVANCE II. 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. The pretest also helped in updating the SPSS template into an acceptable format for data entry.

Training of Field Enumerators

Field enumerators were trained in-situ i.e. in the field, at the ADVANCE regional offices, and it comprised two stages. First, the Regional M&E officers of ADVANCE offered GPS training for the enumerators which included field exercise to demonstrate the crop cut procedure to them. Emphasis was placed on the quality assurance procedures that were agreed with the Client. Second, 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. The processes were facilitated by the Team Leader, the supervisors and some selected members of the team.

Plate 3: Training of Enumerators

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

Plate 4: Crop cut exercise

3.2.2 Qualitative data collection method

To complement the quantitative data, some qualitative information were collected from Government Institutions, Processors, Input Dealers, Farmer Based Organizations, Commercial/Nucleus Farmers, Financial, Insurance, and ICT Institutions acting in the value chain of the three project commodities. Interview schedules were used (see Annex4) 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 four 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.

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 regional differences according to commodities. 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.

3.3 Study limitations

- The communities visited were too dispersed; this made travel time longer than planned.
- The initial engagement processes of some of the enumerators were fraught with disagreements on their contracts; this delayed the commencement of the data collection
- Most farmers had harvested their crops; this was particularly so with soya. This made the crop cut process difficult.
- The list of nucleus farmers given to the consultant was outdated; some of the selected nucleus farmers were no longer residing in their respective communities. This made it very difficult to reach them and their out-growers
- 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 land boundaries and farm sizes; in the extreme situations the selected respondents were politely replaced; this was done only for the crop cut.

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

A total number of 2,657 respondents was selected for the survey, which comprised 61.40 percent males and 38.60 percent females. The study ensured females were adequately represented. Generally, gender disaggregation as shown in Figure 5 indicates that within the regions, male farmers outnumber females.

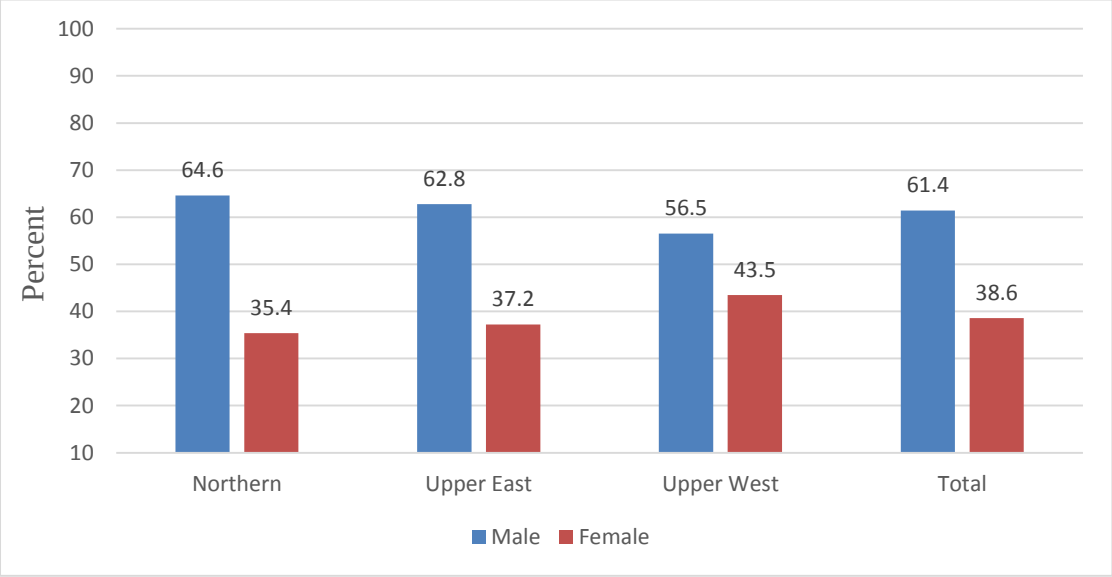


Figure 5: Distribution of respondents by sex and regions

The analysis in shows that 20.70 percent of respondents were below 30 years and about 69.30 percent were in the age groups of 31 to 60 years. The study indicates that the mean age of the respondents was 41 years (SD 12.60). The minimum age was 16 years whilst the maximum was 90 years. The majority (69.38%) of respondents were within the economically active age of between 18 and 59 years.

Table 1: Distribution of respondents by age, sex and region

Age of Respondent	Northern				Upper East				Upper West				Total	
	Male		Female		Male		Female		Male		Female			
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
<30	152	12.60	112	9.40	62	11.90	42	8.10	108	11.60	74	7.90	550	20.70
31-40	244	20.20	144	11.90	91	17.50	56	10.70	141	15.10	105	11.30	781	29.40
41-50	205	17.00	110	9.10	72	13.90	46	8.90	140	15.00	99	10.60	672	25.30
51-60	116	9.60	43	3.60	46	8.90	26	5.00	85	9.10	71	7.60	387	14.60
Above 60	55	4.60	15	1.20	50	9.60	18	3.50	37	4.00	33	3.60	208	7.80
Don't know	7	0.60	3	0.20	5	1.00	5	1.00	16	1.70	23	2.50	59	2.20
Total	779	64.60	427	35.40	326	62.80	193	37.20	527	56.50	405	43.50	2657	100

4.1.2 Marital Status of respondents

The marital status of the respondents is shown in below. About 90 percent of respondents were married. The percentage married was higher than the national average of 58.5% (GSS, 2010). From focus group discussions and key informant interviews, the high percentages could be attributed mainly to the perception in most societies in the Northern regions that married adults are responsible community members. Also, the various religions in the ZOI particularly Islam frown upon unmarried adults. Indeed, there were other views that the higher percentage of married respondents could be attributed to need for farm labor. 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). The separated and divorced rates were found to be very low. The respondents mentioned religion, Christianity and Islam, as the major driver for these conditions.

Table 2: Distribution of Respondents across ZOI by Sex and Marital Status

Category	Northern						Upper East						Upper West						Totals (%)
	M			F			M			F			M			F			
	No	%	SD	No	%	SD	No	%	SD	No	%	SD	No	%	SD	No	%	SD	
Married	717	26.98	0.73	388	14.6	0.29	285	10.73	0.02	165	6.2	0.02	491	18.47	0.09	352	13.25	0.06	90.23
Single	54	2.03	.00	13	0.49	.00	24	0.9	.00	3	0.11	.00	28	1.05	.00	5	0.18	.00	4.76
Divorced	2	0.07	.00	1	0.04	.00	1	0.04	.00	1	0.04	.00	2	0.07	.00	1	0.04	.00	0.33
Separated	0	0	.00	1	0.04	.00	2	0.08	.00	2	0.07	.00	2	0.07	.00	1	0.04	.00	0.34
Widowed	6	0.23	.00	24	0.9	.00	14	0.52	.00	22	0.82	.00	4	0.15	.00	46	1.73	.00	4.35
Total	779	29.31		427	16.07		326	12.22		193	7.23		527	19.81		405	15.24		100

4.1.3 Educational levels by sex and regions

The survey showed that 73.21% of the respondents had no formal education (Table 3). The result is relatively higher than the national rural average of thirty three percent (33.0%) which has no formal education (GSS, 2012). Regarding those with no formal education, the study showed that 41.63% were males and 31.58% females.

Further analysis on the educational levels on regional basis indicates that generally, majority of respondents who indicated that they had acquired formal education were basically at the primary level as shown Table 3. The Northern region has the highest male respondents with no formal education (46.3%). Upper West had the highest female respondents with no formal education (35.5%).

Table 3: Educational levels by sex and regions

Region	Sex	None	Primary	JSS/JHS/ MSLC	SSS/SHS/ Voc./Tech	Tertiary
Northern	Male	46.3	5.10	5.10	5.50	2.60
	Female	30.8	1.2	1.5	0.9	1
Upper East	Male	34.7	13.1	6	5.6	3.4
	Female	26.4	6.4	3	1	0.4
Upper West	Male	39.5	7.2	5.2	3.2	1.5
	Female	35.5	3.4	3	1.1	0.4
Total		73.2	10.4	7.6	5.7	3.1

A further analysis of education among the surveyed female respondents showed that majority of them (81.9%) had no formal education. The largest number of respondents (13.8%) said they had formal education up to the basic level (see Table 4).

Table 4: Distribution of Female Education by Region

Region	**None**		**Primary**		**JSS/JHS/MSLC**		**SSS/SHS/Voc./Tech**		**Tertiary**		**Total**	
	No	%	No	%	No	%	No	%	No	%	**No**	**%**
Northern	371	36.20	14	1.40	19	1.90	11	1.10	12	1.20	**427**	**41.80**
Upper East	137	13.40	33	3.20	16	1.50	5	0.50	2	0.20	**193**	**18.80**
Upper West	331	32.30	32	3.10	28	2.70	10	0.90	4	0.40	**405**	**39.40**
Total	839	81.9	79	7.7	63	6.1	26	2.5	18	1.8	**1025**	**100**

4.1.4 Household composition

Figure 6 presents the household composition of the three regions. The household types were categorized into male no female, male and female, female no male and child no adult.

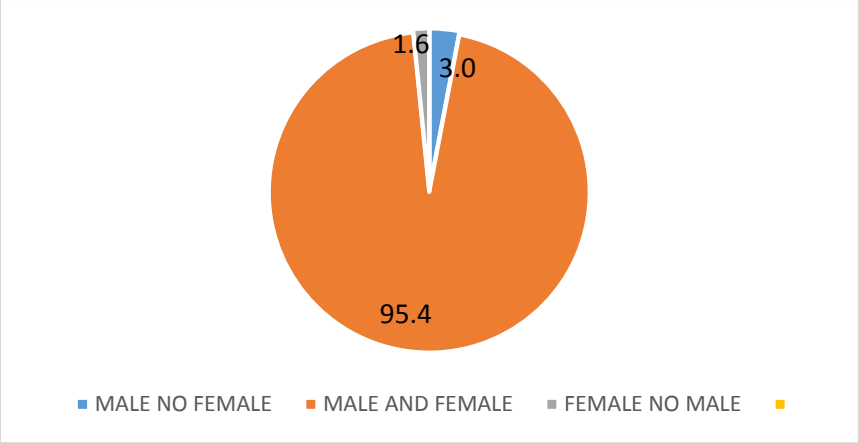


Figure 6: Distribution of household composition of respondents

Households were predominantly male and female (95.4%). Households with only male adults accounted for 3.0% with female adults only comprising 1.6%. In the analysis, there was no respondent with household type of child no adult and this clearly portrays the Ghanaian culture where the marriage institution and external family systems have a central place in the social structure.

The survey results also showed that the household composition did not have any correlation with application of major technologies that farmers were found practicing (see Section 4, and Annex 5 and Annex 7). For instance, the p-values for crosstabs of the various categories of households with yields for maize, rice and soya were all more than 0.05.

Table 5: Household Size

Region	Household size distribution.	N	Mean	SD
Northern	Number of children under 5yrs	1081	3.52	2.55
	Number of children between 6 -17yrs	1077	4.22	3.05
	Male Adults over 18yrs	1171	3.69	3.01
	Female Adults over 18yrs	1169	3.61	2.92
Upper East	Number of children under 5yrs	411	2.53	1.83
	Number of children between 6-17yrs	444	3.13	2.25
	Male Adults over 18yrs	505	2.48	1.79
	Female Adults over 18yrs	504	2.43	1.62
Upper West	Number of children under 5yrs	662	2.12	1.47
	Number of children between 6-17yrs	759	3.24	2.51
	Male Adults over 18yrs	852	2.41	1.97
	Female Adults over 18yrs	859	2.38	1.85

Household sizes have a direct effect on household wealth, which influences nutrition and poverty (Agbaje et al., 2013). Large household sizes could adversely affect the wealth and health of the members of the household. The average household size was 11.39 (SD=7.79). About forty two percent (41.25%) of respondents had household sizes between six and ten people with almost a fifth (20.1%) having more than sixteen people (see Table 5).

4.1.5 Religious status of respondents

Three major types of religion were captured with distribution in Figure 7. They include Christianity, Islam and Traditional Religion. The figure portrays that within the ZOI, a total 54.6% of the households were Muslims, with 33.5% Christians and only 0.7% of respondents forming the other religions. Thus Muslims dominate in the three regions.

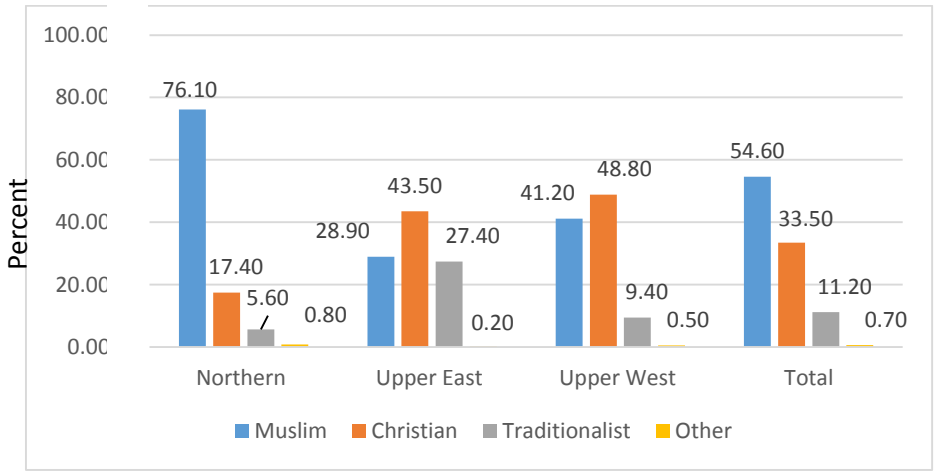


Figure 7: Distribution of respondents by Religion

4.1.3 Housing

Majority of houses in the ZOI have been occupied for over ten years: Northern Region, 37.7%; Upper East, 16.7%; and Upper West, 31.8% (Table 6). Newly inhabited houses (occupied for less than 6 months) were not significant.

Table 6: Duration of Occupancy

Categories	Northern Region		Upper East Region		Upper West Region		Total (%)
	No	%	No	%	No	%	
Less than 6 months	9	0.3	3	0.1	1	0.0	0.4
6months-1years	28	1.1	2	0.1	1	0.0	1.2
1-5years	56	2.1	34	1.3	27	1.0	4.4
5-10 years	111	4.2	37	1.4	58	2.2	7.8
10+	1002	37.7	443	16.7	845	31.8	86.2
Total	1206	45.4	519	19.6	932	35.0	100

House ownership was very high across the 3 regions as shown in Table 7. Living in one's own house and family house are the two dominant occupancy statuses. In the Northern Region, 72.5% of respondents lived in their own houses and 23.4% living in family houses. The characteristics of house occupancy status in the Upper East and Upper West Regions were not different from that of the Northern Region. In the Upper East Region, 76.1% of the respondents lived in their own houses; family house represented 21.5% and renting 1.2%. In the Upper

West Region 83.3% of the respondents owned their houses, 10.8% lived in family house and 5.5% in free dwelling provided by extended family members and friends.

In terms of gender ownership, the study revealed that 64.1% males and 35.9% females in the Northern region lived in their own houses. In the Upper East, 63.8% males and 36.2% females whilst in the Upper West, 57.9% males and 42.1% females were living in their own house. Renting of houses and temporary shelters were not significant in the ZOI and this underlines the rural nature of the study communities.

Table 7: House occupancy status

Occupancy Status	**Northern Region**		**Upper East Region**		**Upper West Region**	
	N	**Percent**	**N**	**Percent**	**N**	**Percent**
Own	874	72.5	395	76.1	776	83.3
Renting	15	1.2	6	1.2	4	0.4
Dwelling provided for free (by provided by extended family members and friends	29	2.4	5	1	51	5.5
Temporary Shelter	6	0.5	0	0	0	0
Family house	282	23.4	112	21.6	101	10.8
Other (Specify)	0	0	1	0.2	0	0

Construction materials for housing are shown in Table 8. The houses were predominantly built with mud walls which accounted for 80.8%, 85.9% and 59.9% in Northern, Upper East and Upper West Regions respectively.

Table 8: Materials used for wall structures

Materials	Northern	Upper East	Upper West	*Total
Concrete/Brick	14.4	11.2	39.7	22.6
Wood	1.9	2.1	0.3	1.4
Mud	80.8	85.9	59.9	74.5
Bamboo	2	0	0.1	0.9
Jute Straw	0.7	0	0	0.3
swish	0	0.4	0	0.1
Grass/Straw	0.2	0.4	0	0.2
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

The study also revealed that aluminum sheets and thatch were the two major roofing materials in the study communities with bamboo as the minor roofing material. Aluminum sheets and thatch account for 53.9% and 44.2% respectively of roofing materials in the Northern Region (Table 9). In the Upper East region, 71.6% of roofing material is aluminum sheet with thatch representing 25.2%. The Upper West Region recorded the highest usage of aluminum sheet for

roofing which predominated with 97.9%. The quality of housing is relatively poorer in the Northern region than the Upper East and Upper West regions.

Table 9: Roofing materials of buildings

Type of roofing	Northern (%)	Upper East (%)	Upper West (%)	Total (%)
Aluminum sheets	53.9	71.6	97.9	72.8
Thatch	44.2	25.2	1.3	25.4
Bamboo	1.7	1.5	0.5	1.3
Others	0.2	1.7	0.3	0.5

Water and sanitation

The study showed borehole as the predominant source of water for household accounting for 59.3% in the Northern Region, 80.3% in the Upper East region and 94.3% in the Upper West Region (see Table 10). Access to pipe borne water is significantly higher in the Northern Region than the other regions (17.8%). Rain water was the least source of water (0.6% in Upper East Region only) as source of household water and this was an indicative that water harvesting was not practiced in the three regions.

Table 10: Sources of water

Source	Northern (%)	Upper East (%)	Upper West (%)	Total* (%)
Supply Water (piped)	17.8	3.1	3.1	9.8
Borehole	59.3	80.3	94.3	75.7
Own tube well	2.9	7.1	0.0	2.7
Neighbor's tube well	0.7	0.8	0.0	0.5
Community tube well	2.9	6.4	0.5	2.7
Rainwater	0.1	0.6	0.0	0.2
Stream/River/Pond	16.3	1.5	2.1	8.4
Sachet/Bottled Water	0.0	0.2	0.0	0
	100	100	100	100

*Total= Percentage of variable for entire project area.

Households have limited access to toilet facilities as indicated in Table 11. Majority (81.8%) of households do not have access to decent places of convenience with the highest in the Northern region (86%). Traditional pit latrine was the other important toilet facility used by the households. Personal communication with some respondents revealed that though open defecation was a bad practice, it added to soil nutrient and was therefore seen as "natural manure" together with that of their animals.

Table 11: Toilet facility

Toilet facility	Northern (%)	Upper East (%)	Upper West (%)	*Total (%)
None (open field)	86	70.9	82.5	81.8
Traditional pit latrine	6.7	22.1	16.2	13.1
Improved pit latrine	6.5	6	1.3	4.6
Septic Tank	0.2	0.6	0	0.2
WC linked sewer	0.5	0.4	0	0.3
Other	0.1	0	0	0
Total	100	100	100	100

*Total= Percentage of variable for entire project area.

ENERGY

The three main sources of lighting in the study regions are electricity, charger light and lantern (Table 12). A large proportion of households indicated using electricity from the national grid for lighting in the Northern Region (58.8%) and Upper West Region (61.6%). In the Upper East region the main source of lighting was the charger light (torch flashlight) (39.10%).

Table 12: Sources of lighting

Source	Northern	Upper East	Upper West	Total
Electricity (government provided)	58.8	27.6	61.6	53.7
Private Generator	1.3	1	0.9	0.8
Solar Electricity	1.6	5.8	1.8	2.1
Kerosene	4.2	7.1	5.2	3.9
Candles	0.4	0.2	25.1	0.2
Lantern	13	19	5.4	11.5
Charger Light (torch flashlight)	20.7	39.1		25.9
Others		0.2		1.9

As pertains to rural communities in Ghana energy for cooking are largely firewood or charcoal. The results from the survey indicated that almost ninety-nine percent (98.7%) of respondents in the Upper West Region depended on firewood for cooking/heating followed by the Northern Region and Upper East region accounting for 94.0% and 82.3% respectively (Table 13).

Table 13: Sources of energy for cooking

Source	Northern	Upper East	Upper West	Total
Electricity	2.2	0.6	0	1.1
LPG	0.7	1.9	0	0.7
Kerosene	0.5	1	0	0.3
Firewood	94	82.3	98.8	93.5
Dried cow dung	0.2	0	0	0.1
Coal	0.8	0.8	0.1	0.6
Rice bran/saw dust	0.2	0.2	0.5	0.3
Dried leaves/straw	0	3	0	0.6
Charcoal	1.4	10	0.6	2.8
Others	0	0.2	0	0

Informal and focus group discussions confirmed that in the absence of wood lots, cereal stalk (maize and millet) and rice straw were used for cooking. Generally, women and children are the gatherers of wood for domestic use in the study area. This activity is laborious and time consuming which may affect farm level productivity as well as leisure of women and children.

4.2 Farming characteristics and practices

4.2.1 Land tenure

The age long tradition of communal land ownership is still predominant in the three northern regions. From Figure 8, more than ninety percent of households in the three Northern regions have access to family land under the control of the family head or compound head. Focus group discussions indicated that land is gradually becoming scarce as a result of increasing population growth particularly in the Upper East Region. Land is held in trust by the Tindana (custodian of the land), who leases the land to household heads. The latter in turn gives the land to other household members. Such land is transferrable to household members through inheritance. Further discussions revealed that, new lands can be acquired from the Tindana as reported in earlier study by Birner et al. (2005).

Access to land: Although all household members have free access to family land, the socio-cultural settings 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 income (Keele et al., 2005; Duze and Mohammed, 2006). Access to land in northern Ghana is skewed towards men who are by custom the family or compound heads. According to Otchere et al. (2006), putting land aside, the household head is in charge of all other resources and he reserves the right to make final decisions on the use of these resources.

The study showed that women have access to land through three main means:

- allocation by family/compound head
- through the spouse (farm on husband's land)
- land as part of the bridal price

Women are disadvantaged in the allocation and access to land in the three northern regions. In the household, males allocate the most fertile lands to themselves.

Apart from accessing land through family lineage, both natives and non- natives (strangers) could access land through various terms and agreements between tenants and family/ compound head or the Tindana. Generally, sale of land was not allowed and was considered as a taboo in some communities to accept monetary gift in return for land given out. Therefore, any agreement on land was paid for in kind (part of farm produce or provision of farm labor to land owner). However, some communities reported that one could rent a plot of land and pay by "goro" which was defined to include physical cash, bottles of drinks/local gin or cola.

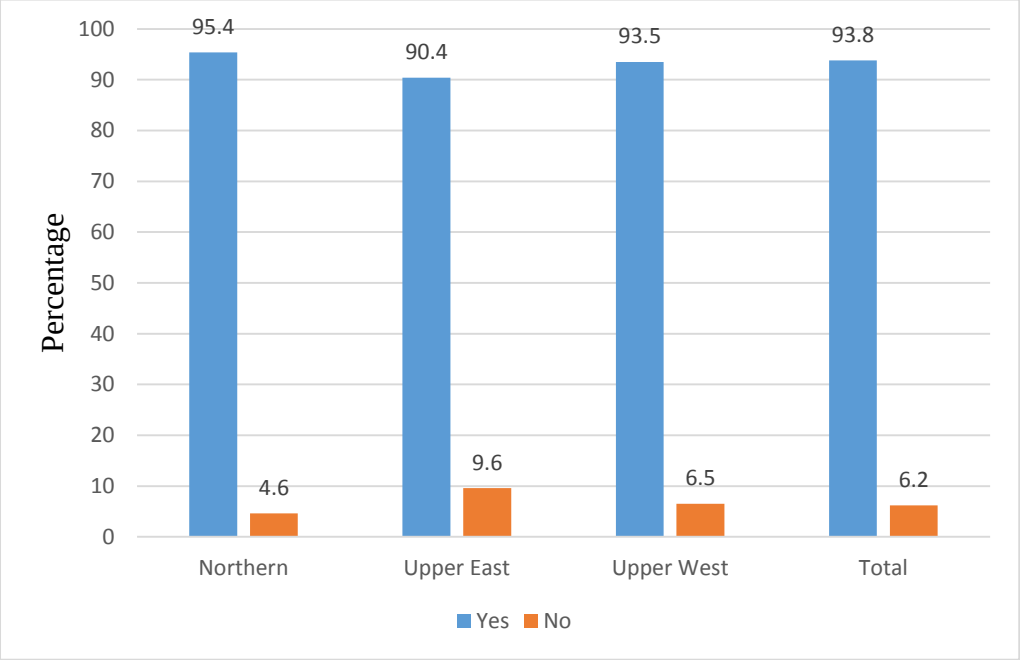


Figure 8: Land ownership in northern Ghana

The study revealed as shown in Table 14, that in the Northern Region 65.9% of those who owned land are male and 34.1% are female. In the Upper East Region land ownership was 63.5% for males as against 36.5% females and in the Upper West Region the gap between both sexes was closer as 55.3% and 44.7% males and females respectively owned lands. Among the 1025 women in the sampled population, a far majority of 92.9% own land under the control of family or compound head as against only 7.1 without any form of land ownership

Table 14: Distribution of Land owners by gender

Regions	Male	Female	*Total
Northern	65.94	34.06	46.21
Upper East	63.54	36.46	18.83
Upper West	55.34	44.66	34.97
Total	61.78	38.22	100.00

*Total= Percentage of variable for entire project area.

Table 15 gives the mean acreage of land by regions in Northern Ghana. Most people in the ZOI have small land holdings averaging 4.9 hectares except in the Upper West region (6.20) where

they are relatively larger than in the country as a whole. However, this is changing due to increasing population.

Table 15: Average agricultural land in hectares

Region	Mean	Std. Deviation
Northern	4.64	6.30
Upper East	3.47	4.95
Upper West	6.20	10.62
Total	4.98	8.00

Respondents were asked to state which of the three targeted crops was their major crop. Table 16 gives the distribution of the crops on regional and gender basis.

Table 16: Number of Respondents and crop cultivation by region and sex

Region	Major Crop	Male		Female	
		N	%	N	%
Northern	Maize	457	58.7	189	44.3
	Rice	136	17.5	39	9.1
	Soya	186	23.9	199	46.6
	Total	**779**	**100**	**427**	**100**
Upper East	Maize	152	46.6	76	39.4
	Rice	87	26.7	75	38.9
	Soya	87	26.7	42	21.8
	Total	**326**	**100**	**193**	**100**
Upper West	Maize	262	49.7	166	41.0
	Rice	154	29.2	145	35.8
	Soya	111	21.1	94	23.2
	Total	**527**	**100**	**405**	**100**

In the study area, most of the farmers interviewed (49%) were found to be cultivating maize followed by soya (27.1%) and rice (23.9%). The number of sampled farmers cultivating maize was highest in the Northern region followed by Upper West Region and Upper East Region. The Upper West Region had majority of rice farmers whilst Northern Region recorded the highest number of soya bean farmers.

On the basis of gender, males dominated in the cultivation of all three crops in the ZOI. For soya bean, the number of female farmers was more than their male counterparts in the Northern Region. Moreover, soya bean is the second highest crop cultivated by female farmers. It was mentioned by some female farmers that soya cultivation is comparatively less intensive than maize and rice.

4.2.2 Number of farms and farm sizes

Table 17: Distribution of households across regions, gender and crop by number of plots cultivated

Type of Crop	Number of farms	Northern Region				Upper East Region				Upper West Region			
		Male		Female		Male		Female		Male		Female	
		N	%	N	%	N	%	N	%	N	%	N	%
Maize	One	338	74	163	86.2	106	69.7	58	76.3	243	92.7	160	96.4
	Two	81	17.7	18	9.5	33	21.7	14	18.4	15	5.7	5	3
	Three	38	8.3	8	4.2	13	8.6	4	5.3	4	1.5	1	0.6
	Total	457	100	189	100	152	100	76	100	262	100	166	100
Rice	One	87	64	30	76.9	59	67.8	60	80	140	90.9	133	91.7
	Two	36	26.5	8	20.5	16	18.4	11	14.7	13	8.4	10	6.9
	Three	13	9.6	1	2.6	12	13.8	4	5.3	1	0.6	2	1.4
	Total	136	100	39	100	87	100	75	100	154	100	145	100
Soya	One	134	72	175	87.9	75	86.2	36	85.7	105	94.6	92	97.9
	Two	25	13.4	10	5	7	8	4	9.5	6	5.4	2	2.1
	Three	27	14.5	14	7	5	5.7	2	4.8	0	0	0	0
	Total	186	100	199	100	87	100	42	100	111	100	94	100

For the major crop that a farmer cultivated, the first three largest plots were discussed. The number of plots cultivated by farmers and their percentages are shown in Table 17. Across the three regions, most farmers cultivated one plot for their major crop. Maize recorded the highest number of plots among the three commodities. Upper West had the highest number of plots for rice in terms of males (n=154) and females (n=145). Male farmers had the higher number of maize plots than females in each of the number of plots across the three regions. Female farmers cultivating on one plot in the northern region had the highest number in terms of soya (n=175).

Across the regions, the allocated average hectares for maize, rice and soya was estimated at 1.83ha, 1.14ha and 1.18ha respectively (Table 18). Among the regions, Upper West region recorded the largest average farm size for maize (1.85ha) followed by the Upper East (1.83ha). Among the three commodities, rice recorded the least average farm size (1.14ha) across all the regions.

Table 18: Distribution of Farm sizes by commodity and Region/Project-wide

Commodity	**NR**		**UE**		**UW**		**Total**	**Mean Land size per commodity (ha)**
	M	F	M	F	M	F		
Maize (ha)	877.44	289.17	307.04	110.96	560.68	232.40	2377.69	1.83
Rice (ha)	229.84	44.46	168.78	83.25	120.12	79.75	726.20	1.14
Soya (ha)	319.92	185.07	121.80	40.74	102.12	78.96	848.61	1.18
Total (ha)	1427.2	518.7	597.62	234.95	782.92	391.11	**3952.5**	**1.49**

However, the largest soya farm (1.31ha; SD=1.55) was recorded in the Northern region. A study of the trend in Table 19 shows variations in farm sizes among males and females for the three commodities across the regions.

Most smallholder farmers basically cultivate to feed their households. Among the three crops, Maize is the major staple crop in most of the study communities and therefore farmers will allocate enough resources to that. Apart from feeding households with maize, the market for maize is readily available (i.e. the commodity can be sold easily at the farm gate or at the local market without processing) and has a diverse use as compared to soya and rice. Rice on the other hand, is grown for the market and for feeding households in most communities especially in the upper west region, and mostly grown by women.

Farmers have low interest in the cultivation of soya and this is evident in the farm sizes of the crop as shown in Table 19. Market availability for the crop is a challenge in the three regions. Considering their ability to consume, farmers compare soya to crops like cowpea and prefer to grow cowpea rather than soya since cowpea is easily consumed unlike soya. The tedious production processes mostly associated with shelling, also discourages farmers from cultivating the crop.

Table 19: Farm Sizes in Hectares by Region, Gender and Commodity

Region	Crop	Total for Both Sexes		Male		Female	
		Mean	SD	Mean	SD	Mean	SD
Northern	Maize	1.81	2.29	1.92	2.22	1.53	1.66
	Rice	1.57	2.45	1.69	2.06	1.14	0.86
	Soya	1.31	1.55	1.72	1.7	0.93	0.74
Upper East	Maize	1.83	3.52	2.02	3.47	1.46	1.4
	Rice	1.56	2.19	1.94	2.45	1.11	1.17
	Soya	1.26	1.04	1.4	1.1	0.97	0.6
Upper West	Maize	1.85	2.2	2.14	2.35	1.04	1.09
	Rice	0.67	0.65	0.78	0.61	0.55	0.42
	Soya	0.88	1.1	0.92	0.87	0.84	1.31

4.2.3 Technology and management practices

Land based Technologies

This section deals with technologies and their application among the surveyed farmers. Annex 12 displays percentage users of improved hybrids and technologies. Annex 13 shows the percentages who are new users. All percentages are computed relative to the number of farmers of the three target commodities within region and gender. Annex 14 presents land allocation to technology by gender and Annex 15 shows land allocation to technology by region. With the exception of row planting of soya bean and use of weedicides in rice production, usage rate of improved technologies are below 50% of male and female farmers across the 3 regions. The study suggested that technology application is generally low across the ZOI.

Among the technologies that have been introduced to farmers, fertilizer, weedicides and row planting, showed relatively higher percentage usage. For example, fertilizer application was

practiced by 650 farmers (49.9%), 281 farmers (44.1%) and 172 famers (23.9%) in maize, rice and soya production respectively across the ZOI. Weedicides were applied by 49.8%, 58.8% and 49.7% in maize, rice and soya production respectively. Across the 3 northern regions, the practice of row planting was most common among soya producers (73.7%). There were more farmers using row planting in maize (41.6%) than rice (26.1%).

Other major technologies with relatively high usage across the ZOI include minimum tillage in maize (27.9%) and transplanting (24.1%) and bird scaring (25.6%) in rice production. Janguma, Obaatanpa and Jasmine are the major crop genetic technologies used across the ZOI. They are used by 40.1%, 27.3% and 17.5% of soya, maize and rice producers respectively.

Among the male farmers across ZOI, weedicide application in maize production (53.9%), use of fertilizer in maize (53.9%), row planting in maize (44.7%) and soya (31.8%) and minimum tillage in maize are the top 5 most practiced technologies ranked in that order. Among the females however, row planting (58.7%) and use of herbicides (43.6%) in soya production are ranked first and second respectively. The other 3 in the top 5 most practiced technologies among women are usage of fertilizers (42%), weedicides (41.5%) and row planting (35.5%) all in maize production.

More than 50% of male farmers producing maize, rice and soya in northern region used weedicides in maize (64.8%), rice (52.2%) and soya (58.6%) and practiced row planting of soya (62.4%). More than half of females producing the three (3) crops in the region used herbicides (61.9%) maize and soya (72.9%) and also practiced row planting in soya (77.4%) and use of fertilizer in maize (56.6%). Among males in Upper East, however, technologies practiced by more than half of the producers of the 3 crops include; fertilizer and weedicide application in maize and rice production, row planting in maize and soya and used of the janguma variety in soya and minimum tillage in maize. Among females in the region technologies used by more than half of the producers of each crop include weedicides in rice (96.0%), janguma seed in soya (83.3%), row planting in soya (76.2%) and fertilizer usage in rice (76.0%). In Upper Wes region, however, only row planting of soya and use of weedicides in rice production exceed 50% of male producers of either crop whereas row planting of soya alone exceed 50% among female in the region.

Usage of these technologies is mainly not new among male and female farmers across the northern regions. On the whole, weedicide usage among rice farmers has the most new users (32.1%). New users of all other technologies do not exceed 13% of either maize, rice and soya farmers.

Descriptive statistics of land allocation to land related technologies across the ZOI revealed that technologies in maize had the most extensive land allocation. This is more likely due to the use of maize as a staple food, limited availability of suitable soils and resource intensity in rice production and the relative newness of soya across the ZOI. Application of fertilizer in maize tops the list with 1749.20 hectares allocated on the fields of 828 farmers across the ZOI. Weedicide application (1568.0 Ha), row planting (1536.6 Ha) and minimum tillage (676 Ha) on maize fields are in second, third and fourth positions respectively.

Use of obaatanpa seed and row planting in maize and soya are allocated total land acreage of 279.60 Ha, 493.0 Ha and 328.8 Ha in Northern Region respectively Annex 15. Within the region, weedicide application and fertilizer application are allocated the most land i.e. 691.0 Ha and 637.8 Ha respectively. Fertilizer usage, row planting and weedicide application in maize and weedicide application in rice are allocated the most land in Upper East. Whereas

this trend is not different in the Upper West Region, the study reveals that minimum tillage and the use of Pioneer white maize are among the five (5) technologies with most allocated land allocated and are allocated 321.00 Ha and 143.8 Ha respectively

Annex 14 indicates that the above remain the major technologies in use by male and female farmers in terms of total land allocated across the ZOI. Seed technologies, however, dominate in individual farmer land allocation. Jasmine 85 and IR84 rice varieties and mamaba variety of maize are cultivated on the largest average land tracks with average acreages of 4.57 ha, 3.50 ha and 2.23 ha respectively among male farmers. Women on the other hand allocate most land to certified seed other than janguma, pioneer yellow maize and Tox variety of rice.
Annex 14 also reveals that, whereas only 11 female soya farmers use certified seed other than janguma, the average area they allocate to the variety emerges the largest that a female allocated to any technology. About 32% of users of pioneer yellow maize are women who plant the variety to about 1.66 Ha of their maize fields. This land allocation is lower than the male allocation (1.92 ha) to this technology and the project wide average (1.83 ha). It is however, the second largest area allocated by women across the ZOI to improved technology.

Area allocation to technologies used by most farmers (fertilizers, weedicides and row planting) is as follows across gender. Whereas a typical male farmer in the ZOI allocates an average of 2.16 Ha of maize field to inorganic fertilization only 1.24 Ha of female plots are subjected to same treatment. Project wide value of land allocation to fertilizer averages is 1.85 Ha. Whereas females used fertilizer on more land (1.27 ha) than males (1.24) in soya production, males cultivated more rice field (1.39 ha) under inorganic fertilizers than females (0.90 ha). Among females area allocated to weedicides is largest in maize production (1.24 ha) followed by rice (1.11 ha) and soya (0.91 ha) in that respective order. This order is also maintained among males. Land are subjected to row planting at total and average levels is larger in soya production (1.16 ha) than rice (0.79 ha) but lower than maize (1.81 ha) across ZOI. This order is maintained among males and females.

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

Annex 16 to Annex 18 display relative percentage application of relevant post harvest handling, ICT, weather mitigation and water management for each crop and region. Application of these techologies are low aross the ZOI. That notwithstanding, the study reveals all crop farmers are quite keen on accessing information. This is indicated by the fact that the use of farm radio ranks highest in terms of percentage of farmers using the technology. Use of farm radio was more common relative to the Esoko platform as an ICT facility. Across ZOI, at most 7% maize, 5% rice and 3% soya producers use Esoko platform. Across the ZOI, however, 493 maize producers (38%), 241 rice producers (34%) and 298 soya farmers (41%) reported using the radio services. Project wide, 34% males (292) are farm radio users whiles 30% of females (129) are also users. About 261 user of farm radio are located in the northern region, 44 in the UER and 188 in UWR.

Only 12% of maize producers who use farm radio in the NR did so for the first time during the 2014 production year. However, majority (at least 61%) of farm radio users producing either rice or soya are new users. Whereas only 17% of new farm radio users in maize production are male, as much as 68% of new users in rice and 60% of new uses in soya are male.

Whereas use of post-harvest technologies are relatively low among maize farmers, use of mechanised shellers (421 or 32%), tarpaulins (419 or 32%) and silos (257, 20%) are relatively

high. About 217 of the users of shellers are in NR, 54 in UE and 150 in UW. The UW regions record the highest percentage new users of shellers 41 farmers (27% of users within region) and tarpaulins 42 farmers (39% of users within region). More males maize producers use these technologies than females. Regional gender breakdown of percentage use rate and percentage new users are shown in Annex 19 and Annex 20.

Plate 5: Traditional method of processing rice after harvesting

Use of tarpaulins, warehousing and threshers are the top 3 post-harvest technologies with relatively high percentage usage in rice production in all 3 regions. About 151 (24%), 44 (7%) and 27 (4%) of rice farmers respectively use these technologies. These technologies are respectively used by 28%, 8% and 6% of males in rice production. The majority of he users of tarpaulin in rice production are in UE, whereas among them usage of warehouses and threshers are not significantly different across regions.

The post-harvest techologies with relatively pronounced usage among soya farmers are distributed as follows; About 17% (121) of soya farmers use tarpaulins. 5% (34) use warehouses and 3% (23) use weighing scales. Most of the users of tarpaulins (96 or 25% of regiona soyal producers) and weighing scales 18 (5%) are in the NR wheras most of the users of warehhouuses 20 farmers (10% of regional soya producers) are located in UWR.

Use of tarpaulins and warehousing emerged as the technologies with widesperead usage among producers of all crops among all post-harvest, weather mitigating, ICT and water management technologies. In terms of percentage usage across all 3 regions, these two respectively rank 3rd and 7th among maize farmers , 2nd and 5th among rice and soya farmers. The use of shellers and silos rank relatively high (2nd and 4th repectively) among post-harvest technologies in maize. On the other hand threshers are the 2nd commonest post-harvest technologies among rice producers and weighing scales, 6th among soya producers.

The use of weather mitigation technologies is rather very apalling across the ZOI. Neither weather crop insurance index nor ingtia weather update recorded a project wide percentage usage rate exceeding 10% among producers of any of the 3 crops. At most 8% of maize

producers, 4% of rice producers and 3% of soya producers used one or the other of these technologies.

The story is similar for the use of mulching as a water management technology among maize farmers. Across region, gender and ZOI, no more than 7% of any famer category used the technology. Water management through bunding, however, is practiced by about 20% (126 farmers) of all rice producers. Whereas there may be more male farmers using bunds at the absolute level, the percentage usage rate of bunding is not significanlty differrent between men and women. Prevalence rate of bunding is highest in the UER where about 45% (73) of regional rice farmers report using the technology. It must be noted that most of the bund users in UER (56%) are new to the technology.

Application of improved management practices across gender and region

Sustainability planning, farm budgeting, book keeping and use of SMS in information exchange are among popular improved farm business management practices across the ZOI (see Annex 16 to Annex 18). Between 96- 182 (7%-14%) maize farmers use at least one of these management practices. Relatively fewer rice producers (19-32 farmers or 3%-5%) use these management practices except for sustainability planning in rice where 15% of rice farmers are users. Among soya producers, management practices in relatively wide usage include sustainability planning (among 61farmers or 8% of soya producers) and book keeping (36 farmers or 5% of soya producers). Of the soya producers, most of the practitioners of book keeping (19 farmers out of 36 project wide users) and SMS (16 out of 21) are in NR whereas most sustainability planners (40 out of 61 users) are in the UER. Twelve (12) out of the 17 users of farm budgets are in the UWR. Whereas 2-11% (6-43 farmers) of male soya farmers use at least one improved management technology, usage rate of these practices ranges from 2-5% (3-18 farmers) among female producers of soya (see regional and gender breakdown in Annex 19 and Annex 20).

There a more male farmers using improved management practices compared to females. For instance, male rice producers using improved management practices range from 6 to 57 (2-15%) compared to 0to 39 (0-15%) female rice farmers. In maize, variation is from 51-131 users (6-15% of male users) relative to 20-51 users (5-12% of female users). Regional gender breakdown of percentage use rate and percentage new users are shown in Annex 19 and Annex 20.

No specific and significant co-variation emerged between gender and household type and usage of new technology in soya and rice production (See Annex 10). Being female, however, was found to positively impact application (correlation coefficient = +0.11 significant at 1%) of new technology in maize production. New users of technology recorded significantly lower yields in maize and rice production relative to continuous and non-users. The correlation coefficients, however, suggest weak relationship between yields and new usage of improved technology.

4.2.3.1 Determinants of Technology Application

This section focuses on the distribution of farmers by number of technologies applied, application index and factors influencing the application indices.

A total of 30 technologies each for rice and maize and 25 for soya 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. Table 20 shows the number of farmers applying a given numbers of technologies. Column 3 of Table 20 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.

On the whole, there are more farmers applying at least one technology (continuous users i.e. farmers who would apply technology every season; users i.e. those who use the technology but not every season) than there are new users. For instance, a minimum of 74% of all farmers applied at least 1 technology regardless of time. Among maize also farmers 95% apply at least one technology whereas 30% are new users of at least one technology. Regardless of time of commencement, majority of farmers use two (2) to five (5) technologies. About 50%, 48% and 72% respectively for maize, rice and soya were found doing so. Even within continuous users and new users, use of 2-5 technologies emerges the norm among all 3 food crop farmers.

Ai= [AT/NTR] X100

Where:

Ai = Application Index
AT= Applied Technology
NTR = Total Technologies under Consideration

Table 20: Distribution of farmers by number of technologies applied

Number of technologies applied	**Continuous Users**		**New Users**		**Users**	
MAIZE	N	%	N	%	N	%
≤ One	103	8.3	200	51.2	96	7.6
2 - 5	699	56.5	105	26.9	634	50.2
6-10	346	28	82	21	370	29.3
11-15	50	4	2	0.5	88	7
16-20	11	0.9	2	0.5	45	3.6
> 20	28	2.3	0	0	31	2.5
Sum of users	1237	100	391	100	1264	100
Percentage of users (N=1302)	95.01		30.03		97.08	
RICE						
≤ One	76	16.7	61	44.9	66	14
2 - 5	220	48.5	65	47.8	220	46.7
6-10	136	30	8	5.9	146	31
11-15	18	4	2	1.5	31	6.6
16-20	3	0.7	0	0	6	1.3
> 20	1	0.2	0	0	2	0.4
Sum of users	454	100	136	100	471	100

Number of technologies applied	Continuous Users		New Users		Users	
Percentage of users (N=636)	71.38		21.38		74.06	
SOYA						
≤ One	128	19.5	61	54	125	18.2
2 - 5	481	73.4	42	37.2	492	71.6
6-10	41	6.3	10	8.8	59	8.6
11-15	5	0.8	0	0	11	1.6
Sum of users	655	100	113	100	687	100
Percentage of users (N=719)	91.10		15.72		95.55	

Application index is computed as the average of the ratio of technologies applied and/or used (AT) to total number of technologies under consideration (NTR). It is expressed as a percentage. Table 21 presents the summary results of application indices for male and females.

Mean application index for users (both new and continuous) averages 21%, 17% and 13% for technologies among maize, rice and soya producers respectively. Soya farmers report the highest percentage mean new users of improved technologies (11%) whereas most continuous users of technologies (17%) are among maize farmers. This confirms the assertion of low usage and application of improved technologies across the ZOI.

Mean application index for users regardless of commencement time are significantly higher for males relative to females at a minimum of 5% significance level among all farmers. Among users, mean application indices are significantly different among maize and rice producers but not soya at 1% alpha level. Whereas mean application index for new technology users does not vary significantly with gender among maize and rice farmers, the difference is significant at 1% among soya farmers. The mean of comparison of average application indices via one-way ANOVA is attached as Annex 23

Table 21: Application indices between male and female farmers

Application Index (%)	Female			Male			Total			p-value of F-Stat
MAIZE	N	Mean	SD	N	Mean	SD	N	Mean	SD	
Users	418	18.74	13.80	846	21.53	15.71	1264	20.61	15.16	0.002
New Users	120	9.30	10.38	271	10.70	9.70	391	10.27	9.92	0.200
Continuous users	411	16.34	11.15	826	18.54	13.88	1237	17.81	13.07	0.005
RICE										
Users	212	14.87	11.43	259	18.94	12.37	471	17.11	12.11	0.000
New Users	54	6.98	6.05	82	7.60	6.75	136	7.35	6.47	0.583
Continuous users	203	13.68	10.33	251	17.06	10.94	454	15.55	10.79	0.001
SOYA										
Users	317	12.01	7.61	370	13.55	9.46	687	12.84	8.68	0.021
New Users	302	11.01	5.91	353	12.68	8.62	655	11.91	7.53	0.005
Continuous users	55	8.80	8.05	58	9.24	6.71	113	9.03	7.36	0.752

Given that application indices are computed as proportions with substantive pilling of cases on a score of zero, the Tobit model is the appropriate regression method that produces unbiased and consistent estimates. The regression coefficients are less not interpreted directly, but via respective marginal effects. For the purpose of this study, use is made of only the marginal effects of explanatory variables on expected value of censored observations (observations with expected application indices exceeding zero percent). Note that, the latent variable is farmer's desired application index. It is not expressed until a combination of practices is observed or reported from farmer's production data.

Whereas being male increases usage of new technologies by about 1.3 percentage points, having accessible markets and credit increases it by 1.5% and 3.5% points respectively. Access to extension services also increases the application index new user of technologies by 3.8% point. Higher usage of marketed input, as revealed by higher purchase input cost enhances new application of farm management techniques. A 10% increase from mean purchase input cost (GHC 417 per Ha) is associated with 9% rise in application index. Enhanced crop performance promotes new usage of technology by causing a 17% rise for every 10% rice from average maize yield of 1.05 MT/HA.

Contrary to a priori expectations, effect of better market performance as revealed by increasing gross margins for crop production and being a beneficiary of ADVANCE I was not statistically significant and membership of farmer based associations rather decreased new application of technologies. The latter may be explained by the existence of a lot of ineffective and temporal farmer groupings without real impacts on farmer livelihoods.

Gender, education, FBO membership, yield levels, market input cost and gross margins, seasonal access to markets and market information as well as credit did to seem to matter in the continuous application of improved technologies among maize farmers across the ZOI. This is inferred to the statistical insignificance of their parameter estimates as shown in Table 22. Rather, application is promoted by benefiting from external support (benefiting from ADVANCE I), ownership of arable land, access to extension and NGO visits as well as participation in farmer training programs. All the aforementioned factors are significant at alpha level 0.01. The users' model also posits that a 10 years increase in mean maize farmer age of about 42 years will cause a 0.06 dip in application index whereas a GHC 100.00 increase in labor cost of production will cause up 9% fall in application index. This is consistent with extant literature.

At the aggregate technology user level, access to credit, market information and professional (formal) information sources (Extension, NGOs and farmer training programs) but to access to markets per se are significant promoters of increased technology usage. Being a male, owning land and benefiting from ADVANCE I significantly increased the number of technologies applied. Increased purchase input increased the latter whereas increased labor cost causes a decline in average application index. Yield levels remain significant with an increasing effect on application index and by extension number of technologies applied among maize farmers.

It may thus be said that new usage of technologies are largely determined by gender and policy variables such as access to credit, access to markets, access to production information. Farm expenses in purchase input as well as crop performance (yields) also mediate in new usage of technology. The study reveals that farmers who are active market participant in input markets

have higher application indices in terms of usage of new technologies. Application and continuous usage of technology seem more dependent on more permanent and tangible access to resources and effective information networks other than FBOs with questionable status and mandates.

Table 23 displays the results for determinants of application indices for new, continuous and aggregate users of technology in rice production. It reveals that, being male and increasing household sizes reduce application index among rice farmers at the continuous and aggregate user levels. Gender however, is not significant determinant of increasing new usage of technology options among rice farmers. Whereas benefiting from ADVANCE I increases the application index by 0.61 percentage points among new users at 10% significance level, it is not significant in the decision to continue using or adopt an increasing array of technologies. The situation is similar for land ownership and access to markets among rice farmers, where a rise of 1.67% and 1.83% respectively in expected application index is observed with owning land and having accessible markets among new users alone.

Extension visits was revealed to have larger marginal impacts on expectation of application index in among continuous and aggregate users. The expected rise in application index reaches a high of 4.24% among generic users and 3.87% among continuous users. Access to market information was found to be a relatively pervasive phenomenon among all user categories but with relatively high positive impacts on application index among continuous (2.4%) and aggregate users (3.01%) at 0.05 and 0.01 alpha levels.

A negative impact, significant at 10% is recorded for the role of FBO membership on Application index only among new users. This of course is contrary to both the expected and theorized impact of FBO membership. Cost of production in labor and purchased input as well as yield levels are consistently insignificant even at 0.1 alpha level among all user categories. Gross margins in rice production were found to negatively impact on application index among new users but insignificant among continuous and aggregate users. It is noted that this is contrary to the evidence in the literature but may be explained first by the impact of increasing cost of some rice technologies. Limited expertise is implementation of technology leading to lower yields may also explain the negative impact among new users. It might also be argued that the role of the crop in household food security objectives may have overridden market and profit considerations. This could lead to low emphasis on gross margins.

Table 24 displays the results for determinants of application indices for new, continuous and aggregate users of technology in soybeans production. Access to market information, extension visits, membership of farmer association and input cost per hectare emerged significant factors influencing predicted application index among new users to the technologies. Access to market information and extension visits increase the application index by 1.6% and 1.00% respectively at 1% and 5% significance levels. At an alpha level of 0.10, a GHC 10.00 incremental expenditure on purchase input in soya production causes a 5.1% rise in array of technologies applied as expressed by a rise in the application index for newly used technologies. Being a member of a FBO is associated with a fall in the number of technologies used for the first time by 0.4% contrary to the positive relationship established in theory and practice.

Among continuous users however, smaller households, beneficiaries of ADVANCE I, persons with formal education with access to NGO visits or training show remarkable difference in application index. . Increasing household size and absence of formal education respective

decrease array of improved technologies applied by 2% and 1% at 10% and 1% significance levels. Percentage application index rises by 1.3 with benefiting from ADVANCEI project. A GHC 100.00 rise in farmer annual savings cause a more than 177% rise in the average predicted application index (i.e. a rise from 12% to 21%). For every GHC 10.00 rise in purchase input cost, application index rises by 13% from its average predicted value whereas a similar rise in labour cost per hectare decreases it by 18%. The results also show that a metric tonne rise in output per acre causes an 8% rise in the number of technologies used together in a production season.

Irrespective of when technology was first used, having no formal education and increasing household size reduces application index whereas savings, access to extension, NGO and farmer training programs increases it. Rising purchase input cost and yields were also revealed to impact application index positively among soya producers.

Table 22: Determinants of application indices among maize farmers

Application Index	**New users**		**Continuous users**		**Users**	
	β	dy/dx	β	dy/dx	β	dy/dx
Gender	2.554*	1.26	0.806	0.64	1.64*	0.6
	(1.78)		(0.95)		(1.74)	
ADVANCEI	-0.145	3.44	4.45***	0.037	4.33***	3.43
	(-0.10)		(5.15)		(4.52)	
Household Head	-1.486	0.37	0.92	0.38	0.484	0.69
	(-1.05)		(1.09)		(0.52)	
Age	0.0252	0.026	-0.058***	0.006	-0.034	-0.043
	(0.69)		(-2.60)		(-1.38)	
No Education	-1.062	-0.73	-0.56	-0.27	-0.943	-0.42
	(-0.83)		(-0.73)		(-1.11)	
Household size	0.0191	-0.028	-0.0224	-0.005	-0.0363	-0.18
	(0.17)		(-0.34)		(-0.50)	
Male over18	-0.153	-0.08	-0.0565	-0.39	-0.104	-0.042
	(-0.46)		(-0.29)		(-0.48)	
Land ownership	2.564	3.78	4.80***	0.63	5.20***	3.34
	(1.02)		(3.45)		(3.38)	
Savings	-2.447	-0.88	-0.759	0.61	-1.148	-0.56
	(-1.63)		(-0.87)		(-1.19)	
Access to credit	8.52***	3.31	1.08	2.55	4.08*	0.82
	(2.83)		(0.55)		(1.87)	
Access to market	8.80***	1.53	1.058	1.95	2.018	0.78
	(-2.65)		(0.67)		(1.15)	
Market information	1.534	2.00	1.119	0.38	2.64**	0.83
	(0.83)		(1.04)		(2.21)	
Extension visits	2.37*	3.78	4.25***	0.62	4.75***	3.26
	(1.67)		(4.83)		(4.88)	
NGO visits	1.262	3.74	4.57***	0.33	4.74***	3.48
	(0.87)		(5.12)		(4.80)	
Training	-0.657	6.25	7.36***	-1.67	7.63***	5.86
	(-0.39)		(7.22)		(6.75)	
FBO member	-2.91***	-0.91	-0.234	-0.74	-1.17**	-1.75
	(-4.30)		(-0.57)		(-2.58)	

Application Index	New users		Continuous users		Users	
	β	dy/dx	β	dy/dx	β	dy/dx
Total farm area	0.722	0.86	0.89**	0.18	1.11***	0.66
	(1.51)		(2.58)		(2.97)	
Labor cost (100s GHC)	0.341	0.88	-1.04**	0.09	-1.14***	-0.78
	(0.62)		(-2.58)		(-2.73)	
Input cost (100s GHC)	0.997*	0.9	0.538	0.26	1.155***	0.4
	(1.77)		(1.37)		(2.67)	
Yield (MT/HA)	2.676**	1.71	0.189	0.69	2.205**	0.14
	(2.33)		(0.22)		(2.36)	
Gross margins (1000s GHC)	-0.398	-74	-0.892	-0.1	-0.96	0.67
	(-0.39)		(-1.35)		(-1.31)	
_cons	-17.29***		7.623***		8.97***	
	(-3.69)		(3.12)		(3.31)	
Sigma						
_cons	15.83***		11.82***		13.12***	
	24.61		49.20		49.96	
Predicted application index (at means of x(s))		21.61		9.82		18.52
N		1302		1302		1302
Log likelihood		-2038.43		-4883.72		-5090.61
LR chi2(21)		137.73		399.34		455.92
Prob > chi2		0.0000		0.0000		0.0000
Pseudo R2		0.0327		0.039		0.0429
Left censored		911		65		38
Uncensored		391		1237		1264
Right censored		0		0		0

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 23: Determinants of application indices among rice farmers

	New users		Continuous users		Users	
	β	dy/dx	β	dy/dx	β	dy/dx
Gender	0.649	0.13	-3.211*	-1.69	-3.205**	-1.75
	(0.37)		(-2.20)		(-2.05)	
ADVANCEI	2.880*	0.61	1.823	0.96	2.391	1.32
	(1.69)		(1.19)		(1.46)	
Household Head	-2.266	-0.47	1.275	0.66	0.901	0.49
	(-1.34)		(0.90)		(0.59)	
Age	0.0584	0.01	0.0914*	0.048	0.104**	0.06
	(1.06)		(2.03)		(2.17)	
No Education	-2.314	-0.49	-1.224	-0.64	-1.596	-0.87
	(-1.43)		(-0.89)		(-1.09)	
Tertiary education	2.217	0.48	5.326	3.05	6.359*	3.81
	(0.60)		(1.53)		(1.71)	
Household size	-0.232**	-0.05	-0.239**	-0.12	-0.290***	-0.16
	(-2.14)		(-2.71)		(-3.06)	

	New users		Continuous users		Users	
Land ownership	10.03**	1.67	-1.491	-0.80	0.171	0.09
	(2.54)		(-0.63)		(0.07)	
Savings	-2.315	-0.46	2.986	1.61	1.885	1.04
	(-1.28)		(1.92)		(1.13)	
Access to credit	0.504	0.10	2.014	1.09	2.847	1.61
	(0.13)		(0.58)		(0.76)	
Access to market	11.16*	1.83	-2.786	-1.52	-1.532	-0.85
	(1.90)		(-0.99)		(-0.51)	
Market information	6.684**	1.24	4.924**	2.41	5.964***	3.01
	(2.47)		(2.72)		(3.07)	
Extension visits	2.347	0.49	6.998***	3.87	7.405***	4.24
	(1.34)		(4.57)		(4.49)	
NGO visits	-0.971	-0.20	1.863	0.98	1.716	0.94
	(-0.54)		(1.16)		(1.00)	
Training	-0.287	-0.06	0.444	0.23	0.0120	0.01
	(-0.15)		(0.27)		(0.01)	
FBO member	-1.283*	-0.26	0.738	0.38	0.364	0.20
	(-1.81)		(1.12)		(0.52)	
Total farm area	-7.204	-1.48	-3.455	-1.80	-4.982	-2.69
	(-1.06)		(-0.94)		(-1.26)	
Labor cost (100s GHC)	-0.085	-0.02	-0.460	-0.24	-0.0505	-0.03
	(-0.10)		(-0.77)		(-0.08)	
Input cost (100s GHC)	-2.353	-0.48	-0.0348	-0.02	-0.272	-0.15
	(-1.30)		(-0.05)		(-0.34)	
Yield (MT/HA)	11.34	2.33	0.360	0.19	0.949	0.51
	(1.50)		(0.09)		(0.23)	
Gross margins (1000s GHC)	-4.214*	-0.83	-0.791	-0.41	-1.080	-0.58
	(-1.76)		(-0.80)		(-1.02)	
_cons	-31.10***		4.356		3.844	
	(-3.96)		(0.99)		(0.82)	
Sigma						
_cons	12.08***		13.70***		14.78***	
	(14.16)		(28.22)		(28.90)	
Predicted application index (at means of x(s))	6.46		14.68		16.34	
N	636		636		636	
Log likelihood	-700.95		-1995		-2089.77	
LR chi2(21)	70.79		93.25		96.96	
Prob > chi2	0.000		0.000		0.000	
Pseudo R2	0.0481		0.023		0.023	
Left censored	500		82		165	
Uncensored	136		454		471	
Right censored	0		0		0	

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 24: Determinants of application indices among soya farmers

Dependent Variable:	New users		Continuous users		Users	
Application Index	β	dy/dx	β	dy/dx	β	dy/dx
Gender	-2.92	-0.55	0.879	0.64	0.21	0.16
	(-1.13)		(1.02)		(0.23)	
ADVANCEI	-1.257	-0.23	1.764**	1.32	1.45	1.13
	(-0.54)		(2.07)		(1.64)	
Household Head	2.180	0.41	-0.393	-0.29	0.49	0.38
	(0.83)		(-0.45)		(0.54)	
Age	-0.008	-0.001	-0.0172	-0.013	-0.025	-0.02
	(-0.11)		(-0.74)		(-1.03)	
No Education	3.235	0.59	-2.533***	-1.91	-2.14**	-1.68
	(1.31)		(-3.17)		(-2.55)	
Tertiary education	-2.674	-0.48	1.620	1.23	0.801	0.62
	(-0.41)		(0.75)		(0.36)	
Household size	0.0686	0.01	-0.0760*	-0.56	-0.072*	-0.06
	(0.68)		(-1.92)		(-1.74)	
Land ownership	7.124	1.19	1.415	1.00	2.022	1.49
	(1.23)		(1.02)		(1.39)	
Savings	-2.850	-0.52	2.332***	1.77	1.58*	1.23
	(-1.10)		(2.68)		(1.73)	
Access to credit	1.608	0.31	0.236	0.17	0.67	0.52
	(0.27)		(0.12)		(0.32)	
Access to market	0.401	0.07	-0.162	-0.12	0.16	0.12
	(0.09)		(-0.13)		(0.12)	
Market information	9.07***	1.57	-0.0514	-0.04	1.19	0.90
	(3.22)		(-0.06)		(1.36)	
Extension visits	4.80**	0.94	0.684	0.50	1.78**	1.39
	(2.09)		(0.79)		(1.97)	
NGO visits	3.969	0.77	1.408*	1.04	1.83**	1.42
	(1.82)		(1.79)		(2.23)	
Training	-2.602	-0.47	1.725*	1.29	1.86*	1.46
	(-0.97)		(1.80)		(1.85)	
FBO member	-2.16**	-0.41	-0.0301	-0.02	-0.49	-3.7
	(-2.08)		(-0.08)		(-1.23)	
Total farm area	-1.105	-0.21	0.484**	0.35	0.36	0.28
	(-1.27)		(1.97)		(1.41)	
Labor cost (100s GHC)	2.92	0.55	-2.511**	-1.84	-1.59	-1.22
	(1.22)		(-2.40)		(-1.53)	
Input cost (100s GHC)	2.73*	0.51	1.833***	1.34	3.14***	2.40
	(1.91)		(2.65)		(4.45)	
Yield (MT/HA)	0.098	0.02	1.029**	0.75	0.85*	0.65
	(0.09)		(2.14)		(1.73)	
Gross margins (1000s GHC)	-5.34	-1.00	-0.0770	-0.06	-1.91	1.46
	(-1.38)		(-0.05)		(-1.27)	
_cons	-27.95***		9.713***		10.46***	
	(-3.40)		(4.30)		(4.43)	
sigma						
_cons	15.19***		7.880***		8.276***	
	(12.39)		(34.87)		(36.16)	

Dependent Variable:	New users		Continuous users		Users	
Application Index	β	dy/dx	β	dy/dx	β	dy/dx
Predicted application index (at means of x(s))		7.67		12.00		13.39
N		694		694		694
Log likelihood		-616.28		-20080.11		-2388.61
LR chi2(21)		62.05		89.30		109.45
Prob > chi2		0.000		0.000		0.000
Pseudo R2		0.0479		0.0192		0.0224
Left censored		585		59		27
Uncensored		109		635		667
Right censored		0		0		0

t statistics in parentheses
* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

4.2.4 Gross margin analysis

In this crop farmers' survey, gross margin is defined in the context of Feed the Future Project as net income from targeted small-holder farmers' production of maize, rice and soya. For this baseline survey, it is calculated and segregated by region, crop and gender 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 inputs plays a key role in 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 limiting constraint to higher input use and better crop husbandry practices, varied surprisingly little across the three regions. Input use, however, varies significantly over time and between regions as well as countries, making actual cost comparisons difficult (i.e. chemical input costs/ha.).

Among smallholders total production costs (per hectare) averages GH¢1200, GH¢ 1517 and GH¢ 879.00 among maize, rice and soya producers across gender and ZOI. Labor input cost accounted for a larger proportion (at least 52%) relative to purchase input cost. Insecticide application and all post-shelling activities (drying, winnowing, sacks and bagging, transport and storage) remain below 5% of total production cost for all 3 commodities. Transportation cost in rice production emerged highest (GH¢ 65.00 for the 2014 production season).

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

Production cost item (GHS per Hectare)	Mean (Maize)	% total cost	Mean (Rice)	% total cost	Mean (Soya)	% total cost
Land rent	124.71	10.4	188.76	12.44	178.17	20.27
Seed	48.2	4.02	88.47	5.83	57.89	6.59
Basal fertilizer	324.94	27.09	366.06	24.13	**	**
Top Dressing	292.39	24.38	231.26	15.24	249.57	28.39
Herbicides	104.58	8.72	119.72	7.89	75.04	8.54
Insecticides	38.19	3.18	62.53	4.12	47.58	5.41
Sacks	43.46	3.62	59.6	3.93	23.34	2.66
Crop Insurance	67.75	5.65	129.51	8.54	*	**
Loans Interests payment	132.84	11.08	163.6	10.79	133.33	15.17
Irrigation fees	**	***	120.76	7.96	**	**
Inoculant	**	**	**	**	41.81	4.76
Total input cost (a)	**575.98**	**48.03**	**699.76**	**46.13**	**336.95**	**38.34**
Labor for land preparation	158.76	13.24	206.15	13.59	148.87	16.94
Planting	64.64	5.39	112.74	7.43	69.41	7.90
1st fertilizer application	44.63	3.72	42.02	2.77	**	**
2nd fertilizer application	40.03	3.34	35.21	2.32	49.89	5.68
Total weedicides application	48.75	4.06	115.46	7.61	42.85	4.88
Manual weed control	108.36	9.04	127.3	8.39	96.17	10.94
Insecticide application	34.15	2.85	35.13	2.32	36.68	4.17
Harvesting	79.42	6.62	149.6	9.86	72.22	8.22
Shelling	90.07	7.51	231.26	15.24	70.28	8.00
Bagging (Jude sacks)	23.39	1.95	39.22	2.59	21.88	2.49
Transporting	39.78	3.32	62.15	4.1	30.15	3.43
Storing	26.2	2.18	51.88	3.42	18.39	2.09
Drying and winnowing	28.59	2.38	**	**	**	**
Inoculant application	**	**	**	**	39.35	4.48
Bird scaring	**	**	103.4	6.82	**	**
Total labor input (b)	623.38	51.98	815.87	53.78	492.46	56.03
Total production cost (a+b)	**1199.32**	100	1516.947	100	878.92	100.00

Average cost of seed is insignificant in maize production (GH¢ 48.00 per hectare) but not in rice and soya. It was found that insecticide cost was significant in soya production (GH¢ 48.00 per hectare) but not in maize and rice. It was also found that soya farmers did not have any insurance for their crops. The average cost of insurance for maize was GH¢ 68 and GH¢ 130 for rice representing 6% and 9% of production cost respectively. With the exception of land preparation, planting, manual weed control, harvesting and shelling in maize production, all other labor input cost remain below 5% of total production cost. Costs of insecticide and fertilizer application as well as cost of insecticide also have average costs below 5% of total rice production cost. Other insignificant costs (less than 5% of total production costs) in soya include application of weedicides and inoculants and cost of inoculant.

Table 25 shows the total input cost as presented under production cost and is valued to include imputed hired labor. Table 26 shows gross margins for smallholder production of the three targeted crops with production cost adjusted for insignificant cost lines as outlined above and exclusions consistent with FTF guidelines. The implications are that land rent and all post shelling activities in all crops are not included. Cost of seed, sacks and cost of insecticide and

the application of insecticides and weedicides in maize are excluded in total cost of input. Insecticide and its application costs are exempted for rice and in soya; cost of inoculant is excluded together with application costs of weedicide, insecticide and inoculant.

Table 26: Gross margins for maize, rice and soya in the three Northern Regions

Category	Northern Region		Upper East Region		Upper West Region		Total (Extrapolated)	
	Male	Female	Male	Female	Male	Female	Male	Female
Maize								
Volume of Production (MT)	920.4	297.7	316.52	114.7	686.1	258.55	2,251.47	315.11
Amount of sales (GHC)	419516	170485	171902	71490	280430	109060	1,053,361.90	183,575.39
Quantity Sold (MT)	473.45	179.05	155.87	69.525	348.85	139.3	1,149.33	189.13
Input Cost* (GHC)	324152.3	109809.1	167712.2	47512.1	347089.3	93154.75	876,196.58	120,805.11
Area (Ha)**	681.2	226	207.2	91.2	385.4	156	1,614.55	240.75
Gross Margin	721.3719	768.3638	875.3062	772.2554	530.4769	700.4347	735.36	768.64
Rice								
Volume of Production (MT)	283.85	59.6	206.1	108.125	248.4	102.35	911.11	318.67
Amount of sales (GHC)	190970	39520	187686.5	94192.5	121893	61403	713,207.25	267,573.87
Quantity Sold (MT)	208.3	44.5	135.5	71.9	96.38	51.36	625.07	215.29
Input Cost* (GHC)	194569.6	32252.15	165525.1	86925.24	137587.7	67719.68	672,947.38	243,930.93
Area (Ha)**	186.76	44.6	106.9	77.28	119.36	79.84	532.81	229.43
Gross Margin (GM)	351.6003	463.6325	1122.099	708.1234	1479.28	684.4185	688.11	663.11
Soya								
Volume of Production (MT)	272.2	145.9	92.3	23.15	118	58.2	649.96	158.53
Amount of sales (GHC)	301294	127635	87165	29305	99990	40720	692,929.25	154,854.81
Quantity Sold (MT)	202.1	88.5	54.25	17.1	75.05	27.3	460.89	101.33
Input Cost* (GHC)	159060.8	97057.25	68749.25	21826.28	65609.78	31804.9	398,809.39	116,958.78
Area (Ha)**	280	185.8	114	40.88	102.6	56.4	689.94	221.93
Gross Margin (GM)	881.2123	610.1196	697.8224	436.5672	892.8169	975.2619	838.31	564.65

*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 8.

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

Following the extraction of smallholder farmers and elimination of insignificant cost items, 1240 maize farmers (95% of total maize farmers), 624 rice farmers (98 % of total rice farmers) and 711 soya farmers (98% of total soya farmers) were obtained. The gross margin analysis is based on these sub-samples of the survey.

Quantity of produce harvested as shown in Table 26, 2593.97MT, 1008.43MT and 709.75MT for maize, rice and soya respectively. Allocation of maize for storage and consumption of maize was higher (664.82MT) compared to rice and soya (146.62 MT and 96.65MT) respectively. This is in consonance with the use of the commodity (Maize) as the largest food security crop across northern 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 soya (76.77%), followed by rice (65.81%) and maize (55.52%). Females were found to participate effectively in marketing of maize and rice (staple foods), selling larger proportions of their harvest. Average production cost per hectare having been adjusted for conformity, may reach GHS 949.67 and GHS 894.18.00 respectively among smallholder rice and maize farmers. However, soya producers may incur relatively lower cost per hectare of GHS 318.92. Thus for a given farm size, rice production cost may be thrice the cost of producing soya.

Among all surveyed farmers, maize production remains the single farm activity with the highest average gross margin of GHS 752.00. Gross margins for maize were estimated at GHS 735.36 and GHS 768.64 for males and females respectively. Similarly, Gross margins for rice were estimated at GHS 688.11 (males) and GHS 663.11 (females), and that of soya were GHS 838.31 (males) and GHS 564.65 (females).

Yield was found to be correlated with gender at 1% alpha-level among rice and soya producers alone. The Negative correlation coefficients (as shown in Annex 10) indicate that being male is associated with higher levels of yield in rice and soya. Yield was also significantly correlated with household type only among soya producers at α-level 0.05.

4.3 General farm management

This section looks at the general farm management practices in the three northern regions and how these practices affect farm level production.

4.3.1 Soil fertility maintenance

Local practices that farmers adopt to improve soil fertility were examined. It was found out that farmers use: land fallow to replenish soil fertility; mulch and cover crop to decrease soil erosion; irrigation to retain soil water; mulching and manure as organic fertilizer; and chemical fertilizer to maintain or improve soil fertility (see Table 27.). Chemical fertilizer was comparatively the most popular means of maintaining soil fertility among farmers with project wide practice by 41% males and 21.9% females.

Table 27: Distribution of respondents by local practices for soil fertility maintenance

Technology	Northern Region		Upper East Region		Upper West Region		Project wide Averages	
	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)	Male (%)	Female (%)
Land Fallow to replenish soil fertility	22.0	0.6	14.1	5.4	20.8	15.1	20.0	10.7
Mulch/ Cover Crop to decrease soil erosion	1.0	0.0	1.5	0.6	2.1	0.8	0.9	0.4
Irrigation to retain soil water	29.0	17.6	24.5	15.2	27.5	25.9	26.3	17.2
Mulching/manure as organic fertilizer	11.7	3.5	26.5	15.2	4.4	1.3	11.9	5.0
Chemical fertilizer to maintain or improve soil fertility	42.9	18.2	48.6	29.3	34.3	22.6	41.0	21.9

Further discussions indicate that in the past, fertility regeneration was achieved through long fallow period of over 15 years, which as a result of increased human population has reduced to an average of 4 years. Upper East recorded the least number of years with regards to land fallowing as shown on the Table 28.

Table 28: Period of Land fallow

Region	Sex	<2 yrs.		2-3 yrs.		3-4 yrs.		5 yrs.+	
		N	%	N	%	N	%	N	%
Northern	Male	119	22.40	104	19.50	27	5.10	15	2.80
	Female	49	17.10	58	20.30	9	3.10	1	0.30
Upper East	Male	38	7.10	26	4.90	6	1.10	3	0.60
	Female	15	5.20	11	3.80	2	0.70	0	0.00
Upper West	Male	41	7.70	75	14.10	59	11.10	19	3.60
	Female	33	11.50	57	19.90	32	11.20	19	6.60

Farmers' focus group discussions indicated that farmers find it difficult to apply inorganic fertilizers due to the high cost of the commodity. The result of the quantitative field data shows that majority of farmers applied inorganic fertilizer with NPK recording the highest usage of 76.9%, 86.2% and 97.2% in Northern, Upper East and Upper West regions respectively. Figure 9 gives details of the fertilizer type applied.

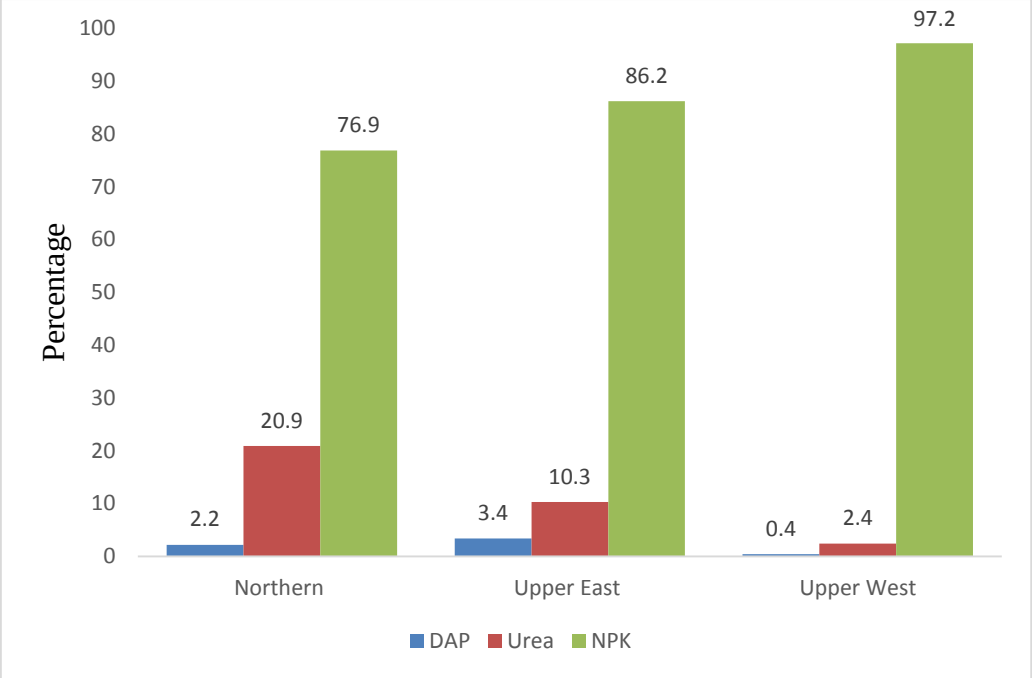


Figure 9: Regional distribution of type of fertilizer applied

Plate 6: Irrigation system in Northern region

The regional and sex distribution of farming households by practice of irrigation shows that, apart from Upper East region which recorded 55% and 52% for males and females respectively for rice plots, soya and maize plots recorded less than 20% for both males and females (Find attached Annex 21).

4.3.2 Farm finance, savings and credit

The survey found that less than 30% of respondents were saving indicating a poor savings culture. Generally, the average amount saved per season was GHS658. Personal savings serve as a form of economic security for the farm household. It also provides formal financial institutions with a financial history on which they can base lending decisions (Morris and Meyer, 1993). The savings status of the study area is shown in Figure 10.

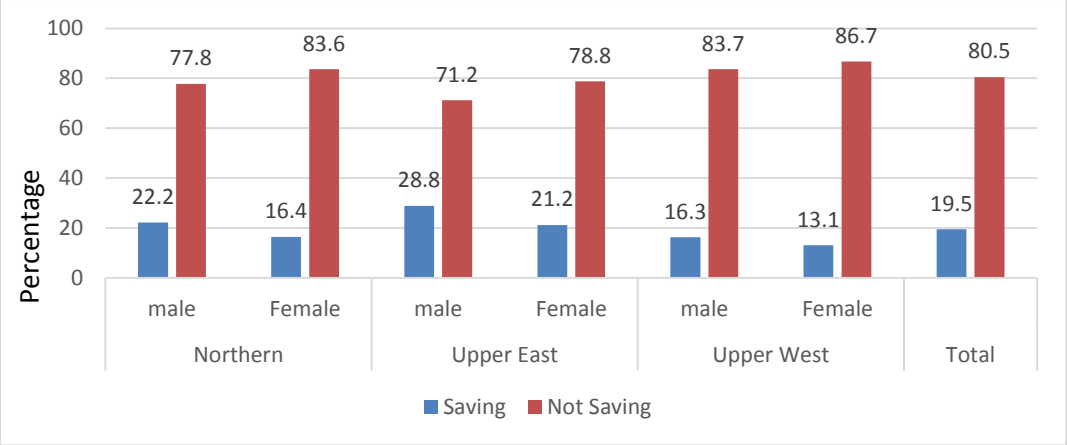


Figure 10: Distribution of saving status for Region and sex

As a result of poor savings culture, access to credit by smallholder farmers in rural areas is lacking despite the general growth in financial service delivery worldwide (World Bank, 2007). Financing of farm inputs and labor wages requires liquid cash which often is not readily available to the smallholder farmers. Credit is a very important resource that allows farmers to expand their operations, improve agricultural productivity and adopt new technologies. Figure 11 gives the distribution of loans in the three Northern regions. A total of less than 3% each of the respondents in the Northern region and Upper West and about 5% of the total respondents in Upper East had access to loan from commercial banks. Respondents without access to loan from the banks either self-financed their farming operations or relied on moneylenders and traders. These respondents complained that traders in particular charge exorbitant interest rates ranging between 50 and 100 percent per season which they have no option than to accept. Focus group discussions and key informant interviews with farmers revealed that farm credit was necessitated by the limitations of self-financing. It was also learnt that the farmers were concerned about the uncertainty of the level of output, and the time lag between utilization of the credit and the sale of outputs. The prime concern emphasized by the farmers was obtaining enough money from sales of one's output early enough to pay back the credit.

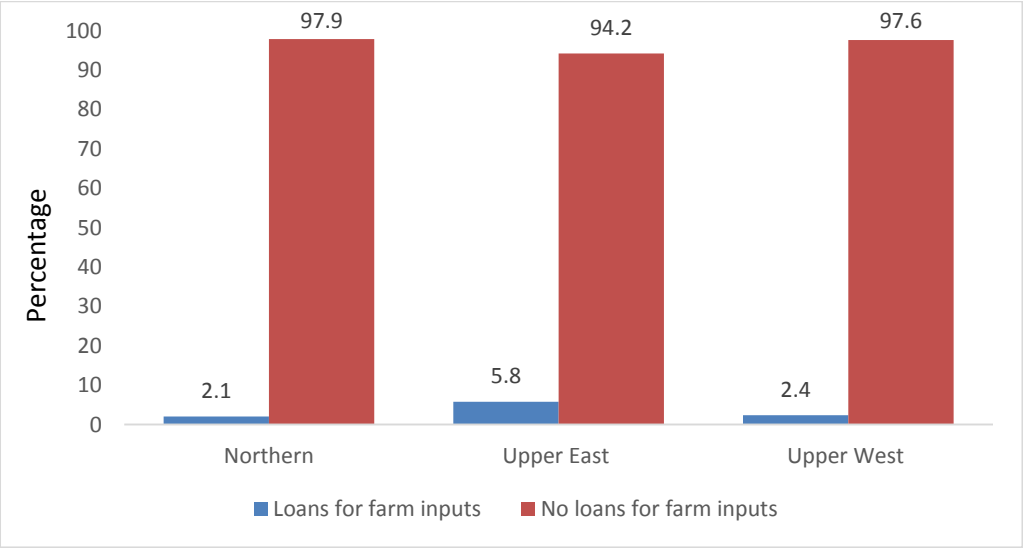


Figure 11: Distribution of Loan Status in the three Northern regions

Figure 12 provides an analysis of the total number of household who used loans to purchase farm input during the last farming season. It was observed that, only 19.6% of respondents used loans to purchase farm inputs. About 5% of farmers in the Upper East region used loans to purchase farm inputs whilst the other two regions recorded less than 3%. The figure below displays gender disaggregation of farmers using loan to procure farm inputs.

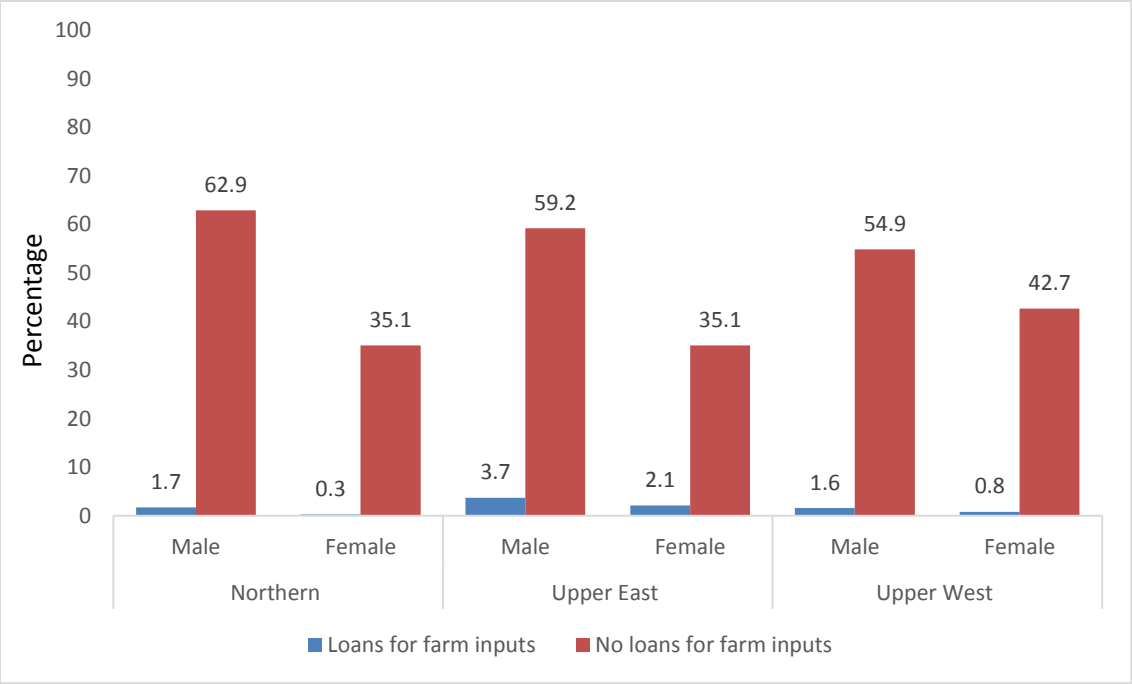


Figure 12: Access to loans for farm inputs

Apart from Upper East region where 7% of the females had outstanding loans, the rest of the farmers interviewed across the regions recorded less than 5% for both males and females (See Table 29).

Table 29: Frequency distribution of outstanding loans of households by Region and sex

Region	Loan Status	Male		Female	
		N	%	N	%
Northern	Outstanding loans	27	3.5	7	1.6
	Without outstanding loans	752	96.5	420	98.4
Upper East	Outstanding loans	13	4	14	7.3
	Without outstanding loans	313	96	179	92.7
Upper West	Outstanding loans	15	2.8	12	3
	Without outstanding loans	512	97.2	393	97

4.3.3 Access to markets

In general, 93% of respondents had market for their produce. Table 30 shows that markets were more available among farmers in the Northern region with 48.80% for maize and 52.90% for soya. Upper West region, however, had the most available market for rice (42.60%). Rice comparatively had the highest available market.

During farmers' focus group discussions, respondents indicated a number of marketing constraints. Prominent among these were: low pricing of produce; high marketing cost; unstandardized measurement of produce; and lack of appropriate storage facilities. The latter was particularly noted to compel some farmers to sell immediately after harvest when prices are at the lowest.

Table 30: Distribution of farmer assessment of ready market across regions and crop

Crop	Name of Region	Ready market (%)	No Ready Market (%)
Maize	Northern	48.80	0.80
	Upper East	16.00	1.50
	Upper West	29.30	3.50
	Total	94.10	5.90
Rice	Northern	27.40	0.20
	Upper East	24.40	1.10
	Upper West	42.60	4.40
	Total	94.30	5.70
Soya	Northern	52.90	0.70
	Upper East	15.40	2.50
	Upper West	24.20	4.30
	Total	92.50	7.50

Local markets were the main access point for farmers to sell their produce, recording more than 70% across regions and commodities and followed by Aggregators with Nucleus farmers recording the least percentage. Farmers' sources of market are shown in Table 31.

Table 31: Types of markets accessed by Farmers

Crop	Source of Market	Name of Region					
		Northern		Upper East		Upper West	
		N	%	N	%	N	%
Maize	Local Market	456	71.80	192	92.30	315	82.50
	Aggregator	165	26.00	12	5.80	59	15.40
	Nucleus farmer	14	2.20	4	1.90	8	2.10
Rice	Local Market	125	71.80	129	83.20	247	91.10
	Aggregator	43	24.70	24	15.50	17	6.30
	Nucleus farmer	6	3.40	2	1.30	7	2.60
Soya	Local Market	314	82.60	100	90.10	153	87.90
	Aggregator	56	14.70	8	7.20	20	11.50
	Nucleus farmer	10	2.60	3	2.70	1	0.60

Figure 13 shows farmers access to market information. Respondents (72%) had access to marketing information. Marketing information for maize was readily available to farmers. The Northern region has the highest marketing information on maize (92.3%) and soya (76.9%). Upper East region recorded the highest (91.4%) for rice.

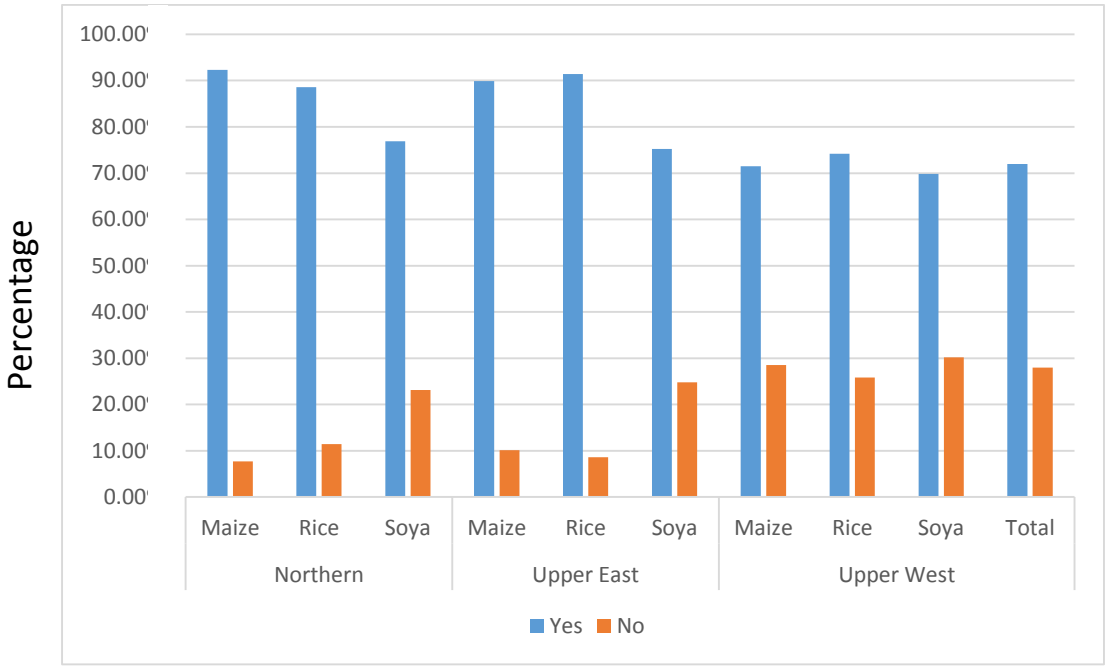


Figure 13: Access to market information

The distribution of market information was mainly through farmers (see Table 32). Traders were recorded as the second largest informant on market conditions in Northern region (17.7%) and Upper East region (11.8%). In the Upper West region, radio (20.9%) and aggregators (5.2%) were mentioned as the second and third largest information sources.

Other sources of market information with extensive usage included traders (second in Northern and Upper East regions). FBOs, TV and extension officers are rarely used as sources of information. ICT-based modes of accessing information such as SMS and Esoko were less popular across the ZOI. Test of correlation between access to market information and access markets revealed significant variation. The computed correlation coefficient is positive and of the magnitude, 0.41 (see Annex 9).

Table 32: Source of market information

Source	Region					
	Northern		Upper East		Upper West	
	N	%	N	%	N	%
Farmers	715	68.30	345	76.70	424	63.20
SMS	9	0.90	1	0.20	3	0.40
Esoko	9	0.90	2	0.40	2	0.30
Nucleus farmers	53	5.10	26	5.80	18	2.70
FBOs	6	0.60	1	0.20	6	0.90
Aggregators	41	3.90	12	2.70	35	5.20
Traders	185	17.70	53	11.80	33	4.90
TV	0	0.00	0	0.00	1	0.10
Radio	23	2.20	3	0.70	140	20.90
Extension	0	0.00	0	0.00	1	0.10
Others	6	0.60	7	1.60	8	1.20

4.3.4 Input supply

Inputs purchased by farmers were fertilizers, herbicides, insecticides and improved seeds. Ease of access to these is similar across the regions (see Table 33). The most difficult to access input was found to be improved seed. Farmers (64 %) had difficulty in obtaining improved seeds. The next most limiting input with wide access was insecticides and fertilizer. Comparatively, inputs were generally not accessible to farmers in the Northern region.

Table 33: Access to inputs

Region	Fertilizer		Insecticide		Herbicide		Improved seed	
	Easy (%)	Uneasy (%)	Easy (%)	Uneasy (%)	Easy (%)	Uneasy (%)	Easy (%)	Uneasy (%)
Northern	39.2	60.8	37.4	62.6	40.5	59.5	36.2	63.8
Upper East	43.2	56.8	44.3	55.7	43.4	56.6	41.2	58.8
Upper West	35.3	64.7	36.8	63.2	37	63	31.8	68.2
Total	38.61	61.39	38.54	61.46	39.82	60.18	35.64	64.36

4.3.4 Farmer satisfaction with access to inputs

Satisfaction with access to inputs was assessed on a 5 point Likert scale (satisfied to unsatisfied) .The results indicate that respondents in the ZOI were generally not satisfied with access to various farm inputs. About 56.7% of all farmers (sum unsatisfied and very unsatisfied in Annex 11) were at least unsatisfied with access to improved seeds. Farmers in the 3 northern regions who are at least unsatisfied with access to fertilizer herbicides and insecticides are 54.8%, 52.2% and 53.7% respectively. Regional and gender breakdown is presented in Annex 11.
Discussants at the various FGDs noted that even though these inputs were available on the market, they did not have enough funds to purchase them. It was further emphasized that

farmers had to travel long distances to access these inputs as they were not available in the local market. A typical farmer in the ZOI travels about 19 km to access purchased farm input as shown in

Table 34. Distances were most variable in Upper East Region (SD=39.63), a situation largely caused by farmers in the Mamprugu-Moagduri area. Farmers in Upper West travelled the longest distance to the nearest agro dealers.

Table 34: Distance to nearest farm input dealership

Region	N	Max	Min	Mean	S.D
Northern	807	162	0.20	15.50	21.21
Upper East	321	360	0.50	18.89	39.63
Upper West	627	105	1.00	23.73	25.96
Total	1755	360	0.20	19.06	27.34

4.3.5 Access to Extension Services and Training

Analysis of household interviews and focus group discussions indicated that the existing agricultural extension system in northern Ghana has not been the best. Majority of farmers (73.2%) across the study area indicated that they had not had access to extension services since the previous farming season.

Figure 14 indicates visits by extension officers to household farms. Of the 2657 farmers surveyed, 26.8% indicated that they were visited by an extension officer during the farming season preceding this survey. Across the three regions 67.1%, 68.2% and 83.9% of the surveyed farmers in the Northern, Upper East and Upper West Regions respectively indicated no visits by government extension workers (MoFA) during the last farming season were reported.

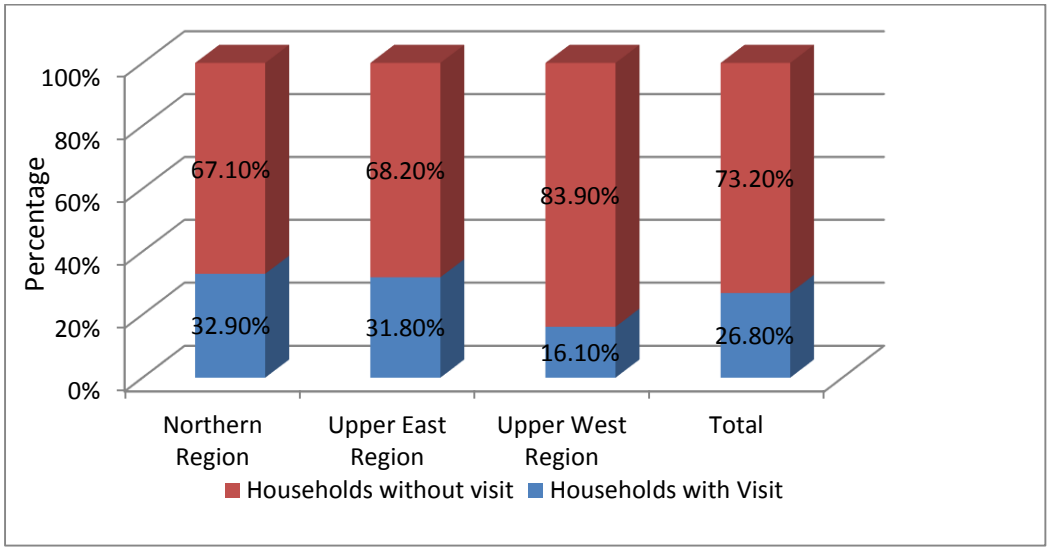


Figure 14: Visits of extension workers to farms

Table 35 shows types of extension officer and their accessibility to farmers in the study area. Government extension officers from MOFA provided more technical services to farmers in Northern (47.8%) and Upper East regions (21.1%). The Upper East region recorded the highest number of government extension officers visits to maize (93.0%), rice (89.1%) and soya bean

(87.5%) farms. Significantly, however, Nucleus Farmers provided more extension services to farmers in the Upper West Region (13.1%) than government extension workers (4.6%). Provision of extension services by Nucleus farmers in the Northern and Upper East Regions was very low (4.6%) and (0.8%) respectively.

Table 35: Type of extension officer and visits to farmers

Region	Government	Nucleus farmer	Government and NF
Northern	47.80%	4.60%	3.40%
Upper East	21.10%	0.80%	1.30%
Upper West	4.60%	13.10%	3.40%

Comparatively, farmers in Northern and Upper East Regions had more extension officer visits than their counterparts in the Upper West Region. Extension workers visits to farmers on the focus commodities in the Northern region were as follows: 31.11%, 42.29% and 31.69% for maize, rice and soya farms respectively. In the Upper East region it was 37.72%, 33.95% and 18.60% for maize, rice and soya. The corresponding figures for Upper West were 17.76% (maize), 16.72% (rice) and 11.71% (soya). Soya bean farms received the lowest extension officer visits across the three regions.

The low accessibility to extension services by a significant proportion of farmers was found to impact negatively on application of new technologies, improved varieties and good agronomic practices.

Access to Training

The study indicated that the number of farmers who have received training in the ZOI was very low. About 82% of farmers had not attended any training during the past 6 months. Comparatively, Upper West region had the largest proportion of farmers (91.6%) who had not received any training during the reported period. Those who received training indicated the topics covered included use of improved seeds (41%), fertilizer application (27.5%), cropping practices (20.4%), pests and diseases control (3%) and pesticide application (2.1%). Training providers included MoFA, Nucleus Farmers and NGOs (notably ACDEP, ADRA and IFDC). Most of the beneficiaries of the training confirmed that they had been able to improve their agronomic practices, particularly ridging, row planting, fertilizer application and seed selection.

4.3.6 Farmer Organizations and Networking

Focus group discussions indicated that memberships of FBOs in the study area are often small and pretty homogeneous. It was revealed further that FBOs were formed by members from the same community or from neighboring areas. It was also found that FBOs and agricultural cooperatives often emerged from an already existing and well-defined social network.

Plate 7: Members of Titietemene Co-operative farmers and marketing society in Doung, Upper west region

Membership of farmer based organizations (FBOs) amongst respondents is summarized in Figure 15. Of the surveyed respondents in ZOI; membership of FBOs was highest in the Northern region for both males (44.6%) and females (39.6%). Male membership of famer groups was higher than females. However, the study revealed that membership of FBOs amongst respondents was low. This information clearly indicates that the potential of social-network (social capital) through farmer groups as source of agricultural related information has not been fully utilized in northern Ghana. More than half (56%) of the few farmer groups were associated with ADVANCE. Most of the FBOs have been in existence for the past 10 years.

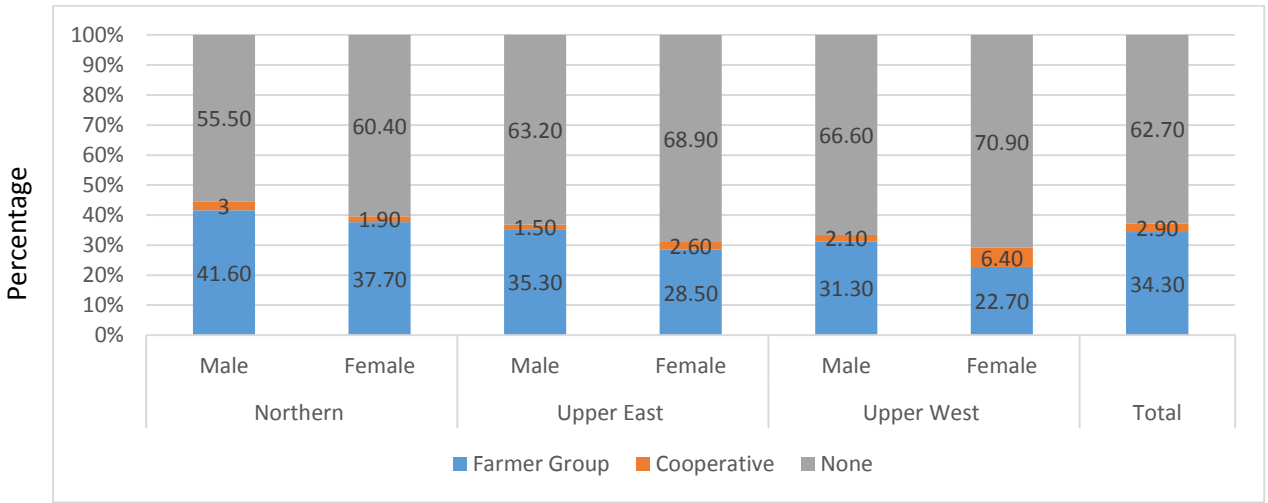


Figure 15: Membership of farmer group

The FBOs were mainly focused on Integrated Crop management, Integrated Pest management, Soil Fertility 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.

4.3.7 Multiple regression analysis of some key variables

The following variables: assess to extension services; assess to training; level of education; land size; and whether a beneficiary of ADVANCE I or not, were examined to assess their influence on maize, rice and soya bean outputs within the Zone of Influence.

The results indicated that all variables contributed 3.3% to maize yield per hectare. Among the selected variables, 'beneficiaries of ADVANCE I', had the highest contribution to maize yield (11.2%, p=0.000) followed by 'agricultural land size' (10.2%, p=0.000).

For Rice, results indicated that all variables contributed 10.2% to yield. Among the selected variables 'beneficiaries of ADVANCE I' had the highest contribution to rice yield (16.2%, p=0.000) followed by 'extension services' (13.6%, p=0.005).

For soya bean, in the ZOI all variables contributed 2.5% to yield. Among the selected variables 'land size' had the highest contribution to soya yield (14.3%, p=0.000).

Furthermore, the following variables; hectares planted, volume of production, Advance I beneficiary and Region were tested to assess their influence on maize, rice and soya gross margins within the Zone of Influence.

The results indicated that all four variables contributed 1.9% to maize gross margins. Among the individual variables Total volume of production was found to be the highest contributor to maize gross margins (18.1%, p= 0.000) followed by total hectares planted (10.9%, p=0.008).

Analysis on the effects of these variables on rice gross margins indicated that, all variables contributed 51% to the rice gross margins. Among the selected variables, total volume produced had the highest contribution to rice gross margins (81.1%, p=0.000) and this was followed by total hectares planted (37.5%, p=0.000).

On the gross margins of soya, the four variables contributed 24.6%. Total volume produced was the highest (62.3%, p=0.000) contributor to gross margin of soya and this was followed by hectares planted (30.5%, p=0.000).

4.3.7 Value Chain of the three commodities (maize, rice and soya)

The value chain for the three focus commodities (maize, rice and soya) have been summarized in Figure 16, Figure 17 and Figure 18. The discussion focuses on the main actors in the chain: input suppliers, producers (farmers), aggregators/ marketers, processors and consumers.

Input suppliers

It was observed during the survey that, production processes of the three commodities start from the input suppliers. The input dealers supply farmers with fertilizers, improved seed, and herbicides among others which establish the nexus of these two actors. The level of linkage between farmers and input dealers is threatened by accessibility. This is because farmers travel long distances to access basic input. This has resulted in some farmers saving seeds for production. Key informant interviews revealed that input providers are not decentralized, but rather centered in urban areas. As result, most farmers travel long distances to urban centers to access basic inputs such as new variety seeds, fertilizers and other farm implements. This

situation compels most farmers not to link up with the input dealers. Therefore, the value chain between farmers and input suppliers were found to be weak. For instance, few depots and agents of input suppliers were found in the ZOI. In the linkage, farmers emphasized the supply of improved seed varieties as very critical to enhancing productivity. The weak link between the farmers and improved seed varieties suppliers was found to affect the quality and value of seeds since farmers lack the knowhow of producing and storing seeds.

Producers/Farmers
The producers of the focus commodities in the ZOI can be categorized into three cohorts: smallholder, out-growers and nucleus farmers. The smallholder farmer is the key actor within the chain in terms of output. Basically, the smallholder farmers in the ZOI do not add any value to the commodity. They 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 farming. Some of the nucleus farmers also served as aggregators and market outlets for smallholder farmers. The linkage between farmers and traders were elaborate but basic support systems including transport and storage facilities were found to be inadequately developed in the ZOI.

Market
Empirical data brought to light three sources of market where harvested commodities are sold. These included the local market, nucleus farmer and aggregators. The survey proved that most of the commodities get to the local market after harvest. Thus, farmers bag the produce and take them directly to the sellers (marketers) either at the farm gate or at the market. Marketers in the ZOI are strongly and directly linked to farmers, processors and consumers. Thus the marketers help both processors and consumers get access to the commodities in question for food and other production. The nucleus farmers and the aggregators buy the produce from the farmers, and resell on the local market to consumers or other aggregators. Although aggregators are connected to the value chain in the three regions, they do not add any significant value to the commodities. Some producers are of the view that, most of the aggregators are the course of most of their financial woes since they tend to buy their produce at a very low price during peak season when the demand for the commodities is low.

Processors
The processors of the commodities are directly linked to the market with the exception of processors for rice and soya who are connected to the farmers. Maize processors buy the commodities from the market and turn it into processed commodities like, corn dough, corn flour and boiled maize.

The processors for the rice and soya beans are the actors that add significant value to the commodity value chains in the three northern regions. Some processors play back and forth role in the value chain since they act as aggregators and marketers. Thus the processors take the commodity from the market, process them, and send the processed commodity back to the market for sale.

Consumers
Consumers are the final users of the commodities and are connected to the markets. Consumers buy both processed and unprocessed maize for consumption but for rice and soya bean, they only buy them processed.

Consumers of the three commodities are not only in the ZOI but are across the whole country and beyond since it was revealed that some aggregators end up selling the commodity outside the zone to other regions and sometime outside the country to the sub-region.
The Figures below are for maize, rice and soya value chain maps across the three Northern regions of Ghana.

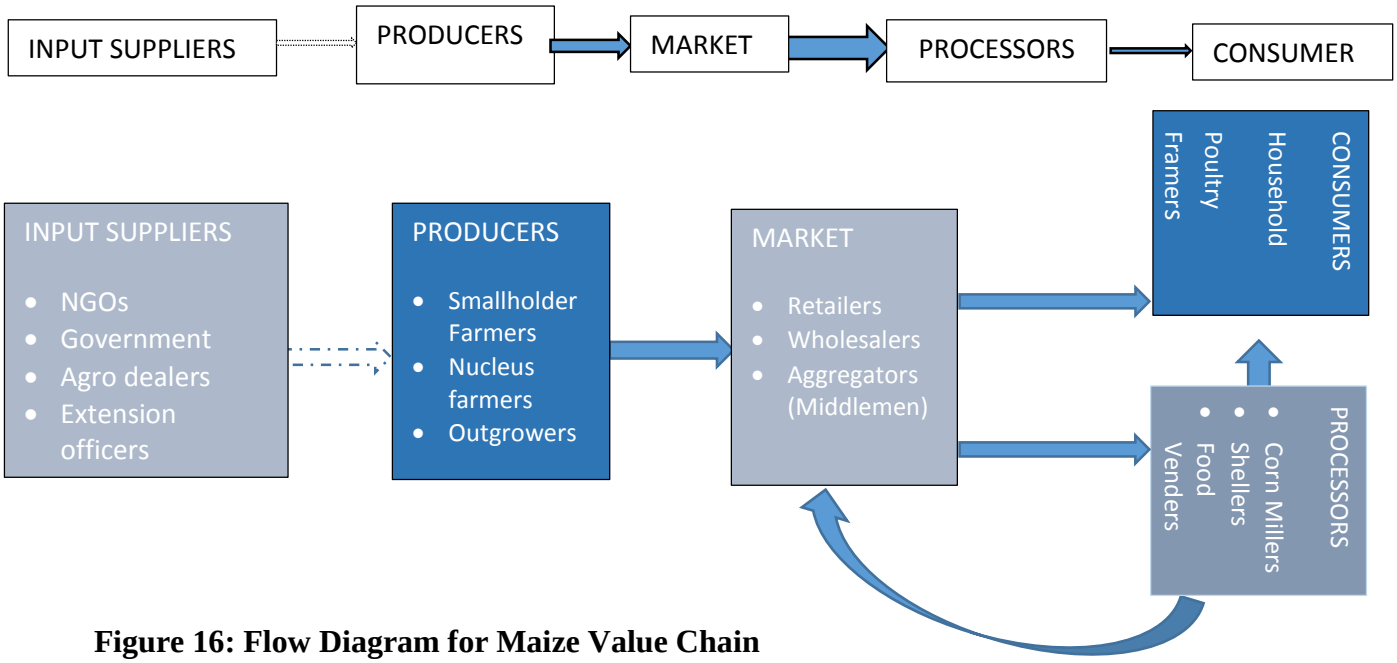


Figure 16: Flow Diagram for Maize Value Chain

For the maize value chain, the marketers sell directly to the consumers and some processors. These processors in turn sell the processed maize back to the marketers and some consumers.

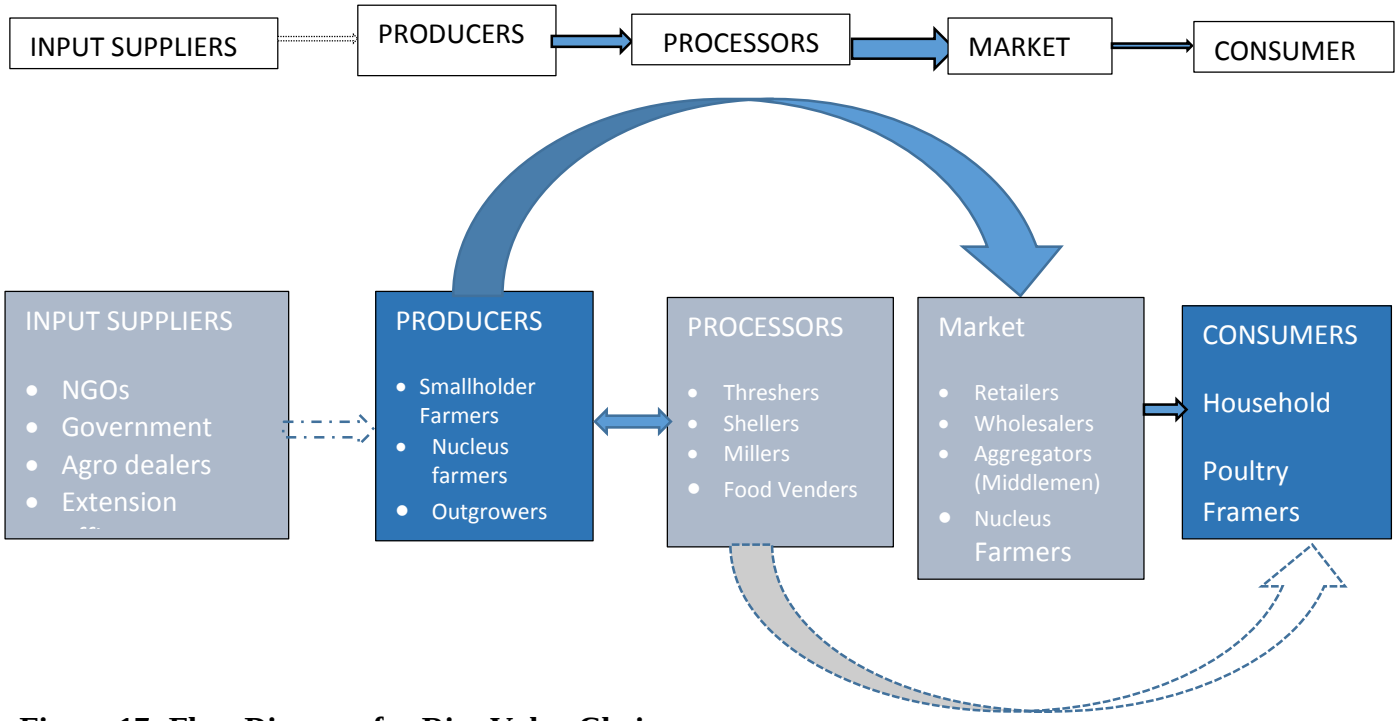


Figure 17: Flow Diagram for Rice Value Chain

Producers often process their own produce and so there exist a reverse relationship with them. There exist weak link between processors and consumers even though there is evidence that some processors sell directly to consumers. There is a stronger link between producers and the market since most producers sell directly their processed rice on the market.

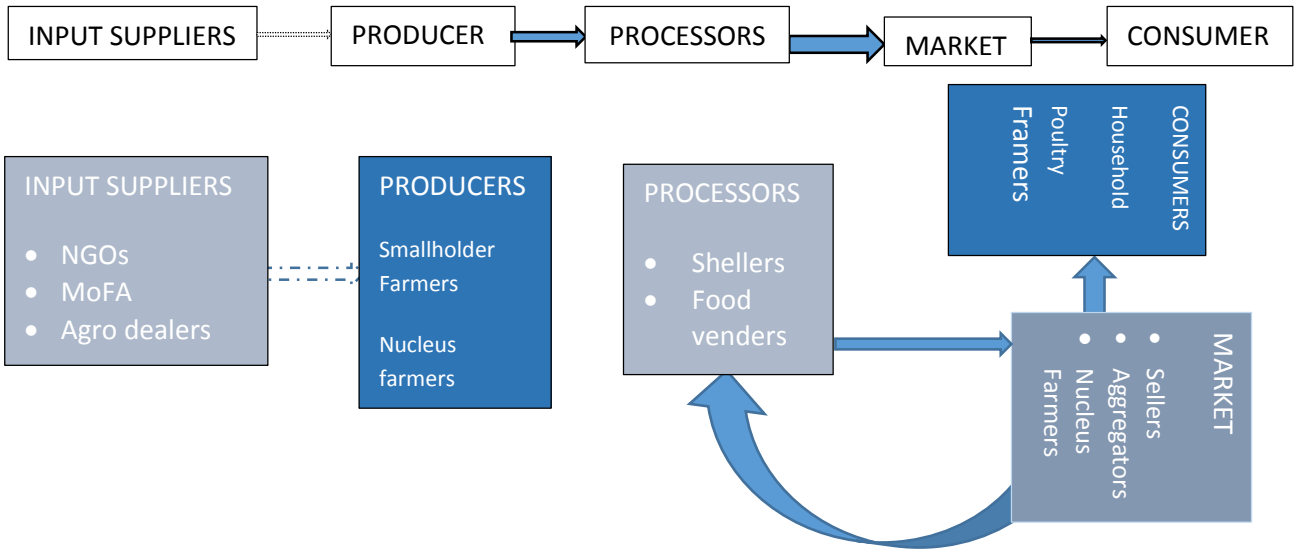


Figure 18: Flow Diagram for Soya Value Chain

Most producers of soya sell directly to the market and the marketers in turn sell to processors and consumers. Some processors also sell directly to the market but do not have any direct link with the consumers.

In our analysis of the three commodity value chains, transporters were non-existent and were not mentioned in our interactions, aggregators bring their own form of transport to collect commodities bought from producers or marketers.

4.3.8 Major constraints

The identification of major production constraints is necessary in the design of interventions to increase the production of farmers in northern Ghana. There are a number of challenges that farmers are encountering which affects their production and efficiency. Quite a number of these challenges were outlined by famers across the three regions and these are:

- High cost and Inaccessibility of farm Inputs. A number of farmers who have access to farm inputs complained the chemicals and fertilizers that they purchase does not give them the results they expect and suspects some of these inputs had expired, and expressed interest in getting the inputs from trusted sources.
- Difficulty in gaining access to agricultural credits.
- 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 most parts of Northern Ghana with a direct effect on farmers production cost.
- Limited knowledge about good agricultural practices that enhance production.
- Limited access to farm machinery. Most farmers gave this as a reason why there is a limited number of farmers in the cultivation of soya, since the shelling of soya involves high level of mechanization.
- Low level of efficiency in the activities of farmers. For instance the low quality of rice produced by these farmers is attributed to the traditional method of threshing.
- Markets for farm produce possess a major challenge to farmers. These challenges ranges from pricing, lack of buyers, poor road networks, lack of standardized unit for measurement per price for produce, among others.
- Lack of technical support and extension services.

5.0 KEY OBSERVATIONS AND LESSONS LEARNT

The under listed are among the key observations and lessons from the study:

- Among all surveyed farmers, maize production remains the single farm activity with the highest average gross margin of GHS731.63 and GHS635.53 for males and females respectively. Similarly, Gross margins for rice were estimated at GHS 428.70 (males) and GHS 422.73 (females), and that of soya were GHS229.06 (males) and GHS 359.61 (females).
- Most farm sizes were small. Women were disadvantaged in terms of land allocation and access in the three northern regions. The average farm size for males and females in the ZOI were 1.61 ha and 1.06 ha respectively. Across the regions, the allocated average hectares for maize, rice and soya was estimated at 1.83ha, 1.14ha and 1.18ha respectively. Among the regions, Upper West region recorded the largest average farm size for maize (1.85ha) followed by the Upper East (1.83ha). Among the three commodities, rice recorded the least average farm size (1.14ha) across all the regions
- The nucleus farmers played a significant role in the value chain in terms of FBO formation, supply of inputs and provision of information and communication.
- The farming population comprised mainly the youth. From the data set, 50.1% of the respondents fall within the range of less than 30 to 40 years (<30=20.70%, 31-40=29.40%). However, the minimum age from the dataset is 16 years.
- Most households lived in family owned dwelling; northern region 72.5%; upper east 76.1; and upper west 83.3. These houses are mainly constructed with mud. Boreholes were the commonest source of drinking water while places of convenience were in the open field. Source of energy for cooking was primarily firewood.
- Female ownership of land was marginal as females could not acquire land on their own but from their husbands and male relatives.
- On the basis of gender, males dominated in the cultivation of all three crops in the three regions, except soya bean which female farmers were more than their male counterparts in the Northern Region.
- Among the technologies that have been introduced to farmers, fertilizer, weedicides and row planting, showed relatively higher percentage usage. Fertilizer application was practiced by 650 farmers (49.9%), 281 farmers (44.1%) and 172 famers (23.9%) in maize, rice and soya production respectively across the ZOI. Weedicides were applied

by 49.8%, 58.8% and 49.7% in maize, rice and soya production respectively. Across the 3 northern regions, the practice of row planting was most common among soya producers (73.7%). There were more farmers using row planting in maize (41.6%) than rice (26.1%).

- On the whole, there are more farmers applying at least one technology than there are new users. For instance, a minimum of 74% of all farmers applied at least 1 technology regardless of time. Among maize also farmers 95% adopt at least one technology whereas 30% are new users of at least one technology. Regardless of time of commencement, majority of farmers use two (2) to five (5) technologies. About 50%, 48% and 72% respectively for maize, rice and soya were found doing so. Even within continuous and new users, use of 2-5 technologies emerges the norm among all 3 food crop farmers.
- None of the banned chemicals were identified to be used by respondents in the ZOI though most farmers referred to almost all pesticides as DDT.
- The practice of irrigation was very low and some farmers were still using mulch as water conservation and soil manure.
- Savings culture among respondents was poor resulting in small percentage of farmers having access to loans.
- Extension services had concentrated on agronomic practices relegating agriculture business management skills to the background. 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 new in the ZOI. They were found to be dominated by males. Though less structured, majority had savings account with formal financial institutions.

6.0 SUMMARY OF INDICATOR FRAMEWORK

Table 36 is a summary of the ADVANCE II impact areas and shared indicators. 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 II intervention in future.

Table 36: Indicator Framework

Type	Indicator	Baseline 2014					
			Region			Sex	
		Regional	Northern	Upper East	Upper West	Male	Female
Outcome	Yield per hectare of maize (MT/ha)	1.38	1.34	1.45	1.74	1.39	1.31
	Yield per hectare of rice (MT/ha)	1.61	1.48	1.71	1.76	1.71	1.39
	Yield per hectare of soya (MT/ha)	0.89	0.90	0.75	1.11	0.94	0.71
Outcome	Gross margins for maize (GHS)*	752.00	744.87	823.78	615.46	735.36	768.64
	Gross margins for rice (GHS)*	675.61	407.62	915.11	1081.85	688.11	663.11
	Gross margins for soya (GHS)*	701.48	745.67	567.19	934.04	838.31	564.65
Outcome	• Number of targeted farmers and others who have applied new technologies or management practices	2432	1106	519	807	1475	957
	• New application of technology	513	275	112	126	353	160
	• Continuing application of technology	1919	831	407	681	1122	797
Outcome	Value of sales of maize (GHS)	1,236,937.29	590,001	243,392	389,490	1,053,361.90	183,575.39
	Value of sales of rice (GHS)	980,781.12	230,490	281,879	183,296	713,207.25	267,573.87
	Value of sales of soya (GHS)	847,784.05	428,929	116,470	140,710	692,929.25	154,854.81
Output	Number of hectares under hybrid maize, and other new technologies or management practices	3290.66	1452.4	759.26	1079	2386.3	904.36
Output	Percentage of farmers with access to agricultural training	18.1	22.1	26.2	8.4	19.1	16.5
Output	Percentage of farmers with access to credit	2.9	2.1	5.8	2.4	3.4	2.1

1USD=GHS 3

* The Regional Gross Margin figures are averages from extrapolated values

7.0 CONCLUSIONS

The purpose of this study was to estimate and present baseline information of the required indicators of ADVANCE II. The study covered the three Northern regions (Zone of Influence); Upper East, Upper West and the Northern region. The target commodities were maize, rice and soya.

Yield per hectare, gross margins per hectare, application of technology, value of sales for the target commodities among others were the relevant baseline indicators that were required to track the performance and assessment of the ADVANCE II project interventions. These indicators have been disaggregated by region, gender and commodity.

The estimates were derived from farmer household survey and were complemented with institutional survey conducted in the ZOI. The data collection methods included the use of structured questionnaire, key informant interview guides, focus group discussion guides and field verification forms. Data collection was carried out between November and December 2014 with a farmer household sample of 2,657 which comprised a male proportion of 61.4% and 38.6% for females.

Among the commodities studied (rice, maize and soya), maize production had the highest gross margins per hectare among farmers. Females had higher performance in maize in terms of gross margins per hectare (GHS 768.64) as compared to males (GHS 735.36). It was found from focus group discussions and key informant interviews that females had relatively smaller farm sizes which they were able to maintain better than the larger fields of men. For instance, weeds infestation which contribute to reduction in yields were difficult to control on the larger farms of men. As a result, yield per unit area from male's farms were comparatively lower thus accounting for the lower gross margins.

Generally, there was a weak linkage between input suppliers and producers for the three commodities. Rice had the best developed value chain linkage.

The ADVANCE II will impact positively on the livelihoods of the farmer households in the three Northern regions. This is because the activities that the project seeks to implement are those that would improve incomes of farmers. Therefore, if ADVANCE II activities are implemented as anticipated in the project, it will reduce poverty among farmers and improve the quality of lives in the three Northern regions.

8.0 RECOMMENDATIONS

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

8.1 Productivity in target commodities

- Improve access to input supply to producers in the value chain.
- Train farmers on Good Agronomic Practices (GAPs) to improve their production
- Farmers should be educated on value addition of the commodities, especially soya, to increase their profit margins.
- Women access to farm inputs and support services such as credit, tractor services, improved seed and fertilizer should be improved to encourage more women to go into Agricultural production especially rice.

8.2 Market access and trade linkages

- The nucleus farmers should be supported to enhance the provision of services to the out-growers particularly marketing, storage facilities such as silos, credit and technical know-how.
- Transporters should be identified and mainstreamed into the value chain process.
- Improve accessibility and linkages between out-growers and nucleus farmers.
- Collaboration between ADVANCE, local radio stations and MoFA should be enhanced to improve market information to farmers.
- Improve the link between nucleus farmers, aggregators and other farmer platforms, example ESOKO.
- Ensure standardization of market prices of farm produce.

8.3 Local capacity

- The link between farmers and credit institutions must be enhanced to streamline and help farmers acquire credit.
- Strengthen leadership capacity of women.
- Encourage the use of group savings to help investment in agriculture.
- Improve extension services and training.
- Individual farmers should be encouraged to have better savings culture.
- It will be prudent that for similar future assignments, field visits should be done around harvesting period to ensure that the crop cut activity could be executed.

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ANNEXES

Annex 1: Baseline scope of work

Baseline study objectives

The FTF baseline study aims to provide knowledge to test the Partners projects' causal pathways as outlined in the above Theories 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 and technological development, growth, investment, policy and innovation.

Scope of Work

This baseline study and the recruitment of a firm/consultants (herein referred to as the Offeror) to conduct it are the purposes of the present scope of work. The baseline study will adopt mixed methods and will be conducted through 1) desk reviews, 2) a 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.

1) Desk reviews

The Offeror will start the baseline activities with a desk review of key documents on the ADVANCE Project 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 and technological development, growth, investment, policy and innovation.
Documents to review will include but are not limited to:

Project documents; (e.g. Projects Reports, Projects Descriptions, IPTTs, etc.);
The Project performance management plan or Project M&E Plan;
Feed the Future (FTF) indicators handbooks;
The USAID Feed the Future strategy in Ghana;
USAID Feed the Future population-based survey compiled by Monitoring Evaluation and Technical Support Services (METSS – Ghana) in 2012;
The 2011-2015 Medium Term Agricultural Sector Investment Plan (METASIP) of Ghana;
The Country Development Cooperation Strategy (CDCS) 2013-2017 (Published 2012); and
Other relevant resources on the agriculture sector in Ghana and on the targeted commodities value chains.

All documentation for review will be provided by the Partners.

2) 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 FTF projects.

Study Population

The study population will be composed of the potential farmer and other value chain beneficiaries, meaning smallholders, nucleus farmers, members of farmer based organizations, production and business development service providers in the targeted regions. These will include both current and potential beneficiaries. Current beneficiaries will include ADVANCE II beneficiaries who have not been influenced yet, and potential beneficiary will include any farmer in the Zone of Influence who is not a beneficiary yet and cultivating < or = 5 hectares of land of maize, soybean or rice.

Survey Design

This project will utilize a non-experimental pre-post-test design survey. This survey will be farmer based, those cultivating at least one of the three value chain crops (Maize, Rice or Soyabean) in the Zone of Influence (ZOI), refer to map in page 7. The survey data will be collected in two phases.

Phase 1: Data at this phase include but 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, technology and management practices for the yield estimated.

Information from the second phase of this survey will complete the data needs to calculate Gross Margin of the three commodities (Maize, Rice or Soyabean).

Indicators baseline values to collect

Type	Name	Definition	Disaggregated by	Responsible Partner
Outcome	Yield per hectare of maize, rice and Soyabean	Measure the amount of agricultural product obtained per unit hectare of land under cultivation. Specifically maize, rice and Soyabean	Region, commodities, sex	USAID/ATT
Outcome	Gross margins per hectare for maize, Soyabean and rice	Difference between the total value of production of the agricultural product (crop) 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	Region, Ring & Non Ring Zones, Crop, and sex of farmers	ADVANCE II
Outcome	Number of targeted farmers and others who have applied new technologies or	% of farmers, and other primary sector producers, individual processors (not	Region, , Sex of farmers,	ADVANCE II, GAMSAP and USAID/ATT

	management practices	firms), rural entrepreneurs, traders, etc. that applied new technologies or management practices	new vs. continuing	
Outcome	Value of sales	This indicator will collect both volume (in metric tons) and value in GHS but converted to (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)	Rice, Soyabeana nd maize value chains	ADVANCE II
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	USAID/GAMSAP

In addition to the indicators above, the quantitative survey will collect data on the training and support received by the surveyed households from various projects, their agricultural and business practices, networking, partnerships and collaborations among them, and any other data that will help answer the survey's objectives.

3) Qualitative survey

The qualitative survey will consist of focus group discussions of a multi representative sample of potential beneficiaries and key informant interviews of key resource persons/subject matter experts in the areas concerned by the baseline survey (Government Institutions, Processors, Input Dealers, Farmer Based Organizations, Commercial/Nucleus Farmers, Financial, Insurance, and ICT Institution acting in the value chain). 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, the qualitative information will be used to interpret and explain the quantitative results. Finally, the qualitative survey will help answer as much as possible some of the below learning questions.

ADVANCE learned that women have better yields than men on plots of less than three acres; that men use more fertilizer than women on maize and rice in northern Ghana; and women's field sizes are generally smaller than men's.
Learning question: What are the underlying factors that contribute to women having higher productivity than men (land size, fertilizer use) and how can the project use these findings to further increase women's productivity?
Female smallholder farmers were able to increase their production and income with ADVANCE support, enabling them to take on some of the responsibility for their families' education and health care
Learning question: *How does increased work load and income for women impact intra-household dynamics/conflicts?*

Policy Process	Number of agriculture legislations/laws/regulations passed since 1992
	Number of agriculture legislations/laws/regulations outstanding
	Number of agricultural policy documents prepared passed
	Number of existing agriculture policy dialogues, advocacy platforms and networks/forums held in the last decade.
	Number of agriculture legislations/laws/regulations/policies reviewed
	Number of public gender-based agriculture policies/regulations/programs/strategies initiated and/or undertaken
	Number of capacity building/training programs organized for the MOFAPPMED, SRID, CAADP country team (METASIP SECRETARIAT, STEERING COMMITTEE &SAKSS NODE), in line with the METASIP
	Number of country teams' decisions implemented
Civil Society/Private Sector Influence On The Agriculture Policy Process	Number of agriculture policy issues being currently discussed among civil society/private sector organizations/groups
	Number of specialized/focused agriculture policy research institutions or think tanks in the country (private/public), and number of them involved in the agricultural policy process.

	Proportion of TV programs focusing in agriculture sector issues production land, environment and water inputs (fertilizers, seeds and agrochemicals technologyISFM, varieties and breeds pre-harvest, harvest and post-harvest processing, value addition & marketing/trading
Media	Proportion of radio programs discussing above issues
	Proportion of articles/columns in newspapers (print media) devoted to agriculture issues above
State Of Agriculture In The Ghanaian Economy	Agriculture's share to GDP
	Rate of growth of the agriculture sector
	Levels of production and value of trade of rice, Soyabean, maize and marine fisheries

Important notes on the survey methodology and tasks

Survey Instruments

The Offeror's team will design the quantitative and qualitative data collection instruments in coordination with the study team (organized by ACDI/VOCA) and with approval by the Partners' team. The questionnaires and interview guides should 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 Partner's projects' 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. Training of enumerators will be provided by Offer or Team Leaders and Specialist.

Data entry and Electronic Devices

Survey data collection will be carried out at two separate periods. (Refer to heading: Survey Design in page 11). Questionnaires will be completed electronically using Smartphone technology, Tablets or Laptop devices which should work both online and offline and 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. 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. The Partners may participate in this verification process.

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

Capturing Open Ended responses

Open ended questions to be included in the electronic questionnaire will address some level of qualitative issues of interest to Partners; however, offeror will ensure that responses are

captured adequately, in any effective and efficient manner that will allow for sufficient analysis to be conducted.

Quality control

The Offeror will include supervisors. Their primary role will be to:
Ensure that the enumerators follow all the survey implementation procedures and complete their allocated interviews within the allocated times;
Carry out and follow quality control measures (as developed by the Partners) on a daily basis through the entire course of the fieldwork days;
Manage team logistics;
Review questionnaires for completeness before leaving the surveyed communities;
Monitor the movement of the teams particularly to ensure they reach all pre-selected sampling points within the prescribed timeframe;
Conduct call backs on respondents;
Provide technical advice regarding the implementation of the sampling plan; and
Interpret and code difficult field responses.

The Offeror 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:
fact that the interview took place;
proper application of the sampling plan in selecting the respondent;
the approximate duration of the interview;
the proper administration of the various sections of the questionnaire;
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. 100% of the interviews will be back checked. For every verification conducted, a brief verification form must be completed.

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.

Data analysis

Data will be analyzed following the guidance of USAID/Feed the Future and the Partners' PMPs. Quantitative data analysis will be conducted using any suitable software. The analysis should follow the sample design and presents a comparison of results by Region and by sex where 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 Partners' PMP. All processing and analysis steps will be recorded under syntaxes that the Contractor will hand over to the Partners among the deliverables.

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

Qualitative data may be analyzed using software; however, it is not a requirement. Outputs should clearly answer the different questions and needs mentioned above.

Report Writing

The report writing will be led by the Team Lead of the Offeror. Progress reports will be submitted at the end of each phase of the survey. Once the Partners' team receives the draft report, it will be circulated to the FTF Partners for technical review. Comments will be collated by the Partners' team and passed on to the Offeror. Revisions should take approximately less than 2 weeks. It is anticipated that the final report will be completed by January 2015.

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

Executive Summary
Acknowledgements
List of Acronyms and abbreviations
Table of Contents
Executive Summary
Background/Brief program description, context and rationale
Purpose and expected use of the survey
Objectives of the survey
Survey methodology and data collection techniques
Main findings
Key observations
Conclusions
Lessons Learned and Recommendations

Annexes to the final baseline report:
Baseline scope of work
Time table
List of documents, references and data sets used
Survey instruments: questionnaire, interview guide (s), etc. as appropriate

Field work documentation
Description of sampling procedures
Data analysis procedures and syntaxes

Progress reports
It is expected that the Offeror will provide regular updates on the implementation of the baseline activities on a fortnightly basis. These could be done by short meetings at the METSS's office in Accra or Tamale, by Skype Conference calls and supported by submission of reports through emails.

Deliverables

The following chart outlines the deliverables resulting from the implementation of phases 1 and 2 of the baseline survey:

Phase	**Deliverables**	**Timelines**
Phase 1	Survey Questionnaire	15th -20th August, 2014
	Training & Field Manual	21st-23rd August, 2014
	Methodology	3 Days but Concurrent
	Field Work Plan	2 days but concurrent
	Clean data set with variable and value labels	2 days after Field Work
	Syntaxes used for the analysis.	5 days after cleaning
	Phase 1 report	Concurrent with analysis
Phase 2	Clean data set with variable and value labels	Will depend on sample size to be selected (TBD after phase 1)
	Phase 2 report	5 days after filed work
	Final Baseline report	December 15, 2014

Logistics
Regional Coordinators and Project M&E Officers who will support offeror and the field team to carry out activities. The main points of contact throughout this effort at each point in time and location shall be the M&E Persons and other regional teams when necessary.

CONTRACT MECHANISM & TERMS OF PAYMENT
ACDI/VOCA anticipates issuing a Fixed Price Purchase Order to an Offeror based on activity.

PROPOSAL PREPARATION AND SUBMISSION REQUIREMENTS
Instructions for Proposal Preparation
The selection committee will evaluate the Offerors based upon their written technical and cost proposals. Each section will be evaluated according to the criteria for evaluations in Section V. Offerors are expected to examine the specifications and all instructions in the RFP. Failure to do so is at the Offeror's risk. Interested Offerors must provide the following:
Capability and Technical Experience Statement
Demonstrate capabilities and technical experience by providing the following:
Experience in conducting qualitative studies
Experience in conducting quantitative studies

Experience in conducting baseline surveys
Knowledge of the Northern Region
Knowledge of the targeted value chains
Staff qualifications

Project Staffing
Identify the project staffing and the percentage of the time each staff member will spend on this activity. Include no more than a half-page biosketch for each individual considered essential for the successful implementation of this contract.

Composition of the team and responsibilities
The study team will consist of:
One Team Leader/Lead Consultant;
One Specialist in agriculture/rural development, rice/maize and/or Soyabean value chains;
Enumerators and supervisors; The number of enumerators, supervisors will be determined based on final sample size determination.

The Lead Consultant and his/her team members will have the overall responsibility for the administration of the baseline study. His or her responsibilities will include:
i. Designing the overall Baseline study protocol (methodology, sampling, etc.)
ii. Conceiving and developing the study guides (questionnaire; focus group guides, interview protocol)

iii. Supervising the field administration of the questionnaire;
Preparing a field manual for the supervisors and enumerators training;
Training supervisors and enumerators in data collection and quality control;
Supervising the data entry process using the most adequate software available;
Analyzing collected data and submitting a complete standard report with outlines and fully written text in a timely manner; and
Timely submission of all the deliverables to the Partners.

The Agriculture/Rural Development Specialist will:
Participate in the design of the Baseline study plan;
Support the Team Leader/ Lead Consultant in the design and implementation of the supervisors and enumerators training;
Significantly contribute in the design and testing of the data collection instruments;
Lead the qualitative data collection; and
Significantly contribute in the analysis of the qualitative and quantitative data and the report writing.

The Offeror's team will be selected based on a competitive process. Proposals will be solicited based on the scope of work contained in this document and all requirements listed in this RFP. Initial selections based on these proposals maybe followed by interviews of the top candidates, after which a final determination will be made. The supervisors will be selected and hired through a competitive process by the Team Leader/Lead Consultant.
The supervisors will be trained on data collection techniques, as well as data checking and verification techniques. The enumerators will then join the team and will be trained on data collection techniques. Role plays and pilot testing will be incorporated into the training and the cultural knowledge of the team will be solicited in modifying and culturally adapting the study

instruments. The length of the training will be correlated with the experience of the enumerators.

All field enumerators will have at least one year's experience in conducting survey research fieldwork and all have attained at the minimum a qualification from an education tertiary institution. Further, recruitment of enumerators and supervisors will take into consideration the need for gender balance. A field manual and guide will be prepared for each interviewer as a quick reference when implementing field work. The manual will highlight and detail how to tackle each questionnaire item, response categories and interviewer instructions. A separate supervisor training manual and guide will be prepared by Offeror's Team for field supervisors to serve the same purpose as the interviewers' training manual and guide.

As previously mentioned, the primary role of the supervisors will be to ensure data accuracy and integrity. They will be with their assigned enumerators in the field and will be available at all times to oversee and advise their supervisees as the questionnaires are being administered. As data is being collected, supervisors will review every questionnaire for accuracy and missing data and correct data as needed. Supervisors will be responsible for explaining the purpose of the study to chiefs and other key personnel as they arrive each day to a new community. Supervisors will also inform the Team Leader/Lead Consultant of any issues that arise that may affect the quality or validity of the data.

Team Leader/Lead Consultant Minimum Qualifications

The Lead Consultant should be well qualified in sociology/rural development, agriculture, survey techniques; with a minimum of Master's Degree in related field of study

S/he will be someone with proven experience in participatory evaluation, community based approaches, developing and evaluating agriculture programs;

S/he must have experience working in teams, preferably in a leadership position, and have a strong client orientation;

Strong analytical skills and sociological focus; knowledge, understanding and practical implementation of qualitative and quantitative survey methods and should have significant experience in working on social assessments and conducting focus groups as well as designing qualitative assessments.

S/he will have at least 10 years' experience in survey fieldwork (data collection, validation, entry and analysis) and experience in leading teams in field (training, field logistics, human relations, teamwork).

Prior experience with USAID programs (in Ghana or elsewhere) will be an advantage;

Excellent writing skills, with publication record (in English) in one discipline related to assignment;

Be capable and fully available to travel and live in field sites during the fieldwork;

S/he will have broad understanding of agricultural development and have skills in measuring and assessing the effectiveness of rural production and marketing systems;

Experience in survey planning and directing is necessary while understanding of local government structure in Ghana will be an added advantage.

Agriculture/Rural Development Specialist Minimum Qualifications

University degree in economics, rural development, agricultural, natural resource management;

Minimum 5 (five) years proven work experience in international rural development;

Experience in qualitative/quantitative survey planning methodologies, participatory evaluation, community-based approaches, developing and evaluating integrated food security and development programs; Excellent communication and interpersonal skills, both written

and verbal, including ability to effectively communicate across cultures; Experience and ability in the provision of technical support in agricultural, marketing, and economic growth.

Enumerators Minimum Qualifications

The enumerators must have at least five years' experience collecting similar data and preferably have a Bachelor's degree.

Annex 2: Itinerary of the Fieldwork

Itinerary: Baseline Studies of ADVANCE II, Northern Ghana					
Date	Activity	Time Frame			Facilitator (S)
		Morning	Afternoon	Evening	
18/11/14	Travel from Kumasi to Tamale				
19/11/14	Debriefing at ADVANCE Office, Tamale	do			PSM, RA
19/11/14	Training of Enumerators, Tamale		do	do	PSM, YAS, EOA, EFA, RA
20/11/14	Pretesting of Questionnaires in NR	do	do	do	YAS, EOA, KOO, MA
21/11/14	Revision of Questionnaires	do	do		PSM, YAS, EOA
21/11/14	Travel to Bolga and Training of Enumerators	do	do	do	EOA, KOO, EFA
21/11/14	Training to Wa and Training Enumerators,	do	do	do	YAS, MA, RA
24/11/14	Commencement of Data gathering (Interviews/crop cut, etc) in NR, UER, UWR	do	do	do	BIRD staff, ADVANCE Support Team
6/12/2014	Completion of and wrap-up on data gathering exercise in NR, UER, UWR	do	do	do	BIRD staff, ADVANCE Support Team
7/12/2014	Debriefing with Technical Director, ADVANCE, Tamale	do			PSM, RA
8/12/2014	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				
KOO	Kwaku Oben Okrah				
MA	Mrs. Monica Addison				
ADVANCE Team	DCOP, Technical Director, M&E Officer, Regional Coordinators, Regional M&E Officers				

Annex 2: Data gathering instruments

ADVANCE II Baseline Studies: Farm Household Questionnaire

ADVANCE II Baseline Survey – Northern Ghana
SECTION A: HOUSEHOLD IDENTIFICATION

Part 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.1.4	House Number		|__|__|__|__|
A.1.5	List the closest landmarks to the house		

Part 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 Data Entry Operator 1		Code	|__|__|__|	Date |__|__|/
A.2.6	Initials Data Entry Operator 2		Code	|__|__|__|	Date |__|__|/

SECTION A: HOUSEHOLD IDENTIFICATION
Part 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 ADVANCE II, a USIAD agriculture funded Program in Northern Ghana. The purpose of the survey is to gather information on maize, rice and soyabean 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 II Baseline Survey at 0243140500, or the Chief of Party for the ADVANCE II 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 II?	1 = Yes 2 = No	|__|	If "2" --> STOP SURVEY
A.3.3	Have you benefited from ADVANCE I?	1 = Yes 2 = No	|__|	Either '1' or '2' CONTINUE
A.3.4	Date	Day/Month/Year		|__|__|/|__|__|/2014
A.3.5	Date of First Visit	Day/Month/Year		|__|__|/|__|__|/2014
A.3.6	Start Time of Interview 1	Use 24 Hour Clock		|__|__|:|__|__
A.3.7	End Time of Interview 1	Use 24 Hour Clock		|__|__|:|__|__
A.3.8	Date of Second Visit	Day/Month/Year		|__|__|/|__|__|/2014
A.3.9	Start Time of Interview 2	Use 24 Hour Clock		|__|__|:|__|__
A.3.10	End Time of Interview 2	Use 24 Hour Clock		|__|__|:|__|__

Part 4: 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 crops of interest in this survey are **Maize, Rice and Soya**

A.4.1	**Name of HH Head** Write Name used on official documents,			
A.4.2	HH Head's Religion	1= Muslim 2=Christian 3=Traditionalist 4=Other	|__|	
A4.3	Household Type	Male no Female Male & Female Female no Male Child no Adult	|__|	
A.4.4	Is Respondent the HH Head?	1 = Yes 2 = No	|__|	If 1 --> A.4.6
A.4.5	Respondent Name Write name used on official documents, with nickname in with nickname in			

	parentheses			
A.4.5	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	|__|	
A.4.7	Mobile Numbers of HH Members (for follow-up)	Mobile Owners		
		a.		|__|__|__|__|__|__|__|__|__|__|__|
		b.		|__|__|__|__|__|__|__|__|__|__|__|
A.4.8	Age of Respondent	1= <30		
A.4.9		2=31-40		
		3=41-50		
		4=51-50		
		5=51=60		
		6=60+	|__|	
		Full age	|__|__|	
A.4.10	Marital Status	1=Married		
		2=Singe		
		3=Divorced		
		4=Separated		
		5=Widowed	|__|	
A.4.11	Highest level of Education	1=None		
		2=Primary		
		3=JSS/JHS		
		4=SSS/SHS/Voc/Tech		
		5=Tertiary	|__|	
A.4.12	Household Size	Indicate number	|__|__|	
A.4.13	Number of children under 18	0-5	|__|__|	
A.4.14		6-17	|__|__|	
A4.15	Male Adults	Over 18	__|__	

			|	
A4.16	Female Adults	Over 18	__|__ |	
Land Ownership				
A.4.17	Does your Household Own Agricultural Land?	1= Yes 2=No		
A.4.18	What is the Size of all Agricultural Land (acres)?			
Major Crop Cultivated				
A.4.19	What is your Major Crop?	1=Maize	|__|	If "1" → Section C
		2=Rice	|__|	If "2" → Section D
		3=Soya	|__|	If "3" → Section E

SECTION C-1: MAIZE FARMERINFORMATION

FARM AREA UNDER MAJOR CROP (Acres)	C.1.1 Farmer Estimated Area:	C.1.2 Actual (GPS) Area:
C.1.3 Plant Population Density (*# of plants in crop cut area * 1000*)		
C.1.4 Type of Seed Used	Hybrid |__|	Local open pollinated varieties |__|

SECTION C 2: PURCHASED INPUT COST OF PRODUCTION

<u>Instruction:</u> 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.2.5 Input Cost Section			**C.2.6 Labor Cost Section**	
Farm Activity	**Purchased Input Cost (GHS)**		**Labor Charges**	**Paid Amount (GHS)**
Land rent (per season)			**Labor Charges for Land Preparation**	

Seeds: Pioneer 30Y87 (*Yellow Maize*) ( )		Ploughing (including harrowing) *Probe for 1st& 2nd ploughing cost and sum* Cash: ( ) In-kind Repayment: ( )	
Pioneer 30F32 (White Maize) ( )		Bag ( ) Weight/ KG …… Remark:	
Pan 53 (White) ( )			
Pan 12 (Yellow) ( )			
Etubi ( )			
Mamaba ( )			
Obatampa ( )			
Farmer's Saved Seed ( )		**Cost of Input Application**	
Others ( ) Specify----------			
NPK (Basal) 15-15-15 ( ) 23.10.10 ( ) 21.10.5 ( ) 31.10.10.3S ( ) 23.10.5+2S ( ) Other Specify ……		Fertilizer Application: 1st Application 2nd Application Weedicides Application Broad Spectrum *(Condemn)* Pre-emergence Post-emergence *(selective)*	
Top Dressing		Manual Weed control ( )	
Sulphate of Ammonia/Sulphan ( ) 23.10.10 ( ) Urea: ( ) Others Specify……		Planting: Manual ( ) Mechanized planting ( )	
Herbicides 1: *Applied before ploughing*			
Herbicides 2: *pre-emergence*		Harvesting:	

Herbicides 3: *Post-emergence*			Shelling Cash ( ) In-kind ( ) Bags (kg)----------	
Herbicides total Cost: *(sum 1,2 & 3)*			Bagging (Jude sacks):	
Insecticides :			Transporting:	
Sacks			Storing:	
Crop Insurance				
Interest Payment on Loan				
Total Input Cost: *Sum all cost under this section*			**Total labor 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([1]GHS)	Volume consumed(Kg)	Volume Stored(Kg)

Section C4:TECHNOLOGY and MANAGEMENT PRATCICE

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**		

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

						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**			
C.4.8Obatanpa			C.4.22 Multi-Purpose Thresher			**C.4.35 Others(specify)**			
Pest Management			**Climate Mitigation or Application**						
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.4.13 Minimum Tillage ( ) C.4.14 Zero Tillage ( )			**ICT**						
			C.4.26 Essoko Market Price updates						
			C.4.27 Farm Radio						

Has farmer applied any new technology this farming season? ☐ ☐ (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**
Total hectares planted (Ha) =	

Total volume (production in Kg) =	
Total volume sold (sale in Kg) =	
Total value of sales(GHS) =	
Average price(GHS) =	
Total purchased input cost (GHS)=	
Gross revenue (GHS)=	
Net revenue (GHS) =	
Gross margin per ha (GHS/Ha)=	

REMARKS/NOTES:
Average price = value of sales divided by quantity of sale
Gross revenue = average price x total production
Net revenue = gross revenue – Total purchased input cost
Gross margin per ha = net revenue divided by area planted

SECTION D-1: RICE FARMER INFORMATION

FARM AREA UNDER MAJOR CROP (Acres)[2]	D.1.1 Farmer Estimated Area:	D.1.2 Actual (GPS) Area:
D.1.3 Plant Population Density (# of *Plants * 1000*)		

SECTION D-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 rice 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.

D. 1.4Input Cost Section			**D.1.5 Labor Cost Section**	
Farm Activity	**Purchased Input Cost (GHS)**		**Labor Charges**	**Paid Amount (GHS)**
[3]Land rent (per season)			**Labor Charges for Land Preparation**	
Seeds: Varieties: IR841 ( )			Ploughing (including harrowing) *Probe for 1st& 2nd ploughing cost and sum*	
Jasmin ( )				

[2]Will be determined through GPS Mapping
[3] Provide estimated seasonal cost if land is on long lease

Jasmin 85 ( )			Cash ( )		
Togo Marshall ( )			In-Kind Repayment ( )		
Tox ( )			Bag ( )		
Farmer's Saved Seed ( )			Weight/ KG ……		
Others ……					
NPK (Basal)			**Cost of Application**		
23.10.10 ( )					
21.10.5 ( )			**Fertilizer Application**		
15.15.15 ( )			1st Application		
Any Other: ……..			2nd Application		
Top Dressing			**Weedicides Application**		
Sulphate of Ammonia			*Broad spectrum (condemn)*		
Urea			Pre-emergence		
Herbicides 1: *Applied before ploughing*			Post-emergence (Selective)		
Herbicides 2: *pre-emergence*			**Insecticide Application**		
Herbicides 3: *Post-emergence*			Insecticide Application		
Herbicides total Cost: *(sum 1,2 & 3)*			Planting: Manual ( ) Mechanized planting ( )		
Insecticides (*Include Storage*)			Transplanting:		
Sacks			Broadcasting		
Crop Insurance			Dibbling		
Interest Payment on Loan			Drilling		
			Bird Scaring:		

Irrigation Fee:			
		Harvesting : Manual ( ) Mechanical ( )	
		Threshing/Shelling Manual ( ) Mechanical ( )	
		Bagging:	
		Transporting:	
		Storing:	
Total Input Cost: *Sum all cost under this section*		**Total labor Cost** *Sum all cost under this section*	

SECTION D-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.***

D.3.1	D.3.2	D.3.3	D.3.4	D.3.5	D.3.6	D.3.7	D.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([4]GHS)	Volume consumed(Kg)	Volume Stored(Kg)

Section D-4:TECHNOLOGY &MANAGEMENT PRATCICE

Instruction: ***Kindly Tell the Farmer that you will like to ask her/him questions about the technologies and management practice she/he applied or practiced producing RICE 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**			**D.4.24 Book/Record keeping**		
D.4.1Jasmin 85			D.4.14 Tarpaulin			**D.4.25 Sales/Purchase**		

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

							Receipt		
D.4.2 IR841			D.4.15 Weighing Scale				**D.4.26 Price and costing**		
D.4.3 Togo Marshal			D.4.16 Moisture Meter				**D.4.27 SMS**		
D.4.4 Tox			D.4.17 Thresher				**D.4.28 Warehouse Receipt**		
D.4.5 Jasmin			D.4.18 Warehouse						
Pest Management			**Climate Mitigation or Application**				**D.4.29 Farm/Crop Budgeting**		
D.4.6 Herbicide			D.4.19 Igntia Weather Update				**D.4.30 Sustainability Plan**		
D.4.7 Weedicide			D.4.20 Weather Crop Insurance Index				**D.4.31 Others(specify**		
D.4.8 Insecticide			**Water Management**						
D.4.9 Birds Scaring			D.4.21 Bunding						
Soil Related			**ICT**						
D.4.10 Planting in rows			D.4.22 Essoko Market Price updates						
D.4.11 Fertilizer			D.4.23 Farm Radio						
D.4.12 Transplanting									
D.4.13 System of rice intensification(SRI)									

Has Farmer applied any new technology this season? YES ☐ ☐

(Enumerators only)

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

SECTION D-5: **SUMMARY DATA**

Instruction: ***Do not Complete Section D-5. The Supervisor will complete Section D-5 and authenticate the quality of the data that you have collected***

(For use by Supervisor only for authentication)

CATEGORIES	TOTAL
Total hectares planted (Ha) =	
Total volume (production in Kg) =	

Total volume sold (sale in Kg) =	
Total value of sales(GHS) =	
Average price(GHS) =	
Total purchased input cost (GHS)=	
Gross revenue (GHS)=	
Net revenue (GHS) =	
Gross margin per ha (GHS/Ha)=	

REMARKS/NOTES:
Average price = value of sales divided by quantity of sale
Gross revenue = average price x total production
Net revenue = gross revenue – Total purchased input cost
Gross margin per ha = net revenue divided by area planted

SECTION E-1: SOYA FARMER INFORMATION

FARM AREA UNDER MAJOR CROP (Acres)[5]	E.1.1 Farmer Estimated Area:	E.1.2 Actual (GPS) Area:
E.1.3 Plant Population Density (*# of plant * 1000*)		

SECTION E-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 Soya bean 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.

E.2.1 Input Cost Section			**E.2.2 Labor Cost Section**	
Farm Activity	**Purchased Input Cost (GHS)**		**Labor Charges**	**Paid Amount (GHS)**
[6]Land rent (per season)			**Labor Charges for Land Preparation**	

[5]Will be determined through GPS Mapping
[6] Provide estimated seasonal cost if land is on long lease

Seeds: Certified: Jenguma ( )	`		Ploughing (including harrowing) *Probe for 1st& 2nd ploughing cost and sum* Cash ( )	
Other Certified Seed ……			In-kind Repayment: ( )	
Farmer's Saved Seed ( )			Bag ( ) Weight/ KG ……	
Inoculant ( )			**Cost of Application**	
TSP ( )			**Fertilizer Application**	
Herbicides 1: *Applied before ploughing*			1st Application	
Herbicides 2: *pre-emergence*			2nd Application	
Herbicides 3: *Post-emergence*			**Weedicides application**	
Herbicides total Cost: *(sum 1,2 & 3)*			Broad spectrum *(condemn)*	
Insecticides :			Pre-emergence	
Sacks			Post-emergence *(Selective)*	
Crop Insurance			Insecticide Application	
Interest Payment on Loan			Manual Weed control ( )	
			Planting: Manual ( ) Mechanized planter ( )	
			Harvesting : Manual ( )	
			Threshing Manual ( ) Mechanical ( ) Cash ( ) In-kind ( ) Bags (kg)----------	

			Bagging	
			Transporting:	
			Storing:	
Total Input Cost: *Sum all cost under this section*			**Total labor Cost** *Sum all cost under this section*	

SECTION E-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.***

E.3.1	E.3.2	E.3.3	E.3.4	E.3.5	E.3.6	E.3.7	E.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([7]GHS)	Volume consumed(Kg)	Volume Stored(Kg)

Section E-4:TECHNOLOGY and MANAGEMENT PRATCICE

Instruction: ***Kindly Tell the Farmer that you will like to ask her/him questions about the technologies and management practice she/he applied or practiced producing soy 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

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

Crop Genetics			**Post-Harvest Handling**				E.4.17 Book/Record keeping		
E.4.1 Jenguma			E.4.8Tarpaulin				E.4.18Sales Receipt		
			E.4.9Weighing Scale				E.4.19 Price and costing		
			E.4.10Moisture Meter				E.4.20 SMS		
Pest Management			E.4.11 Thresher				E.4.21 Warehouse Receipt		
E.4.2 Herbicide			E.4.12 Warehouse				E.4.22 Farm/Crop Budgeting		
E.4.3 Fungicide			**Climate Mitigation or Application**				E.4.23 Sustainability Plan		
E.4.4 Insecticide			E.4.13 Igntia Weather Update				E.4.24Others(specify		
Soil Related			E.4.14 Weather Crop Insurance Index						
E.4.5 Planting in rows			**Water Management**						
E.4.6Fertilizer									
E.4.7 Inoculant									
			ICT						
			E.4.15 Essoko Market Price updates						
			E.4.16 Farm Radio						

Has Farmer applied any new technology this season? YES ☐ D ☐ Enumerators only)

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

SECTION E-5: SUMMARY DATA

Instruction: ***Do not Complete Section E-5. The Supervisor will complete Section E-5 and authenticate the quality of the data that you have collected*** **(For use by Supervisor only for authentication)**

CATEGORIES	TOTAL
Total hectares planted (Ha) =	
Total volume (production in Kg) =	
Total volume sold (sale in Kg) =	
Total value of sales(GHS) =	
Average price(GHS) =	
Total purchased input cost (GHS)=	

Gross revenue (GHS)=	
Net revenue (GHS) =	
Gross margin per ha (GHS/Ha)=	

REMARKS/NOTES:

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

SECTION F: FARMING PRACTICES

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

F.1.3	F.1.4	F.1.5	F.1.6	F.1.6	F.1.7	F.1.8
Current operational status	What was the source of seed for planting last season?	Did you irrigate your crop last farming season?	What type of cropping system do you practice?	Have you left the land fallow before?	How long was the land fallowed?	
1=Own 2=Rented 3=Joint ownership 4=Sharecropping	*1 = Community seed bed* *2 =NGO* *3 = Seed multiplier* *4 = Own production* *5 = purchased from private company* *6 = Govt/BADC provided* *7 = Local Market/Shop* *8 = other (spe*	*1 = Yes* *2 = No*	1=Intercropping 2=Crop rotation 3=Cover cropping 4=Others (specify)	*1 = Yes* *2 = No* If 1 go to F.1.7	1= <2 yrs 2=2-3 yrs 3=3-4 yrs 4=5 yrs+	

F.1.9	F.1.10	F.1.11	F.1.12	F.1.13	F.1.14	F.1.15
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*	1=DAP 2=Urea	1 = Yes 2 = No	1=Manure 2=Compost	1 = Yes 2 = No	1=Fungicide	1=Agro dealer

If '1'► F.1.10	3=NPK	If '1'go to F.1.11	3=Biomass transfer 4 Others (specify)	If '1'►F.1.14	2=Herbicide 3=Insecticide 4 Others (specify)	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 G: ACCESS TO MARKET

G.1.1	G.1.2		G.1.3	G.1.4	G.1.7	G.1.8
Do you have market for your produce? *1 = Yes* *2 = No* If '1'► G.1.2	Source of market		Do you have access to marketing information? *1 = Yes* *2 = No* If '1'► G.1.4	What type informat on do you normally re eive?	What is your source of marketing information ?	
	1=Local market			1=Prices	1= Other farmers	6=Aggregators
	2=Aggregators			2=Avai ability of buyers	2: SMS	7=Traders
	3 Nucleus farmer			3=Availability of commodity	3=Esoko	8=TV
	4=Poultry feed			4=Availability	4=Nucleus	9=Radio

	industry	|__|		of sellers	farmers	
				5=Other (specify)_____ ____	5=FBOs	10=Extension officer
						11=Other (specify)____ _____

SECTION G: SATISFACTION WITH ACCESS TO INPUTS

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

	G.1.1	G.1.2	G.1.3
Opportunities	Easy access Yes= 1, No=2	If No, what is the distance to the nearest dealer/outlet (in Kilometers)	Level of satisfaction (score: 1-5) 1=Satisfied 5=Not satisfied
Fertilizer dealer/outlet			
Insecticide dealer/outlet			
Herbicide dealer			
Improved seed dealer			

SECTION H: ACCESS TO EXTENSION & OTHER TRAINING

H.1.1	Did a government extension worker visit your HH farm last farming season to provide advice about farming?	1 = Yes 2 = No			if 2 ►D.1.5
H.1.2	How many times did the government extension worker visit to provide advice about farming?	Number of Visits			
H.1.3	Who met with this extension worker? Multiple responses possible	A = a female HH member B = a male HH member C= a n n-HH member			
H.1.4	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)		
H.1.5	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 ► H.1.8
H.1.6	What topics were discussed in this most	A = seeds	F = soil type		

	recent training? 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)		
H.1.7	Did anyone from an NGO visit your HH farm last farming season to provide advice about farming?	1 = Yes 2 = No			if 2 ►H.1.11
H.1.8	How many times did the person from the NGO visit to provide advice about farming?	Number of Visits			
H.1.9	Who met with this person?	A = a female HH member B = a male HH member C= a non-HH member			
H.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)		
H.1.11	Have you ever accessed information about agricultural markets or agricultural prices using your mobile phone?	1 = Yes 2 = No			

SECTION I: FARMER GROUPS

I.1.1	Are you a member of a Farmer Group or Cooperative?	*1 = Farmer Group* *2 = Cooperative* *3 = None*		if "3" --> Section J
I.1.2	Is the Farmer Group or Cooperative Part of the ADVANCE I?	*1 = Yes* *2 = No*		
I.1.3	Which year was the Farmer Group or Cooperative formed?	*Record year of group formation*		
I.1.4	How many years have you been a member of this group or Cooperative?	*Record Number of years*		
I.1.5	What is the name of your Farmer Group or Cooperative?	*Record Name*		
I.1.6	What is the current number of male group members in the Farmer Group or Cooperative?	*Number of male members*		
I.1.7	What is the current number of female group members in the Farmer Group or Cooperative?	*Number of female members*		

I.1.8	What is the purpose/theme of your Farmer Group? Multiple Responses Possible	*A= Cereal Crops* *B = ICM (Integrated Crop Management)* *C = IPM (Integrated Pest Management)* *D = SFFP (Soil Fertility Farmers' Production* *E = Irrigation* *F = Other (Specify)*		
I.1.9	Does your farmer group have a savings account?	*1 = Yes* *2 = No*		
I.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 FINANCE

J.1.1	Does your household currently [date of interview] have any savings (formal or informal)?	1 = Yes 2 = No		If 2 ►J.1.3
J.1.2	What is the current [date of interview] amount of savings?	GHC US$		
J.1.3	Does the household currently [date of interview] have any outstanding loans?	1 = Yes 2 = No		If 2 ►J.1.5
J.1.4	What is the current [date of interview] amount of outstanding loans?	GHC US$		
J.1.5	Did the HH use any loans for farm inputs (crops, fish, livestock) last farming season?	1 = Yes 2 = No		If 2 ►Section K
J.1.6	What was the total amount of loans for farms inputs (rice, maize, soya) received during this time?	GHC US$		

SECTION K: HOUSING

Background and Status of Housing Occupancy				
K.1.1	How long has your household inhabited this dwelling?	1 = Less than six months 2 = 6 months - 1 year	3 = 1 - 5 years 4 = 5 - 10 years 5 = 10+ years	
K.1.2	What is your current occupancy status?	1 = Own 2 = Renting 3 = Dwelling provided for free	4 = Temporary Shelter 5 = Other (Specify)	
Physical Characteristics of the House				

K.1.3	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)	
K.1.4	What is the main material used for roofing your main dwelling?	1=Aluminium sheets 2=Thatch 3=Bamboo 4=Others (specify)		If 2 ►Section H
Water & Sanitation				
K.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)	
K.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				
K.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)	
K.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 farmers (Maize, Rice & Soybean)

A: General Information
Note the region, district, community and number of farmers interviewed

B: Cropping Systems

What are the main crops grown in this area? Which one of them are food/cash crops? (Focus on maize, rice and soyabean)
Which crops are mainly grown by males, which by females and which equally by both sexes?
What is the cropping calendar of maize, rice and soybean? (From planting to marketing)

What is the trend in production of these crops and how can it be explained?
What are the smallest, average and the largest farmers for these crops?
How do you obtain inputs you use in production of these crops? (Probe land, labor, seed, machinery/ox-ploughs/hoes, chemicals/drugs, fertilizers, extension services)
What problems do you face in accessing farm inputs?
Which crop varieties are being grown here? Does anyone of them outperform the others? (Probe yields, pest & disease resistance, consumption attributes etc.)
Do you produce these crops individually or collectively and why? (Probe acreage for block farms)
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.)

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
Who are the land owners?
Is land readily available for farming?
Are the lands suitable for maize, rice and soybean cultivation?
Is it equally easy for men and women to acquire land for farming purposes?
For how many years to you fallow your land?
Cash
What is your source of finance for production?
When is it most difficult for you to get cash?
What are the particular reasons for the difficulties?

D. Insects, Pest and Diseases
What are the major insect, pests and diseases or maize, rice and soybean?
How do you detect these pests and diseases?
What control measures to you use?
What are key constraints to producing these crops?
In case there is any natural disaster in your area, what control measures do you always take to minimize damage to your crops?
Harvesting and Storage
Who does the harvesting of maize, rice and soybean?
What proportion of the harvest is stored as seed?

How do you store the seed?
What are the storage problems?
How do you tackle the observed storage problems?

E. Marketing
Who is involved in the marketing of these crops?
How do you market these crops?
In what form do you market you produce?
Which varieties attract higher prices and why?
What are the average marketing costs you incur? (Probe transport cost, local taxes, bribes etc.)
What is the average market price and what influences it?
List the main marketing problems
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 &Outgrower systems
Are you a member of any outgrower group? If yes, since when and if no why?
How did you become a member of an outgrower group?
What support do you received from the group?
What challenges do you face as a member of the group?
What is your view on the use of nucleus farmers?
What benefits do you/will you derive from nucleus farmer system?
What are the challenges in dealing with nucleus farmers?
How can the outgrower-nucleus farmer linkage be improved?

Learning questions

ADVANCE learned that women have better yields than men on plots of less than three acres; that men use more fertilizer than women on maize and rice in northern Ghana; and women's field sizes are generally smaller than men's.

Learning question: What are the underlying factors that contribute to women having higher productivity than men (land size, fertilizer use) and how can the project use these findings to further increase women's productivity?

Female smallholder farmers were able to increase their production and income with ADVANCE support, enabling them to take on some of the responsibility for their families' education and health care
Learning question: *How does increased work load and income for women impact intra-household dynamics/conflicts?*

Interview guide for Nucleus Farmers
When did you start your organization/business?
What is the size of your organization and in which areas are your operating in Northern Ghana?
Is your organization a registered entity?
What types of crops do you deal with?
How many out grower farmers do you have?
How do you select the out growers?
What kind of support do you give to the out growers? (Probe: machinery, equipment, seeds, chemicals, market linkages, etc.).

What kind of arrangement do you have with the out growers? (Probe: Memorandum of Understanding, Signed contract, etc.)
Do you provide training to the farmers? (Probe: type of training, content of training, who the participants are, etc.).
Do you provide market and credit linkage services to out growers?
Have you received any training? (Probe: type of training, by whom, when, where, etc.)
Have you receive any support services from ADVANCE? (Probe: type of service received, accrued benefits, etc.).
What is your relationship with input supplies, traders, processors, transporters and other any other actor in the value chain?
What problems/challenges do you face as a nucleus farmer and how can these problems be best addressed?

Interview guide for input dealers

When did you start your organization/business?

What is the size of your organization and in which areas are your operating in Northern Ghana?
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.).*

What are their selling prices and how do you determine these prices? (*Probe: buying prices, transport costs, etc.*)
Who are your customers and who among them are the most important and why? (*Probe: individuals, government and non-government organizations, CSOs*).
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*).

Do you charge your customers for any these services and what are the rates looking like?
What challenges are you facing in this business?
What can be done to mitigate these challenges and by whom?
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

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

Who are your main clients (buyers)?
Whom are you currently selling to? If different from the past, what are the reasons for the change?
Where and how did you find your clients for the first time?

How do you learn about your clients' preferences? (Probe: order quantities, types of product preferred, standards, quality requirements, delivery dates)
What type of storage do you have currently? What is your storage capacity?
If you desired a different form of storage, what would that be and why?
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?

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)
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?
Does your firm receive any assistance/help or collaboration from your clients? (Probe: Advances, credit, information, inputs, technical assistance, recommendations)

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?)

What challenges do you face in your business arising out of the operating environment (corruption, bureaucracy, transparency)?
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?
What is the government's role in your industry? Do you view their activities positively or negatively?
What are the challenges exporting crop commodities?

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

Questions about Suppliers/Producers

What are all the ways you source the products you sell, how do you find your products? Who are your main suppliers?

Do you buy your products from individual producers, from associations (groups) of producers or brokers?
What is the purchase price?
What determines the price you purchase at?
How many producers do you work with?
Do you have preferred areas to buy from?
If you have different types of suppliers, how would you characterize them? (In other words, what are the characteristics of each type of supplier?)

How do you communicate information to your suppliers regarding your requirements in terms of quality of produce, size, chemical use, delivery dates, etc.?
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?

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?
What changes would you like to see your suppliers make?
Have you communicated this to them? How do they respond?
What are the difficulties suppliers have in making these changes?
What can you (yourself) do to facilitate or demand these changes?

Other questions

What are the three most serious risks for your enterprise?

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

What are the main products that you sell?

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

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

Value Addition

How much are you currently paying for raw materials?

What are your processing costs?
What is your current sales price for finished product? Do you sell to everyone at the same price? If no what causes price variance?
What is your current sales price for by-products? Do you sell to everyone at the same price? If no, what causes price variance?
How do you arrive at an agreed sales price for products and by-products?
Have you identified any needs for technological upgrades? If yes what are the likely efficiencies that this technology update will deliver?

Are there hindrances or enablers for this technology upgrade?

Questions about Suppliers/Producers

What are all the ways you obtain the products to process? Who are your suppliers?

What are the differences between the suppliers you work with? (Probe: quality, price, punctuality, standards, volume, costs of collecting raw materials, risks)
Which type of supplier do you prefer to buy from?
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?
How many suppliers (of each type) do you buy from?
How do you first find your suppliers? (Probe: people you know, contacts, family, neighbors, language groups)
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)

How do you communicate your product requirements to your suppliers?
What are the difficulties suppliers have in meeting their requirements?
In what ways are suppliers reluctant to make these changes?
What type of storage do you have currently? What is your current storage capacity?

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

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

How and when did this association form and how has it evolved over time?

What was the initial objective of this association? Has the objective changed through time?
How many members do you have?
How many are women?
How does one become a member of your association?
Do you have special considerations for women and men to become members?
Which gender is predominant in the group and why?
Which types of crops are your members involved in?
Do your members specialize in certain stages of production?
What services do you provide to your members?
What are the advantages of being a member of this association?

Questions about Sales and Markets

Does the association coordinate the sales of their members' products? If so, how does this work?

Does the organization negotiate the sales price? Do they charge a commission on this?
Where does the association sell their products? (probes: local markets, farm gate, millers, export)

How do you locate new buyers?
Are individual members allowed to sell their products outside the association?
How is the role of the association different from the role of traders?

Questions about Upgrading

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?

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

Other Questions

How do producing selected crops fit in with the other activities of the households of members (i.e., the household economic portfolio)?

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)
Can some farmers produce more efficiently than others? If so, why?
Would you say that it is sometimes hard for members to trust the leaders of the association? Why or why not?
What do you think about the future for smallholders who grow these crops?
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
To start with, can you please provide general information about this area in terms of geographical/political units, population, and major economic activities?

What is the importance of the agricultural sector to the economy of this area? (Probe: food security, incomes, exports especially to neighboring countries)
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)
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?
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)

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?
What do you see as being constraints to increased performance of the agricultural sector in this area?
Which strategic interventions has government so far put in place to boost agricultural production in this area?
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

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

When did you begin your operations in this area?
What motivated you to come to do business in this area?
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?

How many farmers and agribusinesses have over time obtained credit from your organization?
What are the loan sizes offered – smallest, average, largest?
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?

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

How do you monitor those farmers and agribusinesses who obtain loans from your organization?
What are the repayment rates for farmers and agribusinesses overtime looking like?
Are there any institutional problems that impede your operations in serving farmers and agribusinesses?
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 CSOs

For how long have you operated in Northern Ghana and in which districts are you?

Which activities, both humanitarian and developmental, have your organization been engaged in?
Have your organization ever been involved in the development of sesame/cassava/g-nut/soybean/maize/rice value chains? (If No, skip to question 9).
If yes, how were your organization involved (or still involved), where and for what period of time?
What were some of the challenges your organization faced in the development of these value chains?
What has been the impact of your organization's involvement on the development of these value chains?
What still needs to be done to further develop any of these value chains and by whom?
Do you know of any CSO operating in this area with focus on these 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 3: List of some persons contacted

LIST OF KEY INFORMANTS				
UPPER EAST REGION				
NAME	**DISTRICT**	**COMMUNITY**	**DATE**	**DESIGNATION**
Input dealers				
Antiku Abdullah	Wa Municipal	Wa	03/12/2014	Input Dealer
Institutions				
Abdullai Froko	Wa municipal	Wa	08/12/2014	Assistant Manager (Radio Upper West)
Lambori N. Damtal	Wa Municipal	Wa	04/12/2014	Branch Manager (Sinapi Aba savings and loans)
Salifu James	Wa Municipal	Wa	04/12/2014	Micro finance coordinator (Wa Community Credit Union)
Nucleus farmers and aggregators				
Yahaya Iddirisu	Wa Municipal	Wa	03:12/2014	Aggregator
Martin Domtiehao K	Kaleo-Nadowli	Jang	02/12/2014	Nucleus Farmer
Mathew Tiitaabo	Kaleo-Nadowli	Doung	04/12/2014	Nucleus farmer
F**armer groups**				
Habiba Dunee	Kaleo-Nadowli	Jang	02/12/2014	women organizer (Benluonuma farmer group)
Stephen Abuo	Kaleo-Nadowli	Serekpere	03/12/2014	Secretary (Lanboore Nmaarong Farmer group,)
Focus Group				
Jocelyn Tiraam Comfort Korbeih Felicia Tiee Ama Mekare Mary kobena Francisca Dave Justina Beyere Theresa Bayor Alfredina Gyelekabon Manize Solayen	Jirapa	Kuucheni	03/12/2014	Focus Group Discussion (women's group)
Polee-naa Sidik Gberi (Chief) Naa Abdullah Polee-naa Seidu Sidik Mohammed Polee-naa Mieri	Wa West	Polee	02/12/2014	

Polee-naa Aminata Hamidu Adama Polee-naa Mahama Adama Yakubu Seidu Mwnibobu				
Martin Kooben (Chief) Christiantus Mickare (Lead farmer) Cecilia Mmentuo Magolo Alonsie Felicia Gyee Lydia Mummuni Sylvia Lamaa Domatus Yellezole Emmanuel Doore Alfred Bedomie	Jirapa	Kuucheni	03/12/2014	
Mathew Tiitabo Luca Yender Francis B. Nyaah Ako Karnimye Janet Tiitabo Afua Dagoe Afia Bayor AKusia Kogo Francis Ambala Alice Yirimambo	Kaleo-Nadowli	Doung	04/12/2014	

NORTHERN REGION

NAME	DISTRICT	COMMUNITY	DATE	DESIGNATION
Institutions				
Sadiq Haruna	Tamale Metro	Tamale		Programme Manager (North Star Radio)
Amadu Malik	Tamale Metro	Tamale		Radio Savanna
William Boakye-Acheampong	Tamale Metro		03/12/2014	MofA
Peter Claver Anyeembers	Tamale Metro		03/12/2014	MofA
Ahmed Yussif	Tamale Metro		03/12/2014	MofA
YakubuIddrisuSherif	Tamale		03/12/2014	NRGDP (MoFA-(MISO)
Felix Darimaani	Tamale		03/12/2014	NRGDP (MoFA-M&E specialist
Alfred Bukari	Tamale		04/12/2014	SINAPI ABA

Richard Bayor	Tamale		04/12/2014	Branch Manager (UT Bank)
Priscilla	Tamale		04/12/2014	project Officer (UT Bank)
Dominic O Ansah	Tamale		08/12/2014	Training Technical Specialist (FinGAP)
Rashid Y Manibana	Tamale		08/12/2014	Business Advisory specialist (FinGAP)
Nuclear Farmers				
Osei Kojo Ernest	Tamale Metro	Chireponi	02/12/2014	Nuclear Farmer and manager of Kukumansu women groupg
Mohammed NGyimah	Tamale Metro	Nawiaku	02/12/2014	Nuclear Farmer and Secretary of Papaye farms
Nicholas Lambini	Tamale Metro	Chireponi	02/12/2014	Nuclear Farmer and manager of Asoshe women group
Mr Hassan	Tamale Metro	Gundaa Produce Comp. Tamale	05/12/14	Nuclear farmer
Focus Group				
Yakobu Abdul Rahman Yussif Suhuyini Alhassan Atta Mustapha Nidowo Haruna Abudu Azaratu Abdul Rahman Mariama Wahab Baaba Sabdu	East Gonja	Nyamalaga Nyapala ,	05/12/14	Rice Association
Mohammed Abdulai Abubakari Sariki Alhassan Saeed Musah A. Seidu ImoroIssaku IddrisuSariki AlhassanFuseini Baba Nahim mohammed Sanatu Rahinatu Ibrahim IddrisuNahim Salifu Fati Ayishetu Nindoo	Tamale	Kraal	03/12/2014	Farmer Group

Sadia Iddrisu Azaratu Zakari Habiba Issifu Abibatu Baba Hawawu Ibrahim Alimatu Abubakari Abdulai Kande Sanatu Zakaria Azumi Abukari Adamu Ibrahim Mariama Iddrisu Comfort Akwaaba Ayi Abubakari Rukaya Abdulai Nasike Sayibu	Savulugu	Tibali	03/12/2014	Farmer Group (women's group)
AlhajiZakari Iddrisu Zakaria Abdallah Tiah Abdul Fatal Mahamadu Bakari	Tamale Metro	Tamale	05/12/2014	Corn and Rice Traders Association
UPPER EAST				
NAME	**DISTRICT**	**COMMUNITY**	**DATE**	**DESIGNATION**
Nucleus farmers				
Papanko Isaac	Bunkpurugu yunyoo	Temaa	06/11/2014	Nucleus farmer
Akokorbila	Bulga Municipal	Kalbeo	29/11/2014	Nucleus Farmer
Enoch Akanfeba	Builsa North	Chuchuliga	04/12/2014	Nucleus Farmer
Input dealers				
Simple Prince	Bulga Municipal	Bulgatanga	08/12/2014	Input Dealer
Institutions				
George Adum	BUILSA SOUTH DISTRICT	SANDEMA		Acting Credit Manager (BULSA COMMUNITY BANK)
Robert Kwame Abokaa	Kassena Nankani Municipal	Bonia	05/12/2014	Secretary(Yuawoba Farmers Association)
Focus Groups				
Cynthia Akodigi Azinglie Agoya Apona Amaabode Talata Akisichba Achomsi Amisipa	Builsa North	Chuchuliga	24/11/2014	

David Alugchaaba Martha Agambaga Abawkulie Ali Akanwiba Atarikame Grace Amaka				
Kwame Mayim Mmum Jejeri Aisha Nwebot Mahmoud Akarango	Bunkpurugu Yunyoo	Temaa/Nab an	06/11/2014	

Annex 4: Sample size of the Survey

Gender Against Commodity Strata	Proportionate Commodity Frame	Comment/Assumptions	Sample Size based on Gender and Commodity
Males in Maize Farming	16,666	It was assumed that male maize farmers have equal chance of getting enrolled on ADVANCE II in future as female maize farmers	390
Females in Maize Farming	16,666	It was assumed that female maize farmers have equal chance of getting enrolled on ADVANCE II in future as maize male farmers	390
Males in soyabean farming	16,666	It was assumed that male soyabean farmers have equal chance of getting enrolled on ADVANCE II in future as female soyabean farmers	390
Females in soyabean farming	16,666	It was assumed that female soyabean farmers have equal chance of getting enrolled on ADVANCE II in future as soyabean male farmers	390
Males in rice farming	16,666	It was assumed that male rice farmers have equal chance of getting enrolled on ADVANCE II in future as female rice farmers	390
Females in rice farming	16,666	It was assumed that female rice farmers have	390*

		equal chance of getting enrolled on ADVANCE II in future as rice male farmers(* There may not be enough female farmers in this commodity)	
Total of sample size (addition of all 6 sample sizes)			**2,340**
10% of sample size for Non-Response		%age based on total sample size	234
TOTAL SAMPLE SIZE			**2574**
26% of sample size was allocated to ADVANCE I beneficiaries who are not selected yet			**669**
74% allocated to Non-ADVANCE beneficiaries			**1905**

Annex 5: Rice: Application of New technology by household type

Household Type	Adaptors		Non Adaptors		Total	
	N	%	N	%	N	%
Male no Female	2	0.4	21	4	23	4.4
Male & Female	121	23.3	357	68.7	478	91.9
Female no Male	3	0.6	16	3.1	19	3.7
Total	126	24.2	394	75.8	520	100

P=0.0479

Annex 6: Application of New technology by household type

Household Type	Adaptors		Non Adaptors		Total	
	N	%	N	%	N	%
Male no Female	14	1.10%	22	1.80%	36	2.90%
Male & Female	272	21.80%	926	74.40%	1198	96.20%
Female no Male	3	0.20%	8	0.60%	11	0.90%
Total	289	23.20%	956	76.80%	1245	100.00%

P= 0.071

Annex 7: Soya: Application of New technology by household type

Household Type	Adaptors		Non Adaptors		Total	
	N	%	N	%	N	%
Male no Female	4	0.60%	12	1.80%	16	2.40%
Male & Female	90	13.50%	551	82.60%	641	96.10%
Female no Male	4	0.60%	6	0.90%	10	1.50%
Total	98	14.70%	569	85.30%	667	100.00%

P= 0.623

Annex 8: Distribution of Crop cut by Regions and Commodities

Region	Commodity*		
	Maize	Rice	Soya
Northern	24	20	17
Upper East	8	8	4
Upper West	18	18	4
Total	50	46	25

* Percentage of crop cut to total number of respondents = 4.6% (Sampled farmers=2657)

Annex 9: Correlation test results for access to market information and access to information

		Market for produce
Access to market information	PCC	0.412**
	p-value	0.000
	N	2657

** Correlation is significant at the 0.01 level (2-tailed).

Annex 10: Results of correlation tests

		Gender	Household Type	New users (Maize)	New users (Rice)	New users (Soya)
New users (Maize)	PCC[a]	0.111**	0.051			
	p-value	0.00	0.071			
	N	1245	1245			
New users (Rice)	PCC	0.043	-0.031			
	p-value	0.331	0.479			
	N	520	520			
New users (Soya)	PCC	0.046	-0.019			
	p-value	0.235	0.626			
	N	667	667			
Maize yield	PCC	-0.044	-0.003	-0.077**		
	P-value	0.12	0.92	0.008		
	N	1262	1262	1207		
Rice yield	PCC	-.169**	-0.075		-0.110*	
	p-value	0.00	0.084		0.015	
	N	537	537		490	
Soya yield	PCC	-.105**	-.091*			0.019
	p-value	0.006	0.017			0.637
	N	694	694			647

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

[a] PCC refers to Pearson Correlation Coefficient

Annex 11: Percent of all farmers (N=2657) expressing levels of satisfaction with access to input by region

REGION	INPUT OUTLET	Very Satisfied		Satisfied		Not too satisfied		Unsatisfied		Very unsatisfied	
		Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Northern	Fertilizer outlet	10.9	3.2	11.5	5.1	9.1	3.4	10.5	6.6	22.6	17.3
	Insecticide dealer	8.8	11	13.2	18.8	8.5	11.7	23.5	17	10.6	41.6
	Herbicide dealer	10.7	2.7	13.4	5.9	9.4	3.4	9.4	5.6	21.7	17.8
	Improved seed dealer	9.7	2.3	12.5	5.5	8.4	3	11.6	6.6	22.4	18
Upper East	Fertilizer dealer/outlet	15.8	10.4	7.5	3.9	5.4	4	7.5	6.6	26.6	12.3
	Insecticide dealer	15.4	11.8	8.1	2.9	5.6	4	7.7	6.4	26	12.1
	Herbicide dealer	15.2	10.8	7.7	3.3	5.4	4.2	8.1	6.4	26.4	12.5
	Improved seed dealer	13.9	10.4	8.1	3.7	5.6	4	7.8	6.6	27.4	12.5
Upper West	Fertilizer dealer/outlet	2.9	1	8.8	8.3	14.1	11.8	12.4	9.8	18.4	12.5
	Insecticide dealer	2.1	1.5	10.3	10.1	15.5	12.4	10.4	8	18.4	11.5
	Herbicide dealer	2.7	1.4	10.3	10.3	14.9	11.9	10.7	8.4	17.9	11.5
	Improved seed dealer	2.8	1.7	8.5	7.6	13.9	9.8	11.4	11.3	19.9	13.1
Total		8.83	5.13	11.1	6.63	10.67	6.59	10.71	7.76	17.13	15.45
ZOI	Fertilizer dealer/outlet	12.87		15.74		16.57		18.27		36.54	
	Insecticide dealer	11.55		17.78		16.95		16.91		36.81	
	Herbicide dealer	12.65		18.08		17.06		16.35		35.86	
	Improved seed dealer	11.82		16.12		15.36		19.03		37.67	
Total (N=2657)		12.22		16.93		16.49		17.64		36.72	

Annex 12: Percentage users crop genetic and improved agronomic practices across region and gender

	Northern Region (N=1206)				Upper East Region (N=519)				Upper West Region (932)				Total users	% Maize Farmers (N=1302)
MAIZE FARMERS (N=1302)	Maize farmers (N=646)				Maize farmers (N=228)				Maize farmers (N=428)					
	Male (N=457)		Female (N=189)		Male (N=152)		Female (N=76)		Male (N=262)		Female (N=166)			
	User	% Users	User	% Users	User	% Users	User	% Users	User	% Users	User	% Users		
Pioneer 30Y87 (Yellow Maize)	29	6.35	11	5.82	13	8.55	5	6.58	39	14.89	25	15.06	**122**	**9.37**
Pioneer 30F32 (White Maize)	72	15.75	41	21.69	32	21.05	7	9.21	41	15.65	27	16.27	**220**	**16.90**
Other Hybrid Seeds	40	8.75	17	8.99	1	0.66	9	11.84	43	16.41	29	17.47	**139**	**10.68**
Pan 53	37	8.10	14	7.41	17	11.18	11	14.47	45	17.18	31	18.67	**155**	**11.90**
Pan 12	28	6.13	11	5.82	2	1.32	13	17.11	47	17.94	33	19.88	**134**	**10.29**
Etubi	27	5.91	10	5.29	1	0.66	15	19.74	49	18.70	35	21.08	**137**	**10.52**
Mamaba	41	8.97	16	8.47	7	4.61	17	22.37	51	19.47	37	22.29	**169**	**12.98**
Obatanpa	144	31.51	54	28.57	46	30.26	19	25.00	53	20.23	39	23.49	**355**	**27.27**
weedicide	296	64.77	117	61.90	118	77.63	21	27.63	55	20.99	41	24.70	**648**	**49.77**
insecticide	49	10.72	21	11.11	24	15.79	23	30.26	57	21.76	43	25.90	**217**	**16.67**
Planting in rows	207	45.30	83	43.92	123	80.92	25	32.89	59	22.52	45	27.11	**542**	**41.63**
Fertilizer	266	58.21	107	56.61	142	93.42	27	35.53	61	23.28	47	28.31	**650**	**49.92**
Minimum Tillage	98	21.44	41	21.69	83	54.61	29	38.16	63	24.05	49	29.52	**363**	**27.88**
Zero Tillage	49	10.72	21	11.11	11	7.24	31	40.79	65	24.81	51	30.72	**228**	**17.51**
RICE FARMERS (N=636)	**Rice farmers in Northern region (N=175)**				**Rice farmers in Upper East Region (N=162**				**Rice farmers in Upper West (N=299)**				**Total users**	**% Rice Farmers (N=636)**
	Male (N=136)		**Female (N=39)**		**Male (N=87)**		**Female (N=75)**		**Male (N=154)**		**Female (N=145)**			
Jasmin 85	17	12.50	2	5.13	29	33.33	26	34.67	8	5.19	1	0.69	**83**	**13.05**
IR841	0	0.00	2	5.13	5	5.75	9	12.00	3	1.95	5	3.45	**24**	**3.77**
Togo Marshal	8	5.88	5	12.82	0	0.00	3	4.00	15	9.74	13	8.97	**44**	**6.92**
Tox	3	2.21	1	2.56	8	9.20	3	4.00	3	1.95	1	0.69	**19**	**2.99**
Jasmin	15	11.03	3	7.69	19	21.84	14	18.67	37	24.03	23	15.86	**111**	**17.45**
Weedicide	71	52.21	18	46.15	76	87.36	72	96.00	84	54.55	53	0.37	374	58.81
Insecticide	6	4.41	1	2.56	27	31.03	14	18.67	12	7.79	6	4.14	**66**	**10.38**
Bird scaring	34	25.00	11	28.21	23	26.44	22	29.33	44	28.57	29	20.00	**163**	**25.63**
Planting in rows	15	11.03	3	7.69	33	37.93	28	37.33	50	32.47	37	25.52	**166**	**26.10**
Fertilizer	47	34.56	16	41.03	58	66.67	57	76.00	61	39.61	42	28.97	**281**	**44.18**
Transplanting	12	8.82	4	10.26	39	44.83	36	48.00	25	16.23	37	25.52	**153**	**24.06**

System of rice intensification(SRI)	4	2.94	2	5.13	8	9.20	8	10.67	2	1.30	0	0.00		
SOYA Farmers (N=719)	**Soya farmers in Northern region (N=385)**				**Soya farmers in Northern region (N=129)**				**Soya farmers in Northern region (N=205)**				**24 Total users**	**3.77 % Soya Farmers (N=719)**
	Male (N=186)		**Female (N=199)**		**Male (N=87)**		**Female (N=42)**		**Male (N=111)**		**Female (N=94)**			
Janguma	68	36.56	27	13.57	75	86.21	35	83.33	48	43.24	35	37.23	**288**	**40.06**
Other certified seed	13	6.99	4	2.01	1	1.15	1	2.38	4	3.60	6	6.38	**29**	**4.03**
farmer saved seed	36	19.35	67	33.67	8	9.20	5	11.90	35	31.53	33	35.11	**184**	**25.59**
herbicides	109	58.60	145	72.86	27	31.03	17	40.48	33	29.73	26	27.66	**357**	**49.65**
fungicides	6	3.23	1	0.50	4	4.60	6	14.29	1	0.90	0	0.00	**18**	**2.50**
insecticide	10	5.38	10	5.03	9	10.34	7	16.67	10	9.01	2	2.13	**48**	**6.68**
Planting in rows	116	62.37	154	77.39	73	83.91	32	76.19	88	79.28	67	71.28	**530**	**73.71**
fertilizer	36	19.35	15	7.54	30	34.48	16	38.10	38	34.23	37	39.36	**172**	**23.92**
inoculant	6	3.23	2	1.01	9	10.34	5	11.90	2	1.80	4	4.26	**28**	**3.89**

*the percentages have been calculated from multiple responses

Annex 13: Percentage new users crop genetic and improved agronomic practices across region and gender

MAIZE (N=1302)	**Northern Region (N=1206)**				**Upper East Region (N=519)**				**Upper West Region (932)**				**Total New Users**	**% Maize Farmers (N=1302)**
	Maize farmers (N=646)				Maize farmers (N=228)				Maize farmers (N=428)					
	Male (N=457)		Female (N=189)		Male (N=152)		Female (N=76)		Male (N=262)		Female (N=166)			
	New user	% New user	New user	% New user	New user	% New user	New user	% New user	New user	% New user	New user	% New user		
Pioneer 30Y87 (Yellow Maize)	16	53.45	0	0.00	3	26.726	0	0.00	20	50.39	12	48.99	**51**	**3.91**
Pioneer 30F32 (White Maize)	27	37.03	12	28.79	0	0	0	0.00	13	31.47	9	33.78	**60**	**4.65**
Other Hybrid Seeds	16	40.31	0	0.00	0	0	0	0.00	13	29.42	0	0.00	**29**	**2.21**
Pan 53	11	30.15	0	0.00	0	0	0	0.00	0	0.00	0	0.00	**11**	**0.86**
Pan 12	16	57.74	0	0.00	0	0	0	0.00	0	0.00	0	0.00	**16**	**1.24**
Etubi	0	0.00	0	0.00	0	0	0	0.00	15	30.15	0	0.00	**15**	**1.13**
Mamaba	18	44.43	0	0.00	0	0	0	0.00	0	0.00	0	0.00	**18**	**1.40**
Obatanpa	59	41.08	13	24.96	11	24.964	4	21.32	11	19.99	0	0.00	**99**	**7.59**

weedicide	101	34.18	19	15.87	24	20.23	5	21.55	12	22.33	7	17.32	**168**	**12.87**
insecticide	13	27.18	6	28.87	8	33.166	8	35.36	12	20.85	0	0.00	**47**	**3.64**
Planting in rows	76	36.60	22	26.82	16	12.699	3	13.87	12	21.00	8	18.43	**138**	**10.58**
Fertilizer	77	28.95	21	19.23	12	8.392	3	12.31	13	20.64	8	17.21	**134**	**10.25**
Minimum Tillage	22	22.07	10	24.97	13	15.428	0	0.00	30	46.84	19	38.86	**93**	**7.16**
Zero Tillage	15	29.61	6	27.74	4	37.796	0	0.00	24	37.37	14	26.73	**62**	**4.79**
Total Rice (N=636)	Rice farmers in Northern region (N=175)				Rice farmers in Upper East Region (N=162				Rice farmers in Upper West (N=299)				**Total New Users**	**% Rice Farmers (N=636)**
	Male (N=136)		Female (N=39)		Male (N=87)		Female (N=75)		Male (N=154)		Female (N=145)			
Jasmin 85	12	68.56	2	77.65	16	54.485	14	54.16	7	82.22	1	91.70	**51**	**3.09**
IR841	0	0.00	2	77.65	4	89.279	8	83.78	3	88.64	4	81.69	**20**	**1.24**
Togo Marshal	6	81.11	3	69.27	0	0	2	80.27	11	70.25	10	73.43	**32**	**1.98**
Tox	2	81.11	1	59.09	6	69.369	2	77.38	3	86.13	1	100.00	**14**	**0.89**
Jasmin	10	66.81	2	63.45	12	61.034	9	61.89	22	58.39	15	64.00	**69**	**4.19**
Herbicide	14	64.45	4	66.13	12	58.445	11	56.22	12	68.56	8	73.43	**61**	**3.71**
weedicide	24	47.40	7	55.76	28	50.463	27	52.54	34	51.08	24	56.25	**143**	**8.76**
insecticide	5	85.26	1	83.99	14	53.468	9	61.89	9	75.28	5	80.01	**43**	**2.62**
bird scaring	19	56.54	6	54.41	13	55.645	12	54.80	24	54.99	18	62.71	**92**	**5.65**
planting in rows	11	75.05	2	73.01	17	53.011	15	53.58	27	53.53	21	57.06	**94**	**5.73**
Fertilizer	25	53.33	8	50.17	30	52.586	32	56.22	31	51.39	23	55.15	**150**	**9.18**
Transplanting	9	77.82	3	77.65	20	50.275	18	49.78	16	64.89	20	54.17	**86**	**5.27**
System of rice intensification(SRI)	4	100.00	2	83.99	6	78.935	6	70.71	2	91.94	0	0.00	**19**	**1.19**
SOYA (N=719)	Soya farmers in Northern region (N=385)				Soya farmers in Northern region (N=129)				Soya farmers in Northern region (N=205)				**Total New Users**	**% Soya Farmers (N=719)**
	Male (N=186)		Female (N=199)		Male (N=87)		Female (N=42)		Male (N=111)		Female (N=94)			
Janguma	17	24.29	4	14.29	5	6.67	3	8.57	0	0.00	1	3.03	**29**	**4.09**
Other certified seed	4	30.00	1	25.00	0	0	0	0.00	2	50.00	0	0.00	**7**	**0.96**
farmer saved seed	2	5.56	2	2.99	0	0	0	0.00	0	0.00	0	0.00	**4**	**0.56**
herbicides	10	9.17	8	5.52	0	0	2	11.76	1	3.03	1	3.85	**22**	**3.06**

fungicides	0	0.00	1	100.00	0	0	2	33.33	0	0.00	0	0.00	**3**	**0.42**
insecticide	0	0.00	0	0.00	1	11.11	2	28.57	0	0.00	0	0.00	**3**	**0.42**
Planting in rows	6	5.13	5	3.18	4	5.48	2	6.45	1	1.14	0	0.00	**18**	**2.49**
fertilizer	4	11.11	1	7.14	0	0	4	25.00	3	8.11	3	8.33	**15**	**2.12**
inoculant	3	50.00	1	66.67	1	14.29	2	40.00	2	100.00	2	50.00	**12**	**1.62**

*the percentages have been calculated from multiple responses

Annex 14: Area allocated to land based technologies among males and females across ZOI

Gender	**Male**				**Female**				**Total**			
Technology	N	Mean	Sum	SD	N	Mean	Sum	SD	N	Mean	Sum	SD
Pioneer White Maize	81	2.10	170.00	2.24	41	1.00	41.20	0.79	122	1.73	211.20	1.95
Pioneer Yellow Maize	150	1.92	287.40	2.73	76	1.66	126.40	1.92	226	1.83	413.80	2.48
Other Hybrid Maize	63	1.11	69.80	1.03	31	0.77	23.80	0.40	94	1.00	93.60	0.89
Pan 53 Maize	68	1.76	119.80	1.76	28	0.92	25.80	0.68	96	1.52	145.60	1.57
Pan 12 Maize	36	1.03	37.00	0.57	12	0.87	10.40	0.23	48	0.99	47.40	0.51
Etubi Maize	41	1.12	46.00	0.91	16	0.88	14.00	0.26	57	1.05	60.00	0.79
Mamaba Maize	48	2.23	106.80	4.98	21	1.00	21.00	0.67	69	1.85	127.80	4.19
Obaatanpa Maize	239	1.78	424.72	2.06	108	1.12	120.80	1.11	347	1.57	545.52	1.84
weedicide Maize	568	2.20	1247.40	2.75	260	1.24	321.40	1.33	828	1.89	1568.80	2.43
insecticide Maize	96	2.10	201.20	3.34	40	1.41	56.20	1.95	136	1.89	257.40	3.01
Row Planting Maize	569	2.08	1182.00	2.72	279	1.27	354.60	1.36	848	1.81	1536.60	2.39
Fertilizer Maize	632	2.16	1362.00	2.80	312	1.24	387.20	1.37	944	1.85	1749.20	2.46
Minimum Tillage Maize	275	1.84	505.00	2.05	155	1.10	171.00	1.19	430	1.57	676.00	1.82
Zero Tillage Maize	66	1.28	84.80	1.04	30	0.88	26.40	0.58	96	1.16	111.20	0.94
Jasmine 85 Maize	54	4.57	246.60	17.02	29	0.98	28.28	0.90	83	3.31	274.88	13.80
IR841 Maize	8	3.50	28.00	6.75	16	0.60	9.60	0.32	24	1.57	37.60	3.99
Togo Marshal Maize	23	1.20	27.60	1.43	21	0.69	14.40	0.40	44	0.95	42.00	1.09
Tox	14	1.34	18.80	1.17	5	1.60	8.00	1.47	19	1.41	26.80	1.22
Jamin Maize	71	1.42	100.60	1.35	40	0.76	30.40	0.70	111	1.18	131.00	1.20

Weedicide rice	179	1.85	330.50	2.70	112	1.11	124.36	1.11	291	1.56	454.86	2.25
Insecticide Rice	45	1.19	53.40	1.50	21	0.66	13.88	0.75	66	1.02	67.28	1.32
bird scaring	101	1.22	123.60	1.09	62	0.87	53.80	0.81	163	1.09	177.40	1.00
Row Planting Rice	98	0.90	88.62	0.82	68	0.62	42.20	0.52	166	0.79	130.82	0.72
Fertilizer Rice	166	1.39	231.50	2.16	115	0.90	103.88	0.82	281	1.19	335.38	1.75
Transplanting Rice	76	0.93	70.66	0.81	77	0.64	49.48	0.53	153	0.79	120.14	0.70
System of rice intensification	14	0.58	8.12	0.25	10	0.69	6.88	0.56	24	0.63	15.00	0.40
Janguma Maize	191	1.56	297.00	1.56	97	1.03	99.48	0.81	288	1.38	396.48	1.38
Farmer Saved Seed	79	1.14	90.20	0.85	105	0.72	76.00	0.57	184	0.90	166.20	0.73
Other Certified Seed Soya	18	2.06	37.00	2.12	11	2.60	28.60	3.19	29	2.26	65.60	2.54
Weedicide Soya	169	1.77	299.40	1.80	188	0.91	172.00	0.71	357	1.32	471.40	1.40
Fungicide Soya	11	1.40	15.40	1.05	7	1.60	11.20	0.86	18	1.48	26.60	0.96
Insecticide Soya	29	1.27	36.80	1.02	19	1.16	22.00	0.69	48	1.23	58.80	0.90
Row Planting Soya	277	1.39	386.40	1.09	253	0.91	229.80	0.92	530	1.16	616.20	1.04
Fertilizer Soya	104	1.24	128.60	0.91	68	1.27	86.68	1.52	172	1.25	215.28	1.19
Inoculant Soya	17	4.32	29.40	2.93	11	2.77	12.2	2.09	28	1.49	41.60	1.08

Annex 15: Land allocation to technology per region

Region	Northern Region				Upper East Region				Upper West Region				Total			
Technology	N	Mean	Sum	SD	N	Mean	Sum	SD	N	Mean	Sum	SD	N	Mean	Sum	SD
Pioneer White Maize	40	1.01	40.40	0.68	18	1.50	27.00	0.93	64	2.25	143.80	2.48	122	1.73	211.20	1.95
Pioneer Yellow Maize	113	1.78	201.60	1.75	43	2.29	98.60	4.67	70	1.62	113.60	1.30	226	1.83	413.80	2.48
Other Hybrid Maize	57	1.04	59.20	0.79	1	0.40	0.40	.	36	0.94	34.00	1.04	94	1.00	93.60	0.89
Pan 53 Maize	51	0.95	48.40	0.93	25	1.69	42.20	1.71	20	2.75	55.00	1.94	96	1.52	145.60	1.57
Pan 12 Maize	39	0.84	32.80	0.18	3	1.53	4.60	0.64	6	1.67	10.00	1.06	48	0.99	47.40	0.51
Etubi Maize	37	0.80	29.60	0.00	1	2.00	2.00	.	19	1.49	28.40	1.25	57	1.05	60.00	0.79
Mamaba Maize	57	1.95	111.20	4.59	11	1.40	15.40	1.13	1	1.20	1.20	.	69	1.85	127.80	4.19
Obaatanpa Maize	198	1.41	279.60	1.15	68	1.87	127.12	3.00	81	1.71	138.80	1.92	347	1.57	545.52	1.84

weedicide Maize	413	1.67	691.00	2.14	162	1.92	311.40	2.92	253	2.24	566.40	2.52	828	1.89	1568.80	2.43
insecticide Maize	70	1.51	105.40	1.76	33	2.85	94.20	5.28	33	1.75	57.80	1.54	136	1.89	257.40	3.01
Row Planting Maize	290	1.70	493.00	2.39	176	1.87	328.80	2.81	382	1.87	714.80	2.17	848	1.81	1536.60	2.39
Fertilizer Maize	373	1.71	637.80	2.28	208	1.93	402.00	3.07	363	1.95	709.40	2.24	944	1.85	1749.20	2.46
Minimum Tillage Maize	139	1.42	197.80	1.39	117	1.34	157.20	1.31	174	1.84	321.00	2.33	430	1.57	676.00	1.82
Zero Tillage Maize	70	1.18	82.40	0.97	17	1.15	19.60	0.76	9	1.02	9.20	1.04	96	1.16	111.20	0.94
Jasmine 85 Maize	19	10.38	197.20	28.15	55	1.27	70.08	1.47	9	0.84	7.60	0.90	83	3.31	274.88	13.80
IR841 Maize	2	1.00	2.00	0.85	14	2.11	29.60	5.22	8	0.75	6.00	0.40	24	1.57	37.60	3.99
Togo Marshal Maize	13	1.45	18.80	1.48	3	0.93	2.80	0.70	28	0.73	20.40	0.84	44	0.95	42.00	1.09
Tox	4	2.40	9.60	1.85	11	1.35	14.80	0.98	4	0.60	2.40	0.23	19	1.41	26.80	1.22
Jamin Maize	18	1.91	34.40	1.28	33	1.38	45.60	1.47	60	0.85	51.00	0.86	111	1.18	131.00	1.20
Weedicide rice	66	2.38	156.80	2.68	109	1.71	186.26	2.75	116	0.96	111.80	0.94	291	1.56	454.86	2.25
Insecticide Rice	7	0.63	4.40	0.45	41	1.12	45.88	1.64	18	0.94	17.00	0.50	66	1.02	67.28	1.32
bird scaring	45	1.38	62.00	1.16	45	1.11	49.80	1.00	73	0.90	65.60	0.85	163	1.09	177.40	1.00
Row Planting Rice	18	1.13	20.40	0.77	61	0.92	56.30	1.00	87	0.62	54.12	0.34	166	0.79	130.82	0.72
Fertilizer Rice	63	1.61	101.60	2.18	115	1.28	147.58	2.07	103	0.84	86.20	0.72	281	1.19	335.38	1.75
Transplanting Rice	16	1.35	21.60	1.00	75	0.84	63.18	0.70	62	0.57	35.36	0.49	153	0.79	120.14	0.70
System of rice intensification	6	0.67	4.00	0.21	16	0.63	10.08	0.46	2	0.46	0.92	0.48	24	0.63	15.00	0.40
Janguma Maize	95	1.87	177.60	2.00	110	1.30	142.68	0.83	83	0.92	76.20	0.80	288	1.38	396.48	1.38
Farmer Saved Seed	103	1.14	117.00	0.84	13	0.82	10.60	0.61	68	0.57	38.60	0.36	184	0.90	166.20	0.73
Other Certified Seed	17	1.29	22.00	1.36	2	4.40	8.80	5.09	10	3.48	34.80	3.06	29	2.26	65.60	2.54
Soya																
Weedicide Soya	254	1.35	343.20	1.51	44	1.62	71.40	1.33	59	0.96	56.80	0.83	357	1.32	471.40	1.40
Fungicide Soya	7	0.97	6.80	0.51	10	1.94	19.40	1.00	1	0.40	0.40	.	18	1.48	26.60	0.96
Insecticide Soya	20	1.14	22.80	0.83	16	1.70	27.20	1.07	12	0.73	8.80	0.29	48	1.23	58.80	0.90
Row Planting Soya	270	1.22	328.80	0.95	105	1.37	144.00	1.06	155	0.93	143.40	1.14	530	1.16	616.20	1.04
Fertilizer Soya	51	1.42	72.40	1.00	46	0.99	45.68	0.65	75	1.30	97.20	1.50	172	1.25	215.28	1.19
Inoculant Soya	8	1.70	13.60	1.28	14	1.76	24.60	1.01	6	0.57	3.40	0.27	28	1.49	41.60	1.08

Annex 16: Distribution of application post-harvest, weather mitigating, ICT and water management technologies in maize production at regional, gender and ZOI level

	Northern Region (N=646)				Upper East Region (N=228)				Upper West Region (N=428)				Gender (N=1302)								Zone of Influence (N=1302)			
	Users	% Users	New users	%New users	Users	% Users	New users	%New users	Users	% Users	New users	%New users	Male users (N=871)	% Users	New male users	% New Users	Female Users (N=431)	% Female Users	New female users	% New female users	Users	% Users	New users	%New users
Sheller	217	33.59	28	12.94	54	23.69	9	15.95	150	35.05	41	27.55	292	33.53	49	16.64	129	29.93	29	22.80	421	32.34	78	18.53
Tarpaulin	257	39.78	12	4.58	56	24.56	9	15.44	106	24.77	42	39.44	295	33.87	45	15.12	124	28.77	18	14.21	419	32.18	62	14.85
Weighing Scale	45	6.97	12	25.92	6	2.63	2	36.12	9	2.10	5	55.55	51	5.86	14	28.10	9	2.09	4	50.00	60	4.61	19	31.38
Moisture Meter	36	5.57	11	29.80	3	1.32	2	66.67	7	1.64	5	71.48	37	4.25	14	38.76	9	2.09	3	37.72	46	3.53	18	38.56
Warehouse	75	11.61	13	17.12	28	12.28	4	13.24	36	8.41	0	0.00	109	12.51	12	10.85	30	6.96	5	15.75	139	10.68	17	11.90
Silo	202	31.27	20	9.85	49	21.49	3	5.64	6	1.40	3	56.57	185	21.24	20	10.73	72	16.71	6	8.61	257	19.74	26	10.14
Power Tiller	55	8.51	11	19.95	5	2.19	0	0.00	0	0.00	0	0.00	50	5.74	8	16.23	10	2.32	3	28.57	60	4.61	11	18.28
Multi-Purpose Thresher	54	8.36	20	37.58	6	2.63	2	30.59	20	4.67	0	0.00	60	6.89	17	28.34	20	4.64	5	25.61	80	6.15	22	27.66
Climate mitigation																								
Igntia Weather Update	77	11.92	15	20.00	1	0.44	1	50.00	17	3.97	9	52.94	79	9.07	21	26.03	16	3.71	4	27.09	95	7.30	25	26.21
Weather Crop Insurance Index	107	16.57	6	5.24	1	0.44	1	50.00	2	0.47	1	66.67	70	8.04	6	8.57	40	9.28	1	3.63	110	8.45	7	6.77
Water management																								
Mulching	36	5.57	6	17.59	15	6.58	1	6.66	18	4.21	2	11.11	50	5.74	7	14.00	19	4.41	2	12.28	69	5.30	9	13.53
ICT																								
Esoko Market Price updates	70	10.83	13	18.45	5	2.20	3	66.67	14	3.27	4	26.19	71	8.15	15	20.54	18	4.18	5	29.64	89	6.84	20	22.38
Farm Radio	261	40.40	32	12.19	44	19.30	7	16.48	188	43.93	22	11.78	360	41.33	48	13.32	133	30.86	13	9.98	493	37.87	61	12.42
Management practices																								
Book/Record keeping	57	8.83	13	23.28	16	7.02	2	14.85	35	8.18	22	61.43	82	9.42	26	31.37	26	6.03	11	43.94	108	8.30	37	34.39
Sales/Purchase Receipt	51	7.90	8	14.81	18	7.90	2	9.38	18	4.20	13	71.57	65	7.46	15	22.91	22	5.10	7	32.87	87	6.68	22	25.43
Pricing and costing	50	7.74	6	12.63	23	10.09	2	7.61	12	2.80	10	80.00	64	7.35	11	17.46	21	4.87	6	30.86	85	6.53	18	20.77
SMS	77	11.92	18	23.02	6	2.63	1	22.24	13	3.03	10	73.63	76	8.72	21	27.68	20	4.64	8	37.94	96	7.37	29	29.82
Warehouse Receipt	58	8.98	12	20.25	3	1.32	1	38.89	8	1.87	7	84.15	51	5.86	12	24.10	18	4.17	7	40.87	69	5.30	20	28.47
Farm/Crop Budgeting	52	8.05	4	8.16	31	13.60	4	12.01	61	14.25	5	8.12	107	12.28	8	7.02	37	8.58	5	14.61	144	11.06	13	8.97
Sustainability Plan	50	7.74	7	13.87	31	13.60	3	8.90	101	23.60	3	3.00	131	15.04	11	8.29	51	11.83	2	3.65	182	13.98	13	6.99

Annex 17: Distribution of application of post-harvest, weather mitigating, ICT and water management technologies in rice production at regional, gender and ZOI level

	Northern Region (N=175)				Upper East Region (N=162)				Upper East Region (N=299				Gender (N=719)								Zone of Influence (N=719)			
	Users	% Users	New users	% New users	Users	% Users	New users	% New users	Users	% Users	New users	% New users	Male users (N=377)	% Male Users	New users male	% New Male Users	Female Users (N=259)	% Female users	New female users	% New female users	Users	% Users	New Users	% New users
Post-Harvest technology																								
Tarpaulin	48	27.43	37	77.1	68	41.98	40	59.0	35	11.70	33	93.6	98	26.00	70	71.11	53	20.46	40	75.94	151	23.74	110	72.81
Weighing Scale	3	1.72	3	96.3	3	1.85	3	98.9	7	2.34	7	98.3	6	1.59	6	99.09	7	2.70	7	97.06	13	2.05	13	97.99
Moisture Meter	3	1.72	3	96.3	0	0.00	0	0.0	3	1.00	3	100.0	2	0.53	2	99.63	4	1.55	4	97.44	6	0.94	6	98.17
Thresher	18	10.28	16	91.5	4	2.47	4	97.5	5	1.67	5	98.9	21	5.57	19	92.31	6	2.32	6	98.88	27	4.25	25	93.77
Warehouse	18	10.29	16	89.5	15	9.26	13	89.3	11	3.68	11	96.7	32	8.49	29	89.88	12	4.63	11	94.86	44	6.92	40	91.24
Climate mitigation																								
Igntia Weather Update	14	8.00	13	93.2	1	0.62	1	98.9	10	3.35	10	97.6	19	5.04	18	95.15	6	2.32	6	95.12	25	3.93	24	95.14
Weather Crop Insurance Index	2	1.14	2	98.5	1	0.62	1	98.9	2	0.67	2	99.4	5	1.33	5	98.92	0	0.00	0	0.00	5	0.79	5	98.92
Water management																								
Bunding	14	8.00	13	91.4	73	45.06	41	56.2	39	13.04	35	89.4	73	19.37	52	71.04	53	20.46	37	69.48	126	19.81	89	70.38
ICT																					0	0.00	0	0.00
Esoko Market Price updates	8	4.57	8	94.3	8	4.94	8	97.8	15	5.02	15	97.4	24	6.37	23	96.37	7	2.70	7	97.95	31	4.87	30	96.73
Farm radio	35	20.00	28	79.5	37	22.84	30	80.3	142	47.49	89	62.9	126	33.42	85	67.76	88	33.98	61	69.80	214	33.65	147	68.60
Management practices																								
Book/Record keeping	9	5.14	8	91.9	9	5.56	9	96.3	5	1.67	5	97.4	14	3.72	14	96.80	9	3.47	8	91.69	23	3.62	22	94.80
Sales/Purchase Receipt	7	4.00	7	93.2	7	4.32	7	97.5	4	1.34	4	98.1	11	2.92	11	97.43	7	2.70	7	93.57	18	2.83	17	95.93
Price and costing	13	7.43	12	92.6	13	8.03	12	91.2	6	2.01	6	98.9	19	5.04	18	94.35	13	5.02	12	91.55	32	5.03	30	93.21
SMS	9	5.15	9	94.9	3	1.85	3	100.0	7	2.34	7	97.1	15	3.98	14	96.30	4	1.54	4	97.26	19	2.99	18	96.50
Warehouse Receipt	5	2.86	5	97.8	1	0.62	1	98.9	0	0.00	0	0.0	6	1.59	6	97.97	0	0.00	0	0.00	6	0.94	6	97.97
Farm/Crop Budgeting	7	4.00	7	95.9	11	6.79	10	93.7	5	1.67	5	98.1	18	4.78	17	95.31	5	1.93	5	95.22	23	3.62	22	95.29
Sustainability Plan	8	4.57	8	96.0	9	5.55	8	92.0	79	26.42	59	74.2	57	15.12	45	79.20	39	15.06	29	75.53	96	15.09	75	77.71

Annex 18: Distribution of application of post-harvest, weather mitigating, ICT and water management technologies in soya production at regional, gender and ZOI level

	Northern Region (N=385)				Upper East Region (N=129)				Upper West Region (N=205)				Gender								Zone of Influence			
	Users	% Users	New users	% New users	Users	% Users	New users	% New users	Users	% Users	New users	% New users	Male users	% Male users	Male New users	% New Male users	Female users	% Female users	Female New users	% New Female users	Total Users	% Users	New Users	% New Users
Post-Harvest technology																								
Tarpaulin	96	24.94	74	77.10	15	11.63	13	85.42	10	4.88	9	94.93	64	16.67	52	80.99	57	17.01	44	78.06	121	16.83	96	79.61
Weighing Scale	18	4.67	17	94.25	2	1.55	2	98.24	3	1.46	3	98.80	16	4.17	15	94.02	7	2.09	7	97.87	23	3.20	22	95.19
Moisture Meter	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00	0	0.00
Thresher	10	2.60	10	97.65	0	0.00	0	0.00	2	0.97	2	98.20	7	1.82	7	97.56	5	1.49	5	97.99	12	1.67	12	97.74
Warehouse	5	1.30	5	97.75	9	6.98	8	90.90	20	9.76	18	90.16	24	6.25	22	90.19	10	2.98	9	94.53	34	4.73	31	91.47
Climate mitigation																								
Igntia Weather Update	17	4.42	16	95.94	0	0.00	0	0.00	3	1.46	3	97.30	16	4.17	15	95.56	4	1.19	4	98.49	20	2.78	19	96.15
Weather Crop Insurance Index	2	0.52	2	98.39	0	0.00	0	0.00	0	0.00	0	0.00	2	0.52	2	98.39	0	0.00	0	0.00	2	0.28	2	98.39
ICT																								
Esoko Market Price updates	10	2.60	10	96.91	1	0.77	1	97.62	4	1.95	4	96.40	11	2.86	11	96.98	4	1.20	4	96.39	15	2.09	15	96.82
Farm radio	174	45.19	108	62.17	21	16.28	18	87.66	103	50.25	55	53.30	153	39.85	91	59.60	145	43.28	90	62.27	298	41.45	181	60.90
Management practices																								
Book/Record keeping	19	4.94	18	94.05	6	4.65	6	96.14	11	5.37	10	93.89	26	6.77	24	93.02	10	2.98	10	97.81	36	5.01	34	94.35
Sales/Purchase Receipt	5	1.30	5	98.71	2	1.55	2	97.70	8	3.90	8	95.99	11	2.86	11	96.95	4	1.19	4	97.60	15	2.08	15	97.13
Price and costing	2	0.52	2	99.46	8	6.20	8	94.50	7	3.42	7	95.99	13	3.39	12	95.19	4	1.19	4	97.35	17	2.36	16	95.70
SMS	16	4.16	15	95.99	2	1.55	2	97.70	3	1.46	3	98.20	17	4.43	16	96.00	4	1.19	4	98.49	21	2.92	20	96.47
Warehouse Receipt	3	0.78	3	99.31	2	1.55	2	98.24	4	1.95	4	96.40	6	1.56	6	97.23	3	0.90	3	98.88	9	1.25	9	97.78
Farm/Crop Budgeting	3	0.78	3	99.49	2	1.55	2	97.70	12	5.86	11	93.77	11	2.87	10	94.29	6	1.80	6	97.00	17	2.37	16	95.25
Sustainability Plan	5	1.30	5	98.84	16	12.40	14	87.46	40	19.51	32	79.70	43	11.19	35	81.01	18	5.38	16	88.77	61	8.48	51	83.30

Annex 19: Gender breakdown of percentage continuous and new users of post-harvest, weather mitigating, ICT and water management technologies

	Percentage users of technology						Percentage new users of technology					
	NR		UER		UWR		NR		UER		UWR	
TECHNOLOGIES	**M[8]**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**	**M**	**F**
MAIZE												
POST-HARVEST HANDLING TECHNOLOGY												
Sheller	37.00	31.00	26.00	18.00	41.00	42.00	1.00	21.53	12.50	28.57	29.35	24.14
Tarpaulin	42.00	4.00	26.00	21.00	31.00	25.00	5.98	1.37	12.50	25.00	4.85	37.14
Weighing Scale	9.00	3.00	3.00	1.00	3.00	1.00	23.77	5.00	4.00	1.00	57.14	5.00
Moisture Meter	7.00	3.00	1.00	1.00	2.00	1.00	26.67	5.00	5.00	1.00	1.00	0.00
Warehouse	14.00	8.00	15.00	7.00	1.00	7.00	14.75	28.57	13.43	2.00	0.00	0.00
Silo	34.00	35.00	26.00	13.00	2.00	1.00	1.64	8.20	5.13	1.00	6.00	1.00
Power Tiller	11.00	6.00	3.00	0.00	0.00	0.00	17.78	3.00	0.00	0.00	0.00	0.00
Multi-purpose thresher	11.00	6.00	3.00	1.00	5.00	6.00	36.36	4.00	2.00	1.00	0.00	0.00
WEATHER MITIGATION												
Igntia Weather Update	15.00	6.00	0.00	1.00	5.00	3.00	22.39	1.00	0.00	1.00	5.00	6.00
Weather Crop Insurance Index	16.00	22.00	0.00	1.00	1.00	0.00	7.35	2.56	0.00	1.00	5.00	0.00
WATER MANAGEMENT												
Mulching	7.00	3.00	7.00	5.00	4.00	6.00	16.67	16.67	0.00	25.00	22.22	0.00
ICT												
Esoko Market Price updates	14.00	6.00	1.00	4.00	4.00	3.00	18.33	2.00	5.00	66.67	22.22	4.00
Farm Radio	45.00	34.00	2.00	17.00	51.00	36.00	15.66	1.59	12.93	23.77	9.92	15.79
RICE												
POST-HARVEST TECHNOLOGY												
Tarpaulin	27.00	28.00	47.00	36.00	13.00	1.00	78.38	28.57	53.66	66.67	95.00	93.33
Weighing Scale	1.00	5.00	3.00	0.00	1.00	3.00	1.00	4.00	1.00	0.00	1.00	1.00
Moisture Meter	1.00	5.00	0.00	0.00	1.00	1.00	1.00	4.00	0.00	0.00	1.00	1.00
Thresher	12.00	5.00	2.00	3.00	2.00	1.00	87.50	4.00	1.00	1.00	1.00	1.00
Warehouse	11.00	8.00	13.00	5.00	4.00	3.00	86.67	37.50	10.00	1.00	1.00	1.00
CLIMATE MITIGATION												
Igntia Weather Update	8.00	8.00	1.00	0.00	5.00	2.00	10.00	37.50	1.00	0.00	1.00	1.00
Weather Crop Insurance Index	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00	1.00	0.00
WATER MANAGEMENT												

[8] Number of farmers per category per region (N) is the same in Annexes 11 – 13.

Bunding	8.00	8.00	45.00	45.00	15.00	11.00	10.00	37.50	56.41	55.88	86.96	93.75
ICT												
Esoko Market Price updates	4.00	5.00	8.00	1.00	7.00	3.00	1.00	4.00	1.00	1.00	1.00	1.00
Farm radio	2.00	21.00	29.00	16.00	48.00	47.00	77.78	33.33	76.00	91.67	62.16	64.76
SOYA												
POST-HARVEST TECHNOLOGY												
Tarpaulin	23.66	26.13	14.94	4.76	6.31	3.19	77.27	76.92	84.62	1.00	1.00	1.00
Weighing Scale	6.99	2.51	1.15	2.38	1.80	1.60	92.38	1.00	1.00	1.00	1.00	1.00
Moisture Meter	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Thresher	2.69	2.51	0.00	0.00	1.80	0.00	1.00	1.00	0.00	0.00	1.00	0.00
Warehouse	2.15	0.50	8.50	4.76	11.71	7.45	1.00	1.00	85.71	1.00	84.62	1.00
CLIMATE MITIGATION												
Igntia Weather Update	6.99	2.10	0.00	0.00	2.70	0.00	92.38	1.00	0.00	0.00	1.00	0.00
Weather Crop Insurance Index	1.80	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00
ICT												
Esoko Market Price updates	3.76	1.51	0.00	2.38	3.60	0.00	1.00	1.00	0.00	1.00	1.00	0.00
Farm radio	41.40	48.74	16.90	16.67	55.86	43.62	64.94	59.79	85.71	1.00	48.39	6.98

Annex 20: Gender breakdown of percentage application of improved management practices by region gender and crop

	Percentage users						Percentage new users					
	NR		UER		UWR		NR		UER		UWR	
	M[9]	F	M	F	M	F	M	F	M	F	M	F
MAIZE												
Book/Record keeping	10	8	10	1	10	7	20.93	28.57	13.33	100	62.5	63.64
Sales/Purchase Receipt	9	7	10	4	5	4	13.16	23.08	6.67	33.33	75	66.67
Pricing and costing	8	8	13	4	3	3	11.11	21.43	5	33.33	87.5	75
SMS	14	8	3	1	4	3	22.58	26.67	20	100	66.67	75
Warehouse Receipt	10	8	1	1	2	1	16.28	33.33	50	100	83.33	100
Farm/Crop Budgeting	9	6	17	7	16	14	7.32	18.18	11.54	20	5	14.29
Sustainability Plan	9	6	17	7	27	23	17.95	0	7.69	20	3.03	2.86
RICE												
Book/Record keeping	3	13	6	5	3	0	100	30.77	100	100	100	0
Sales/Purchase Receipt	2	10	5	4	3	0	100	40	100	100	100	0
Price and costing	7	8	6	11	3	1	90	37.5	100	87.5	100	100
SMS	5	5	2	1	4	1	100	40	100	100	100	100
Warehouse Receipt	4	0	1	0	0	0	100	0	100	0	0	0
Farm/Crop Budgeting	4	3	8	5	3	0	100	33.33	100	100	100	0
Sustainability Plan	4	5	10	0	27	26	100	40	88.89	0	73.81	75.68
SOYA												
Book/Record keeping	7.53	2.51	4.6	4.76	7.21	3.19	92.86	100	100	100	87.5	100
Sales/Purchase Receipt	2.15	0.5	2.3	0	4.5	3.19	100	100	100	0	100	100
Price and costing	0.54	0.5	6.9	4.76	5.41	1.06	100	100	100	100	100	100
SMS	6.45	2.01	2.3	0	2.7	0	91.67	100	100	0	100	0

[9] Number of farmers per category per region (N) is the same in Annexes 9 (A and B) and 14.

Warehouse Receipt	0.54	1.01	1.15	2.38	3.6	0	100	100	100	100	100	0
Farm/Crop Budgeting	0.54	1.01	2.3	0	7.21	4.26	100	100	100	0	87.5	100
Sustainability Plan	1.61	1.01	14.94	7.14	24.32	13.83	100	100	84.62	100	77.78	84.62

Annex 21: Distribution of households across regions, gender and crop by practice of irrigation

			Northern Region		Upper East Region		Upper West Region	
Gender	**Crop**	**Practice of irrigation**	**N**	**%**	**N**	**%**	**N**	**%**
	Maize	**Irrigators**	29	6.3	2	1.3	6	2.3
		Non-irrigators	428	93.7	150	98.7	256	97.7
		Total	457	100	152	100	262	100
Male	**Rice**	**Irrigators**	35	25.7	48	55.2	16	10.4
		Non-irrigators	101	74.3	39	44.8	138	89.6
		Total	136	100	87	100	154	100
	Soya	**Irrigators**	6	3.2	6	6.9	4	3.6
		Non-irrigators	180	96.8	81	93.1	107	96.4
		Total	186	100	87	100	111	100
	Maize	**Irrigators**	6	3.2	1	1.3	6	3.6
		Non-irrigators	183	96.8	75	98.7	160	96.4
		Total	189	100	76	100	166	100
Female	**Rice**	**Irrigators**	5	12.8	39	52	7	4.8
		Non-irrigators	34	87.2	36	48	138	95.2
		Total	39	100	75	100	145	100
	Soya	**Irrigators**	0	0	4	9.5	4	4.3
		Non-irrigators	199	100	38	90.5	90	95.7
		Total	199	100	42	100	94	100

Annex 22: Distribution of Respondents across ZOI by Sex and Marital Status

Distribution of Respondents by Sex and Marital Status

Marital Status				Name of Region			Total
				Northern Region	Upper East Region	Upper West Region	
Married	Sex of Respondent	Male	Count	717	285	491	1493
			% of Total	29.9%	11.9%	20.5%	62.3%
		Female	Count	388	165	352	905
			% of Total	16.2%	6.9%	14.7%	37.7%
	Total		Count	1105	450	843	2398
			% of Total	46.1%	18.8%	35.2%	100.0%
Single	Sex of Respondent	Male	Count	54	24	28	106
			% of Total	42.5%	18.9%	22.0%	83.5%
		Female	Count	13	3	5	21
			% of Total	10.2%	2.4%	3.9%	16.5%
	Total		Count	67	27	33	127
			% of Total	52.8%	21.3%	26.0%	100.0%
Divorced	Sex of Respondent	Male	Count	2	1	2	5
			% of Total	25.0%	12.5%	25.0%	62.5%
		Female	Count	1	1	1	3
			% of Total	12.5%	12.5%	12.5%	37.5%
	Total		Count	3	2	3	8
			% of Total	37.5%	25.0%	37.5%	100.0%
Separated	Sex of Respondent	Male	Count	0	2	2	4
			% of Total	0.0%	25.0%	25.0%	50.0%
		Female	Count	1	2	1	4

			% of Total	12.5%	25.0%	12.5%	50.0%
	Total		Count	1	4	3	8
			% of Total	12.5%	50.0%	37.5%	100.0%
	Sex of Respondent	Male	Count	6	14	4	24
			% of Total	5.2%	12.1%	3.4%	20.7%
Widowed		Female	Count	24	22	46	92
			% of Total	20.7%	19.0%	39.7%	79.3%
	Total		Count	30	36	50	116
			% of Total	25.9%	31.0%	43.1%	100.0%
	Sex of Respondent	Male	Count	779	326	527	1632
			% of Total	29.3%	12.3%	19.8%	61.4%
Total		Female	Count	427	193	405	1025
			% of Total	16.1%	7.3%	15.2%	38.6%
	Total		Count	1206	519	932	2657
			% of Total	45.4%	19.5%	35.1%	100.0%

Annex 23: One-way ANOVA test results for average application indices and gender

		Sum of Squares	df	Mean Square	F	P-value
Maize: Application Index (Users) * Sex of Respondent	Between Groups (Combined)	2176.10	1	2176.10	9.54	0.002
	Within Groups	287991.04	1262	228.20		
	Total	290167.13	1263			
Maize: Application Index (New Users) * Sex of Respondent	Between Groups (Combined)	162.10	1	162.10	1.65	0.2
	Within Groups	38239.80	389	98.30		
	Total	38401.89	390			
Maize: Application Index (Continuous Users) * Sex of Respondent	Between Groups (Combined)	1324.73	1	1324.73	7.80	0.005
	Within Groups	209824.66	1235	169.90		
	Total	211149.39	1236			
Rice: Application Index (Users) * Sex of Respondent	Between Groups (Combined)	1931.48	1	1931.48	13.51	0.000
	Within Groups	67033.17	469	142.93		
	Total	68964.65	470			
Rice: Application Index (New Users) * Sex of Respondent	Between Groups (Combined)	12.76	1	12.76	0.30	0.583
	Within Groups	5635.29	134	42.05		
	Total	5648.05	135			
Rice: Application Index (Continuous Users) * Sex of Respondent	Between Groups (Combined)	1287.28	1	1287.28	11.31	0.001
	Within Groups	51461.30	452	113.85		
	Total	52748.58	453			

Soya: Application Index (Users) * Sex of Respondent	Between Groups (Combined)	401.40	1	401.40	5.36	0.021
	Within Groups	51339.67	685	74.95		
	Total	51741.07	686			
Soya: Application Index (New Users) * Sex of Respondent	Between Groups (Combined)	455.69	1	455.69	8.12	0.005
	Within Groups	36642.81	653	56.12		
	Total	37098.50	654			
Soya: Application Index (Continuous Users) * Sex of Respondent	Between Groups (Combined)	5.50	1	5.50	0.10	0.752
	Within Groups	6067.42	111	54.66		
	Total	6072.92	112			

Annex 24: Regression Analysis

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	3647.747	453.481		8.044	.000			
	Did an extension worker visit your HH farm last farming season to provide advice about farming	52.263	189.770	.009	.275	.783	-.060	.008	.008
	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)?	-527.738	219.864	-.079	-2.400	.017	-.098	-.069	-.068
	Highest level of Education	-39.722	69.371	-.016	-.573	.567	-.005	-.016	-.016
	Have you benefited from ADVANCE I?	-676.413	178.491	-.112	-3.790	.000	-.133	-.108	-.107
	What is the Size of all Agricultural Land (acres)?	13.204	3.657	.102	3.610	.000	.103	.103	.102

a. Dependent Variable: Maize: Output per Hectare

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	6183.089	691.835		8.937	.000			
	Did an extension worker visit your HH farm last farming season to provide advice about farming	-821.329	289.518	-.136	-2.837	.005	-.223	-.123	-.118
	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)?	-674.189	335.432	-.097	-2.010	.045	-.214	-.088	-.083
	Highest level of Education	274.875	105.834	.108	2.597	.010	.129	.113	.108
	Have you benefited from ADVANCE I?	-1017.829	272.312	-.162	-3.738	.000	-.225	-.161	-.155
	What is the Size of all Agricultural Land (acres)?	-4.670	5.580	-.035	-.837	.403	-.028	-.037	-.035

a. Dependent Variable: Rice: Output Volume in kg per hectare

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	Correlations		
		B	Std. Error	Beta			Zero-order	Partial	Part
1	(Constant)	1020.846	167.173		6.107	.000			
	Did an extension worker visit your HH farm last farming season to provide advice about farming	-32.910	69.958	-.021	-.470	.638	-.033	-.018	-.018
	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)?	26.290	81.052	.014	.324	.746	-.005	.013	.012
	Highest level of Education	1.616	25.573	.002	.063	.950	.003	.002	.002

Have you benefited from ADVANCE I?	-90.942	65.800	-.055	-1.382	.167	-.062	-.053	-.053
What is the Size of all Agricultural Land (acres)?	5.058	1.348	.143	3.751	.000	.147	.143	.143

a. Dependent Variable: Soya: Total volume produced (kg) per hectare