Agricultural Production Survey for the Northern Regions of Ghana: 2013-2014 Results

Final Report

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with

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Introduction

The Agricultural Production Survey is a complement to the Population-Based Survey conducted to develop baseline indicators for USAID Ghana Mission' Economic Growth Office. The sample of respondents in the Agricultural Production Survey was drawn from the sample used in the Population-Based Survey in 2012. The Population-Based Survey used a two stage sampling approach – defining the enumeration areas in the defined study areas and then selecting households in each enumeration area. A full description of the sampling approach as well as the results of the Population-Based Survey may be found in Zereyesus et al. (2014).[1]

The sub-sample of the Population-Based Survey for the Agricultural Production Survey covered only households directly involved in agricultural production. It is important to recognize that although the original Population-Based Survey covered a broad area, the sampling objective was not to develop baseline information for agricultural households. This means that while drawing the Agricultural production Survey sample from the same sample provided continuity and comparability with the Population-Based Survey results, the results may not be representative of activities in the study area, and any representativeness declines with sub-regional analysis. For example, the original Population-Based Survey sample was not drawn to ensure household representativeness at the district level. Therefore, it is not uncommon to find districts in the survey having too few households to facilitate statistical analysis. Also, by keeping within the original Population-Based Survey sample, we increased the risk of potentially not achieving the required randomness given that not every agricultural household in the study area had the chance to be included in the study. Given the foregoing, the study was structured such that agricultural households already included in the Population-Based Survey had an equal chance of being selected for this study, based on their location.

With the foregoing as a caveat to the data used in this report, our purpose is to provide detailed descriptive information about agricultural production in the study area within the context of the population-based survey baseline sample. The results provide baseline indicators for a number of a number of agricultural production indicators of interest. These include, but are not limited to, area under production for each of the three focus crops, i.e., maize, rice and soybean, revenue and gross margin as well as profitability of production. These results are reported on crop and regional basis for the most part. Although we have no confidence in the statistical accuracy of the results at the district

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[1]   Zereyesus, Y., K. Ross, V. Amanor-Boadu and T. Dalton. *Baseline Feed the Future Indicators for Ghana*, 2012, Manhattan, KS: Kansas State University Press, 2013.

level (based on the sampling method described above), they are reported in Appendix 1 for information purposes only.

Survey Approach

The data in the Agricultural Production Survey were collected using a diary approach in which respondents provided periodic information about their agricultural production activities from June 2013 to March 2014. Fifty-one and seven Management Information System officers in district offices of the Ministry of Food and Agriculture across the study area were engaged as enumerators and supervisors respectively to help with data collection. Each enumerator was each assigned eleven households and each supervisor was assigned about seven enumerators. Enumerators visited each of their household respondents fortnightly over the duration of the study, recording data on farming activities undertaken during the preceding period. The survey diary encompassed a structured questionnaire organized according to specific agricultural production and marketing activities. The front end of the survey instrument was structured to collect household characteristics information. The survey instrument is presented in Appendix 2.

Survey Challenges

Despite the management diligence established for the survey, we experienced compliance challenges with some of the enumeration staff. It is important to recall that the government officials recruited to help with the enumeration were fully employed in their primary jobs as management information officers in the district offices of the Ministry of Food and Agriculture. The help they provided in the data collection effort was an overload to their primary assignments. Therefore, it is not surprising that some challenges occurred. Of the 51 officials, three were discovered to have produced inadequate services, forcing the project to let go of their services. This meant that we lost data on 33 households, leading to a total sample size of 528 instead of the 561 that was planned.

Collecting data over a long period always increases the risks of reporting errors, coding errors, response gaps and missing information. We were not immune to these challenges in the Agricultural Production Survey. The effect of these field challenges was a longer data cleaning process to ensure the quality of the data and preserve its integrity at the same time. This implies an iterative process involving multiple runs of analyses to check for internal consistency and coherence of results. These lessons will inform future planning and execution of such surveys.

Report Outline

The report is divided into eight components, including this introduction chapter. The next chapter provides the summary statistics about the respondents' demographic characteristics. Chapter III describes agricultural production activities undertaken in 2012, which was prior to conducting the survey. The results from this period provide a context for assessing activities in the 2013 and 2014 production and marketing period, which was the focus of the rest of the report. Chapter IV presents the agricultural production activities in 2013, focusing on maize, rice and soybeans. The area, output, yield, types and varieties of seed used and the types of chemical applied are presented in this chapter. It also presents that summary information on land preparation methods and land ownership structures. Chapter V presents the summary information on producer assets while Chapter VI looks at labor resources used in 2013 agricultural production activities. The types of labor assessed encompassed family labor, hired labor and community labor. Chapter VII discussed the marketing and product utilization activities of respondents to the survey while Chapter VIII covered their economic

performance. This included revenues, costs and gross margins. We also discussed the summary statistics of respondents' productivity using gross margin per hectare as the primary productivity measure.   The final chapter provides the summary and conclusions of the report.

Demographic Characteristics of Respondents

Distribution of Respondents and Districts in the Study Area

Five hundred and twenty-seven households formed the *useful* sample in the ensuing analyses of the agricultural production survey of northern Ghana conducted in 2013 and 2014.[2] Northern Region, because of its larger population share in the study area, ended up with a 63 percent share of the study's respondents (Exhibit 1). Brong Ahafo's share of the study's area's total population was very small, and this explains its 2 percent share of the study's respondents.[3] The proportion of survey respondents in Upper East Region and Upper West Region was respectively 27 percent and 8 percent.

There is interest in understanding the distribution of the results in this study by districts even though the sampling process did not consider district representativeness. The district level results presented in Appendix I are, thus, only for *information purposes* and not for inferential purposes. To underscore the foregoing limitations, Exhibit 2 shows that Brong Ahafo has only one district represented in the sample even though it had seven of the 45 districts in the Population-Based Survey. The exhibit also shows that 61 percent of the 24 districts in the Agricultural Production Survey were in Northern Region, a much larger representation than it had in the population-based survey.

Exhibit 1: Distribution of Respondents and Represented Districts by Region

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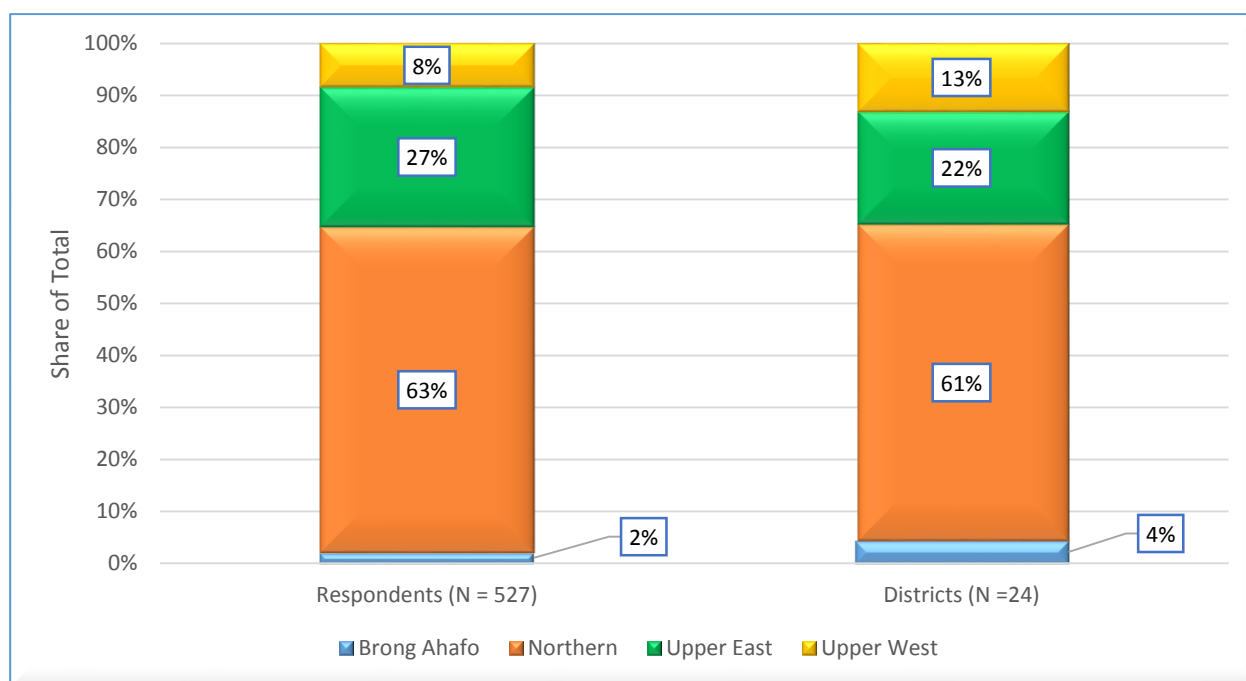
[2]   One respondent was considered inappropriate for the survey and was, thus, dropped, leaving 527 respondents for the analyses. Interviews with nearly 99 percent of the first visit by enumerators was completed.

[3]   Only the portion of Brong Ahafo Region above Latitude 8°N is included in this research. This underscores its size of in the sample.

Gender, Marital Status and Literacy

About 96% of households in the study were male and female adult households, while about 3% were female adult only households and the remainder were male adult only households. All the household types in Brong Ahafo Region were male and female adult households. Of the 14 female adult only households in the survey, nine of them were in Upper East Region, four in Upper West and the remaining one in Northern Region.

Despite the foregoing, about 90% of respondents were male. By region, only about one and one-half percent of the male respondents were in Brong Ahafo Region, nearly 66 percent in Northern Region, about 25 percent in Upper East and the remaining 8 percent in Upper West Region. Unlike males, the majority of female respondents (a little over 47 percent) were in Upper East Region, compared to nearly 36 percent in Northern Region, 9 percent in Upper West and about 8 percent in Brong Ahafo Region. Additionally, about 90% of all respondents indicated being married. Of those married, approximately 5 percent are females. However, among females, about 47 percent are married while 43 percent indicated being widowed. In contrast, while nearly 95 percent of male respondents indicated being married, only 1 percent of them were widowed.

English is important for individuals' long-term economic wellbeing because it is Ghana's official language. While significant effort is being made to enhance formal education in the country, only 12.5% of the 526 respondents could read and write in English. Exhibit 2 shows the distribution of the 66 people who indicated being able to read and write in English by region. It is noted that the Upper West Region accounted for a significantly larger proportion of respondents literate in English than it did in the proportion of respondents illiterate in English. However, while Northern Region accounted for 53% of those literate in English, it also accounted for the majority – 64% – of respondents illiterate in English. Upper East Region's share was the same for both.

Exhibit 2: Distribution of Respondents by Literacy and Illiteracy in English by Regions (N = 526)
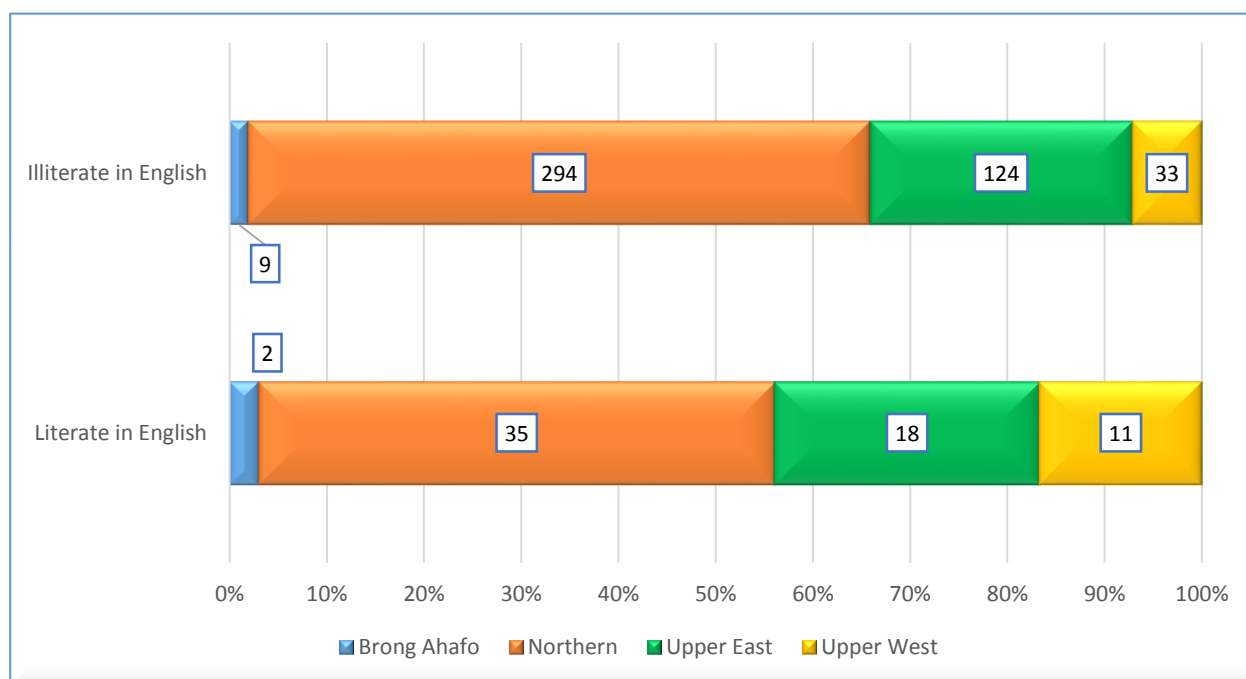
The literacy challenge is not limited to only English. Only about 5% of respondents indicated being literate in Arabic while only 4% of them indicated being literate in a local language. Overall, nearly 88% of respondents had had no formal education of any kind, while only 2% had received up to primary education and about 2.5% had received a Middle School Leaving Certificate. The bottom line is that no matter how literacy and education are sliced, the level is low in the study area and investments to address this must be enhanced if aspirational economic wellbeing objectives are going to be achieved and sustained.

Of the 66 respondents who were literate in English, only about 6 percent were female even though females account for about 10 percent of all respondents. However, for respondents who were illiterate in English, females account for approximately 11 percent, closer to their representation in the sample. If indeed literacy in English is critical for long-term success in Ghana because of its official status, then the foregoing suggests that the ongoing effort to enhance female education be maintained or enhanced in order to address the economic wellbeing gap between males and females.

Household Size, Ethnic Groups and Religion

The average household size was about 11 people, when the whole dataset is analyzed. However, about 39 households indicated having between 20 and 53 people in their households. When these relatively large households are treated as outliers and excluded from the analysis, the average household size was approximately nine people. This is still higher than the average household size of about six people estimated for the 2012 Population-Based Survey in the same study area. However, the difference must be contextualized by the fact that the Agricultural Production Survey focused on agricultural households, which tend to be in rural areas and have relatively larger household sizes than non-agricultural urban households. The results also show that the number of male and female children averaged about three each. The average number of adult males and adult females was about two and three respectively. The difference between the average number of adult males and females was statistically significant at the 1 percent level.

Exhibit 3 shows the distribution of the average number of household members in each of the four categories – adult males, adult females, male children and female children – by region. The exhibit shows that average number of household members by age and gender categories was smaller in Upper East and Upper West regions than was found in either Brong Ahafo or Northern Region. There was no statistical difference in the average number of adult males across the regions. However, the difference in the average number of adult females in Upper East Region was statistically different from those of Brong Ahafo and Northern Region.

Mole-Dagbani was the dominant ethnic grouping in the survey with more than 52 percent of the respondents identifying as such (Exhibit 4). Gurma was the next largest distinct ethnic group with only about 14 percent while Akans and Guans came in at about 4 percent each.   A relatively large proportion of respondents (21 percent) did not indicate a specific ethnic group. This may be because they have mixed ethnicity, making it difficult to select only one. This situation is increasing with inter-marriages and social scientists are looking for new and innovative ways to describe people by their ethnicity.

Exhibit 3: Average Household Members by Region, Gender and Age
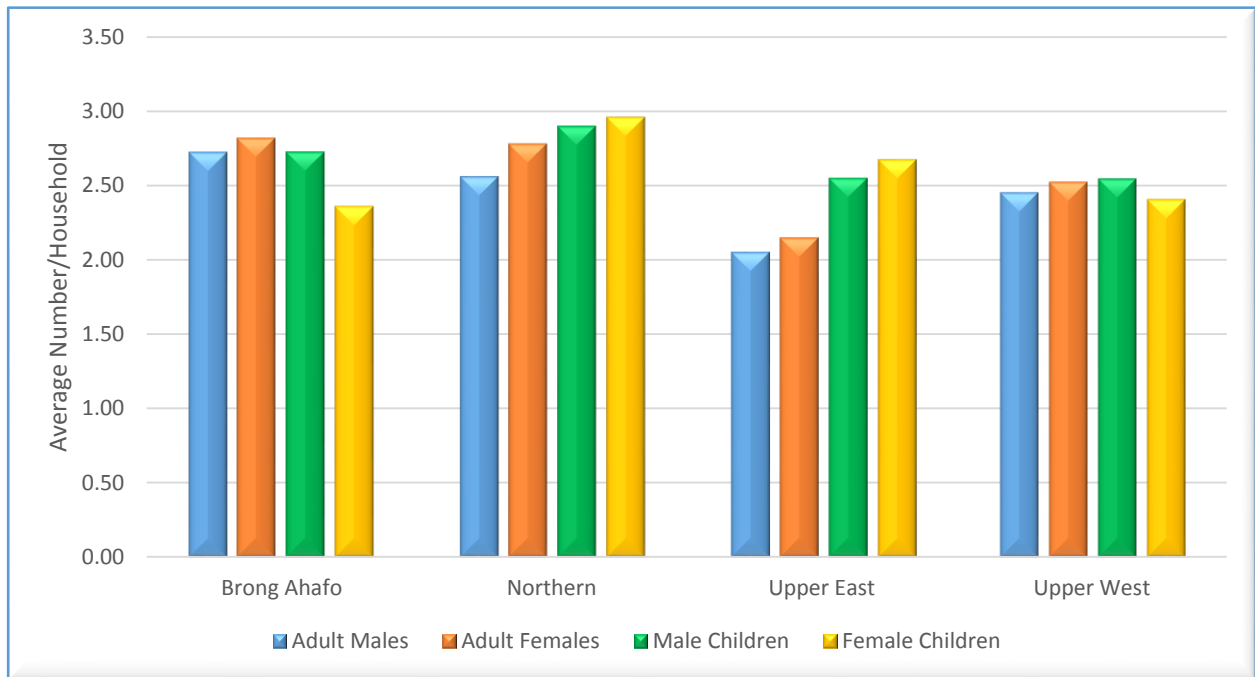
Exhibit 4: Distribution of Respondents by Ethnicity
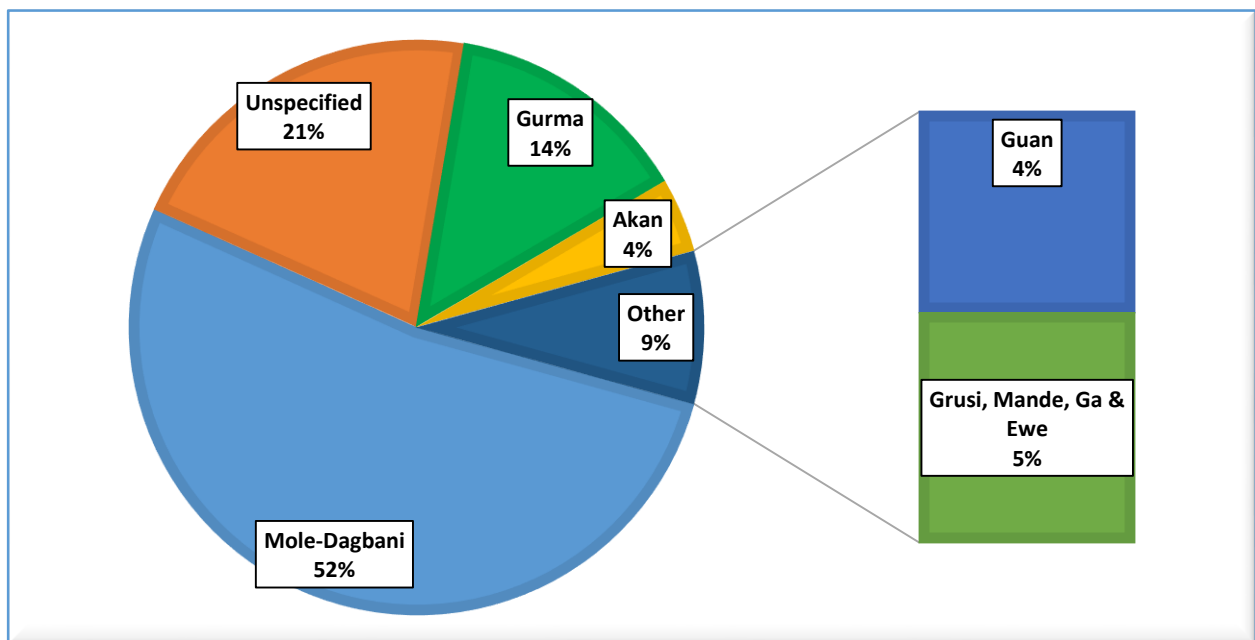
Ethnic groups investing more in education would account for a higher percentage of the total number of people literate in English and a lower share of those illiterate in English than they would in their share of the population. Exhibit 5 shows that the Mole-Dagbani account for about 58 percent of the people literate in English but account for less than 53 percent of the total population. Their investment in education is confirmed by their share of those being illiterate in English being smaller than their share of the total sample size. Similarly, the Mande and the Guan people in the study area account for only

about 1.3 percent and 4.0 percent of the total population but more than 3 percent and 4.6 percent of the people literate in English and about 1.1 percent and 3.9 of those illiterate in English. Contrarily, the Akans and the Gurmas account for 4.2 percent and 13.9 percent of the total sample but only 1.5 percent and 10.6 percent of the literate. Their share of those illiterate in English was found to exceed their share of the sample.

Exhibit 5: Distribution of Ethnic Groups by Literacy and Illiteracy in English

Ethnic Group	Literate in English	Illiterate in English	Total
Mole-Dagbani	57.58	51.74	52.47
Unspecified	18.18	21.3	20.91
Gurma	10.61	14.35	13.88
Guan	4.55	3.91	3.99
Grusi	3.03	2.83	2.85
Mande	3.03	1.09	1.33
Akan	1.52	4.57	4.18
Ga-Dangme	1.52	0	0.19
Ewe	0	0.22	0.19

On the question of respondents' main religion, about 45 percent identified Islam and Ahmadi as their main religions while 23 percent and about 6 percent respectively indicated they were traditionalists and practiced no religion (Exhibit 6). The remainder identified as various denominations of Christianity, with the single-largest denomination being Catholics, coming in a little above 11 percent of respondents.

Exhibit 6: Distribution of Respondents by Religion
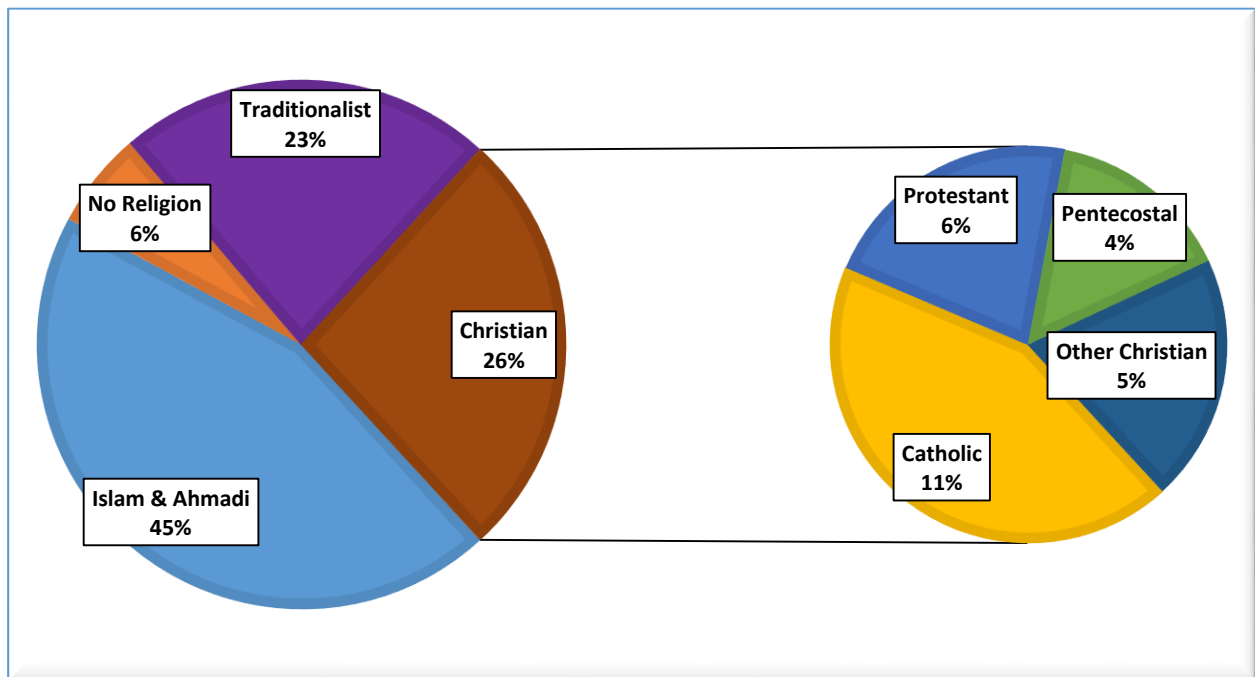
Agricultural Production Activities in 2012

Agricultural production is a continuous process for most people in the study area. They, like most agricultural producers in other parts of the world, work on using their land, labor and other resources to produce crops and other products for their livelihoods. In this chapter, we explore the crop production activities undertaken by respondents in the study area. The activities were not limited to the crops of interest – maize, rice and soybeans – but covered all crops that were produced by the farmers on all plots of land to which they had access.

Plot Size and Crops Produced in 2012

The 527 respondents together operated 1,467 plots of land in 2012. This implied that there was an average of approximately three plots per household. The plots were small, ranging from about of 0.04 ha to 16.2 ha in 2012, with an average of approximately 1.0 ha. We refer to the sum of the area of all plots used by each household as <u>household land holding</u>. The average size of household land holding was about 2.9 ha, and ranged from under a tenth of a hectare to 63.1 ha. Thus, the average household land in the study area was smaller than the average of 4 ha reported by IFPRI.[4] As expected, there were regional differences in these averages (Exhibit 7). The average plot size in Brong Ahafo Region was about 1.2 ha compared to 1.3 ha in Northern Region, but the average household land holding was 3.6 ha and 3.3 ha respectively. In Upper East and Upper West, the average plot size was approximately 0.6 ha and 0.8 ha while the average household land was 1.8 ha and 3.0 ha. There was no statistical difference between the average plot size in Brong Ahafo and Northern Region or between Upper East and Upper West. However, the differences between Brong Ahafo and Northern Region on the one hand and Upper East and Upper West on the other were statistically significant at the 1 percent level. With respect to household land holding, there were no statistical differences among Brong Ahafo, Northern and Upper West but the average household land holding in those three regions differed statistically from that of Upper East Region.

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[4]   International Food Policy Research Institute. Smallholder Agriculture in Ghana. Ghana Strategy Support Program – IFPRI Discussion Brief 3, n.d.

Exhibit 7: Average Plot Size and Average Household Land Holding by Region in 2012
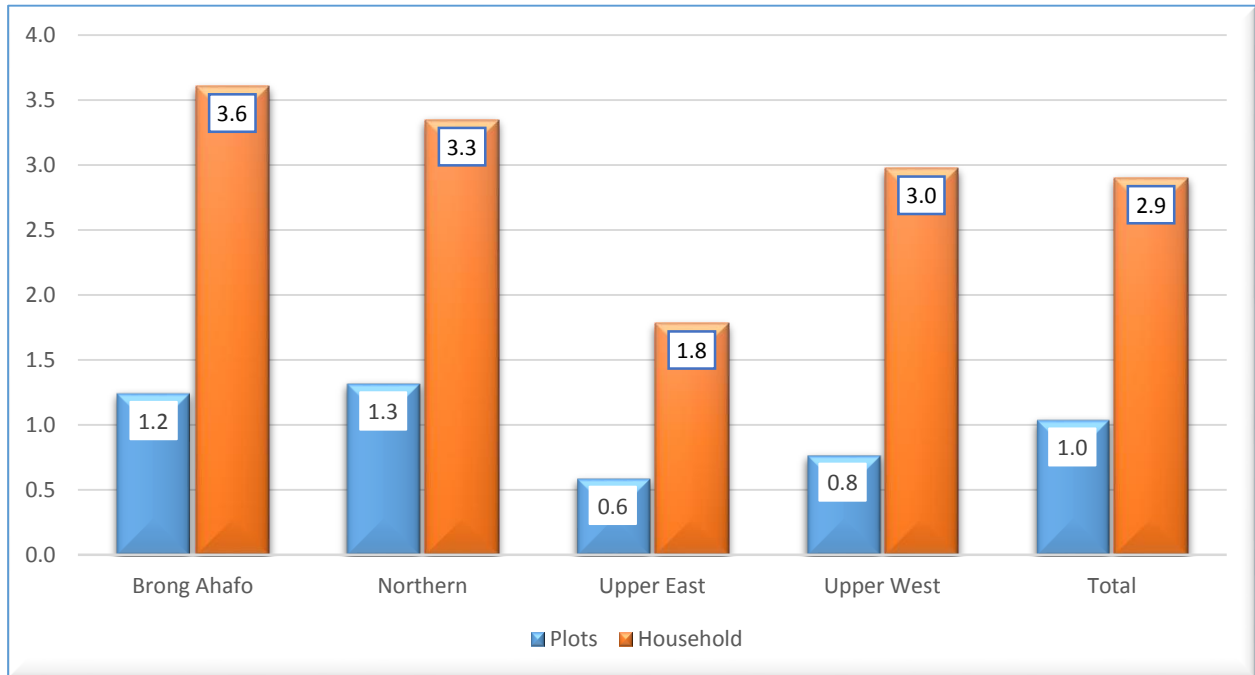
Production in the study area was not done on household land holding basis but on plot basis. It is, thus, plausible to think of the different plots as production enterprises, with farmers making specific and different decisions about what and how to produce on each plot. Only 40 of the 1,467 plots (i.e., about 3 percent) exceeded 4 ha and only about 12 percent were 2 ha or more in size, implying 88 percent of the plots were less than 2 ha. Nearly 82 percent of plots that were 2 ha or more in size were in Northern Region, about 8 percent in Upper East, about 7 percent in Upper West and the remaining 3 percent in Brong Ahafo. However, it is the within region distribution of plot sizes that is interesting. For example, while 6 percent of the plots in Brong Ahafo Region exceeded 4.0 ha, only 4 percent of plots in Northern Region and 2 percent of Upper West Region's were in this category (Exhibit 8). Upper East Region had the largest share of its plots in the under 1 ha category while Northern Region had the least.

Exhibit 8: Distribution of Plots by Average Plot Size and Region in 2012
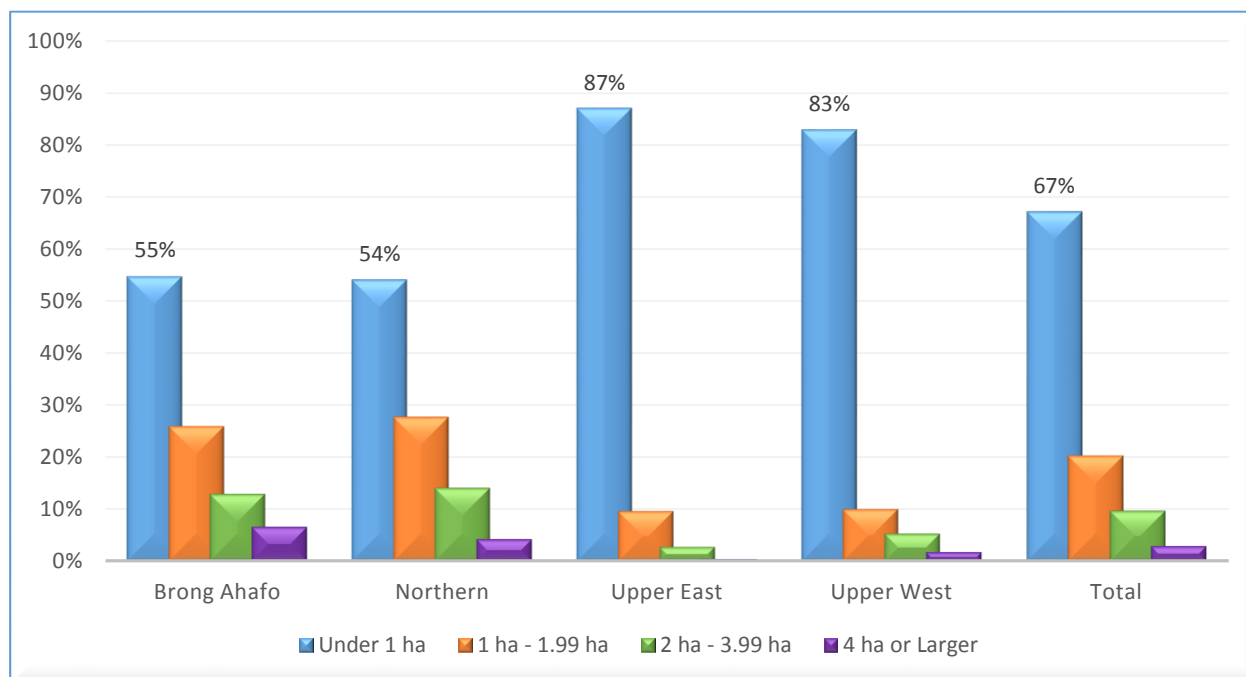
Exhibit 9 shows the distribution of plots by average plot size, crop and region. It is observed that while nearly all rice acreage in Upper East and Upper West regions was under 1 ha, only 41 percent of maize acreage in Northern Region was under 1 ha. Northern Region had the lowest proportion of its plots in all crops in the Under 1.0 ha category, with the exception of rice, for which Brong Ahafo Region posted 55 percent of its plots in the Under 1.0 ha category compared to 61 percent for Northern Region. Thus, Upper East and Upper West regions had the smallest plots and soybean plots tended to be relatively smaller, with about 59 percent of them being less than 2 ha compared to 82 percent for maize and 92 percent for rice.

On household land holding basis, the average household land allocated to maize production in 2012 across the study area was 1.2 ha compared with about 0.8 for rice and soybeans respectively. There were five crops in the study area in 2012 that received more than one hectare of household land allocation on average in addition to maize: cowpeas (1.9 ha); groundnuts (1.0 ha); Millet (1.4 ha); and cassava (1.1 ha). Average maize household land in Northern Region was 1.4 ha compared to 0.9 ha in both Upper West and Upper East regions. Average rice household land in Brong Ahafo Region was about 1.7 ha compared to approximately 1.0 ha in Northern Region, 0.4 ha in Upper East Region and under 0.4 ha in Upper West Region. Average soybean household land was under 1 ha in all regions.

Exhibit 9: Distribution of Plots in 2012 by Average Plot Size, Crop and Region in Percentage

Area Range	Brong Ahafo*	Northern	Upper East	Upper West	Total
Maize					
Under 1 ha	71	41	71	76	52
1 ha - 1.99 ha	14	36	23	19	30
2 ha - 3.99 ha	14	18	6	5	13
4 ha or Larger	0	6	0	0	4
Total	**100**	**100**	**100**	**100**	**100**
Rice					
Under 1 ha	55	61	96	96	77
1 ha - 1.99 ha	27	27	3	0	15
2 ha - 3.99 ha	18	12	1	4	7
4 ha or Larger	0	1	0	0	1
Total	**100**	**100**	**100**	**100**	**100**
Soybean					
Under 1 ha		75	93	100	83
1 ha - 1.99 ha		18	5	0	12
2 ha - 3.99 ha		5	2	0	4
4 ha or Larger		2	0	0	1
Total		**100**	**100**	**100**	**100**

* No Brong Ahafo Region household in the survey had soybean plots in 2012.

Although the survey focused primarily on the three key value chain crops (maize, rice, and soybeans), respondents were also asked to list any other crops of importance. Farmers in the study area indicated planting about a dozen unique crops on their plots. Some of these were cash crops, such as cotton, but the majority were food crops. Exhibit 10 shows that there were 1,470 plots used by the respondent households in the production of these crops. The figure shows that maize was by far the dominant crop in the study area in 2012, produced on more than 500 plots. This is not a surprise given the position of maize in the food basket of the population in the study area. Rice and soybeans were in second and third positions respectively with nearly 300 plots and more than 200 respectively. This confirms that the focus crops were also the dominant crops by plot allocations in the region in 2012.

Exhibit 10: Frequency of Plot Allocations by Crop for 2012 Production Activities (N = 1,470)
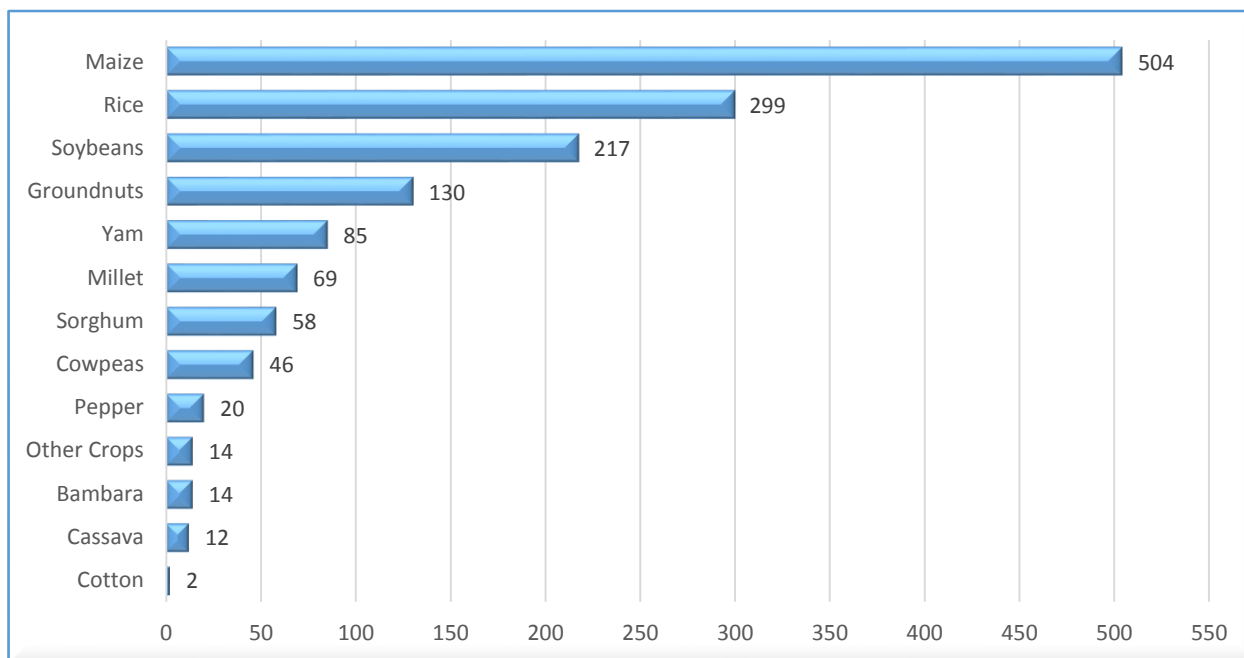
Varieties Planted to Focus Crops in 2012

The dominant variety of maize planted by the farmers in 2012 was Obatanpa, accounting for more than 76 percent of all the maize varieties planted. A distant second to Obatanpa was Okomasa, with under 11 percent of maize plots. Only nine respondents (approximately 2 percent) indicated not knowing their maize variety and the rest were all under 1 percent, including Yellow Maize, Pioneer and Kamanpila. The average plot size planted to Okomasa was about 1.7 ha, nearly 30 percent higher than the average plot size of approximately 1.3 ha for Obatanpa. Pan 12 and local variety had average planted areas of about 1.6 ha and 1.5 ha respectively, both higher than the more popular Obatanpa.

For rice, the dominant variety, Jasmine, accounted for only about 23 percent of rice plots. Its average planted area was 0.8 ha. Molga and Nerica were the second and third most popular rice varieties and they accounted for about 13 percent and 14 percent respectively. While the average planted area for Nerica was about 0.9 ha, that for Molga was only about 0.4 ha. MANDII, Agab and Brown Rice varieties, although not planted on many plots, had average planted areas of 5.3 ha, 2.8 ha and about 2 ha respectively.

Anidaso and Jenguma, with nearly 46 percent and 40 percent respectively of the total soybean plots, were the two dominant varieties planted in the study area. Salintuya 1 was a far third, with only 15 plots or about 7 percent of total soybean plots. However, the average planted area to Salintuya 1 was about 1.1 ha, about 78 percent higher than the Anidaso, which had an average planted area of about 0.6 ha in 2012. Jenguma's average planted area was more than 0.7 ha.

Crop Output and Uses in 2012

The average output for the different crops cultivated in 2012 are presented in Exhibit 11. Yams had the highest average output across the respondents, coming in at about 8,300 kg. The focus crops averaged

1,123 kg for maize, 679 kg for rice and 493 kg for soybeans. The output difference between soybeans and rice was statistically significant at the 1 percent.

Exhibit 11: Average Crop Output on Plot Basis in 2012 in Kilograms
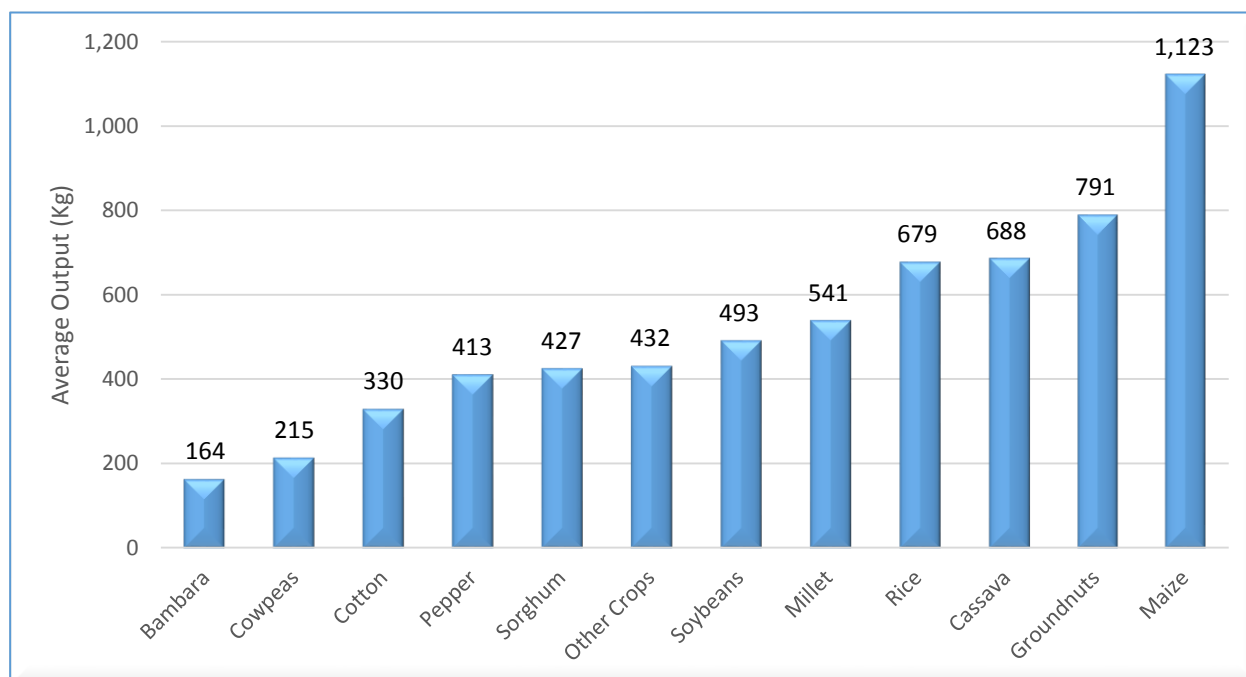
The average output shows that the most popular varieties do not necessarily produce the highest average output. Obatanpa was the most popular maize variety in the study area, followed by Okomasa. Based on output reported by respondent, we estimated the average output from these top two maize varieties as 1,024 kg and 1,824 kg respectively. Pan 12, an "unrated" variety planted on only four plots in 2012, came in with the highest average output of 2,800 kg. A similar result was seen in rice, where the most popular seed varieties were Jasmine and Nerica. Average output from these were respectively 658 kg and 654 kg but brown rice produced an average output of 1,100 kg, about 60 percent higher than these popular varieties. Salintuya 1, which was planted on only 15 soybean plots in 2012, produced the highest average output for soybean, about 1,435 kg. The average output from the most-popular varieties Jenguma and Anidaso was 573 kg and 456 kg.

Average plot output by focus crop and region is presented in Exhibit 12.[5] Northern Region had the highest average maize output with nearly 1,320 kg per plot. The average output in Upper West Region was about 32 percent of Northern Region's compared to Brong Ahafo's and Upper East's of about 55 percent and 69 percent respectively. Brong Ahafo Region had the highest average output of rice, about 1,636 kg. There was no soybean production in Brong Ahafo in the sample drawn for this study. The highest average output per plot of about 683 kg was obtained in Northern Region, while Upper West Region's average output was the lowest, only 23 percent of what was obtained in Northern Region.

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[5]   Complete summary statistics are presented in Appendix 1 for all estimated statistics in this document.

Exhibit 12: Average Plot Output by Crop and Region in Kilograms

Region	Maize (N=497)	Rice (N=294)	Soybean (N=214)
Brong Ahafo	736	1,636	-
Northern	1,319	900	683
Upper East	903	360	232
Upper West	420	326	156
Total Average	1,123.31	676.31	490.37

Crop Yield in 2012

Yield is total plot output divided by the plot area. Exhibit 13 summarizes the average yield for each of the three focus crops by region for 2012. The average yield for maize across the study area for 2012 was approximately 380 kg/ha. The average maize yield in Upper East was the highest, at about 481 kg/ha, which was about 52 percent higher than the average maize yield in Upper West Region, at just about 216 kg/ha. For rice, Brong Ahafo Region posted the highest yield in 2012 at 494 kg/ha and Upper West came in at the bottom with about 276 kg/ha. The overall average rice yield across the study area was approximately 399 kg/ha in 2012. Unlike the other two crops, the average yield for soybeans was lowest in Upper West Region. With an average yield of about 194 kg/ha, this average yield was nearly 80 percent lower than that of Northern Region, which was the highest at about 348 kg/ha. The average soybean yield across the study area was 296 kg/ha.

Exhibit 13: Average Yield by Crop and Region (Kilogram per Hectare)
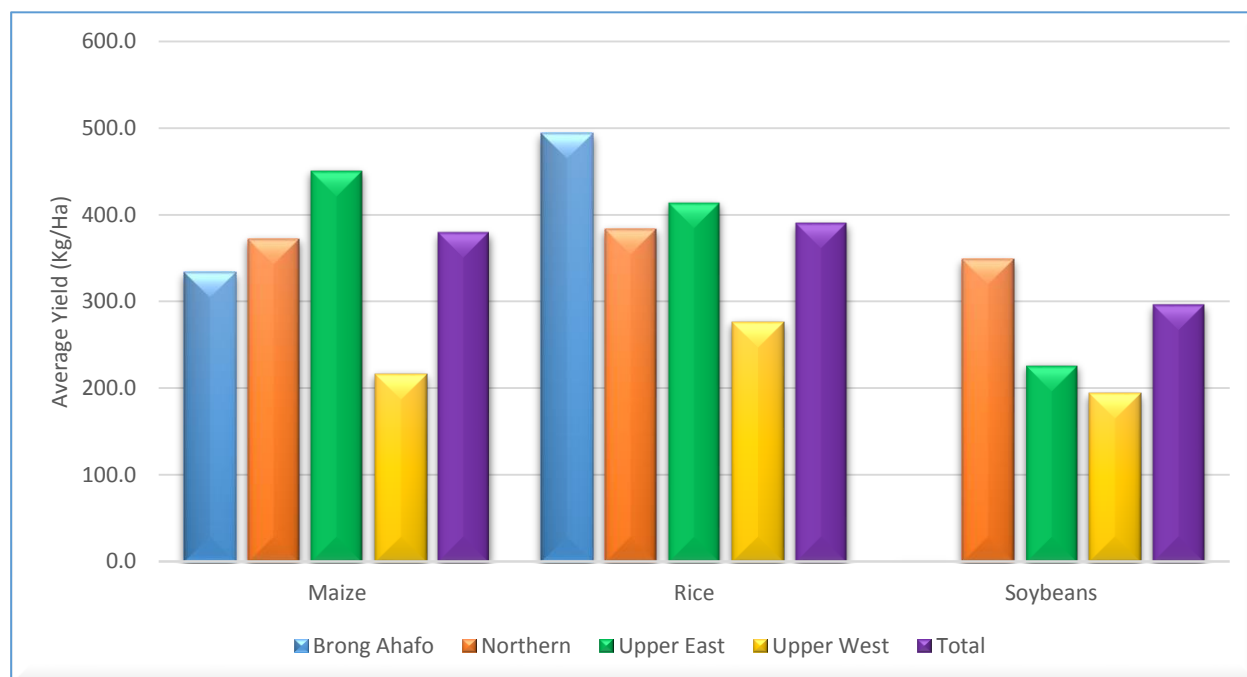
Okomasa maize variety produced a higher average yield (1,022 kg) than Obatanpa (912 kg) even though Obatanpa was the most popular variety in the study area in 2012. Pan 12 had a yield of 1,723 kg in the study area in 2012. The yield for Jasmine rice was about 964 kg compared to Nerica's of 1,034 kg. However, there was no statistical difference between the yields of these two varieties in the study area in 2012. The yield for soybean variety Salintuya 1 was 1,077 kg compared to varieties Anidaso and

Jenguma whose average yield in the study area was respectively 809 kg and 700 kg. Obviously, some farmers are choosing certain seed varieties for reasons beyond yield. Understanding why farmers choose the varieties they plant and where yield sits in their decision framework would be helpful in opening effective communications with upstream stakeholders such as seed breeders and downstream market stakeholders such as traders and consumers to enhance farmer performance through development and supply of appropriate technologies and facilitation of the right markets.

Crop Uses in 2012

A farmer's production may be sold, consumed or given away as gifts. For the three focus crops, Exhibit 14 shows that the average 2012 quantity of maize production consumed by households is about 508 kg compared to only 60 kg of soybeans. Cassava, not shown in the exhibit, is the only crop, after yam and maize, with a larger consumption quantity, about 305 kg. The importance of maize in the study area is reflected by the fact that households gave an average of about 109 kg away as gifts, nearly twice as much as the quantity of rice given away as gifts.

Exhibit 14: Average Quantity of Maize, Rice and Soybeans Sold, Consumed or Gifted in Kilograms
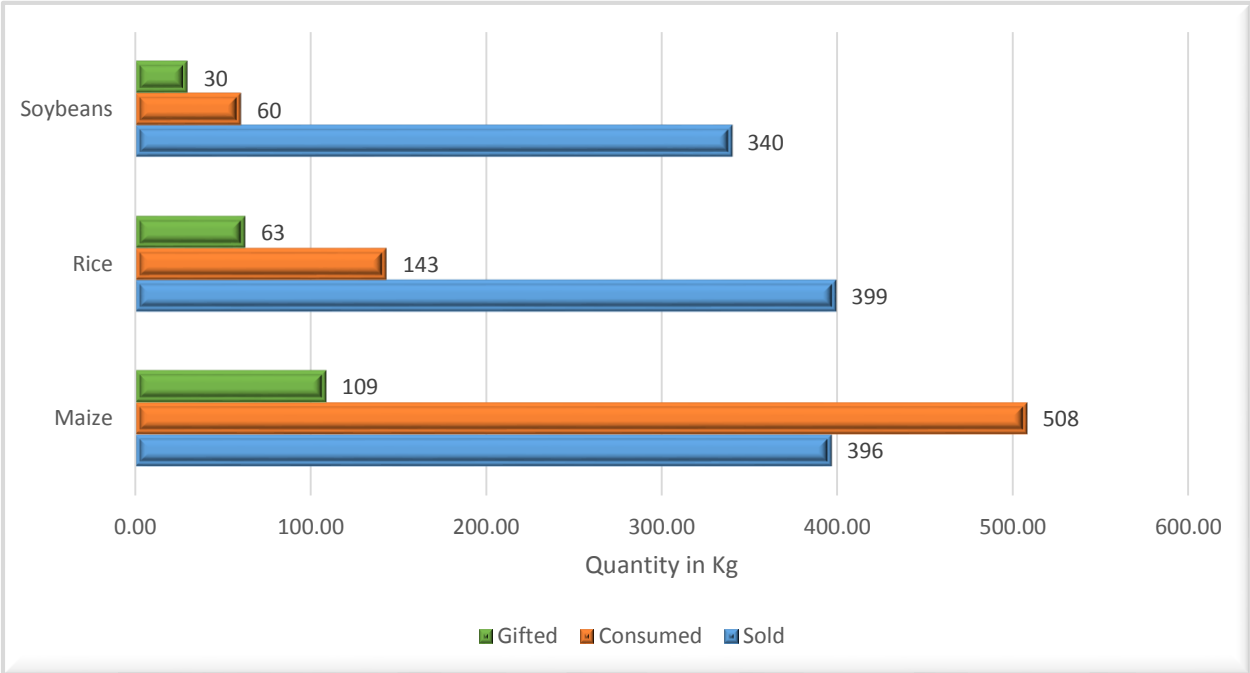
Farmers were asked to provide an estimate of their 2012 production still in storage during the 2013 production year. The average quantity of yams still in storage was approximately 239 kg compared to about 108 kg for maize, 32 kg for rice and 31 kg for soybeans. The amount in storage was equivalent to about 3 percent of total yam output, 10 percent of total maize output, 5 percent of total rice output and 6 percent of total soybean output. Therefore, storage quantities are relatively small. Farmers' ability to store is very important in risk management, but it is a function of the storability of the crop, farmers' accessibility to storage facilities and of their perceptions about the direction of future prices. Their willingness to use storage is, however, not independent of the cash needs situation confronting them at any time.

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Farmers were also asked to provide an estimate of their production that was used for other things apart from being sold, consumed, gifted, or stored. This would include production that was used as seed or feed, for example. On average, about 30 kg of maize went to these other uses, compared with 20 kg of rice and 12 kg of soybeans. They were, thus, very small proportions of total production, between zero percent for peppers and 6 percent for sorghum.

The commercial status of the crop is determined by the proportion of the crop that is sold (Exhibit 15). Cotton, for example, is a commercial crop in the region because farmers did not keep any of their production for their own use or give any away as gifts: everything is sold.[6] Similarly, an average of about 90 percent of yam production is sold compared to 9 percent being held back for home consumption. Although farmers, on average, gave about 5 percent of their pepper output away as gift, they sold nearly 90 percent of it. The foregoing would suggest that these crops had high commercial roles for farmers in the study area. Exhibit 15 shows the ranking of all crops respondents indicated planting by their commercial status. The least commercial crop in the study area in 2012 was cowpeas, with 55 percent being consumed, 9 percent being given away as gifts and only about 35 percent being sold.

Exhibit 15: Ranking of All Crops by their Commercial Status
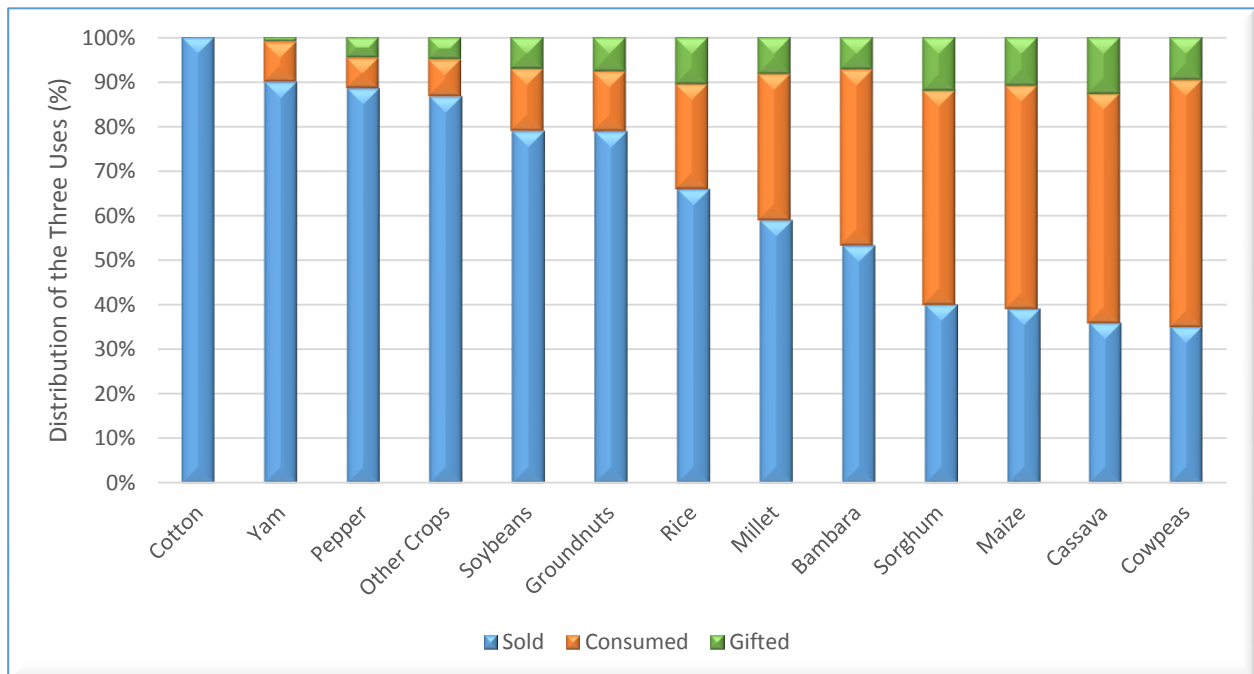
Soybeans and rice are the most commercial of the three program crops. This observation is not surprising because of soybeans' relatively new role in the study area's crop enterprise mix and the relative lack of traditional food recipes for its use compared to rice and maize. Yet, nutrition awareness programs are providing increasing opportunities for soybeans to be included in human diet, especially that of infants and children. Likewise, investments in livestock production may contribute to increasing commercial status for soybeans over time.

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6   Recall from above that only two out of the more than 1,100 plots in the study area were allocated to cotton and their average size was approximately 0.41 ha.

Crop Marketing Activities in 2012

Farmers selling their farm output had four principal channels to market: at the farm gate; in the village market; at a market in another community; and at a market in a district other than the farmer's own district. The market channel used may be determined by the plot location and size, prior relationships with downstream partners or some non-pecuniary objective. We estimated that about 29 percent of households did not participate in the market in 2012 – i.e., wholly subsistence. Exhibit 16 shows that the majority (41 percent) of those who engaged in some marketing activities sold product at the farm gate. Another 28 percent sold at their village market, 24 percent used markets in other communities and 7 percent sold their products in a district other than their own. The average household land holding of farmers selling at the farm gate was 1.5 ha compared to 0.9 ha for those selling in the village market and 1.1 ha for those selling in another district. The average household land holding of farmers selling at the farm gate was statistically different from those using the other channels. The average yield of those selling in another district was the highest – approximately 1,107 kg/ha – but it was not statistically different from the average yield of those using other channels, including that of those who sold at farm gate (1,043 kg/ha) and those who sold in their village market (835 kg/ha), which was the lowest average yield by marketing channel.

Exhibit 16: Household Choice of Market Channels (N = 372)
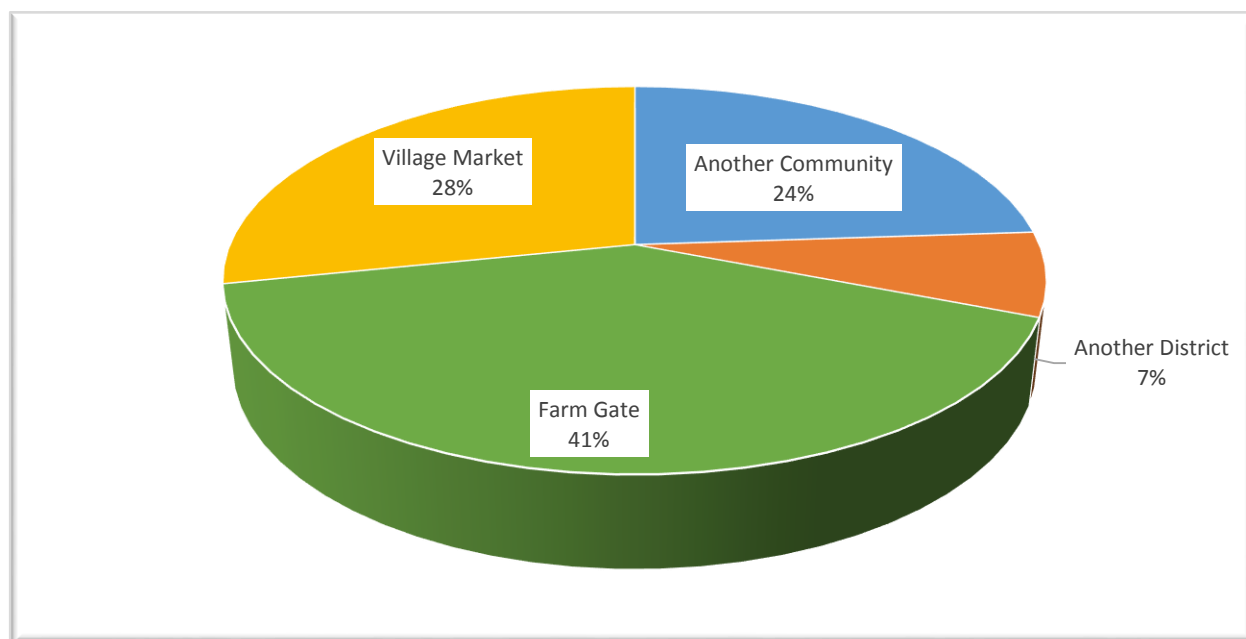
The distribution of marketing participating households by region provides an indication of the infrastructure availability in these regions. For example, the higher the proportion of farmers choosing to sell their produce in another community, the higher the likelihood that they do not have effective market and accessibility infrastructure to support sales in their own communities. Of course, there are transaction costs, such as transportation, security, time, etc. associated with selling outside one's farm gate or local community market. Lack of market and accessibility infrastructure, such as good roads, may make choosing channels other than farm gate and local community market more economical. Therefore, there is a need for a deeper evaluation of infrastructure supporting marketing and market participation by smallholder producers if they are going to successfully alter the existing perceived

adverse supply chain relations they face. Exhibit 17 shows that Upper East Region may lack the most market infrastructure given that about 65 percent of farmers chose to use channels other than farm gate or village market. Northern Region may have the most market-supporting infrastructures because about 83 percent of farmers in that region sold at the farm gate or in their village market.

Exhibit 17: Distribution of Market Channels by Region
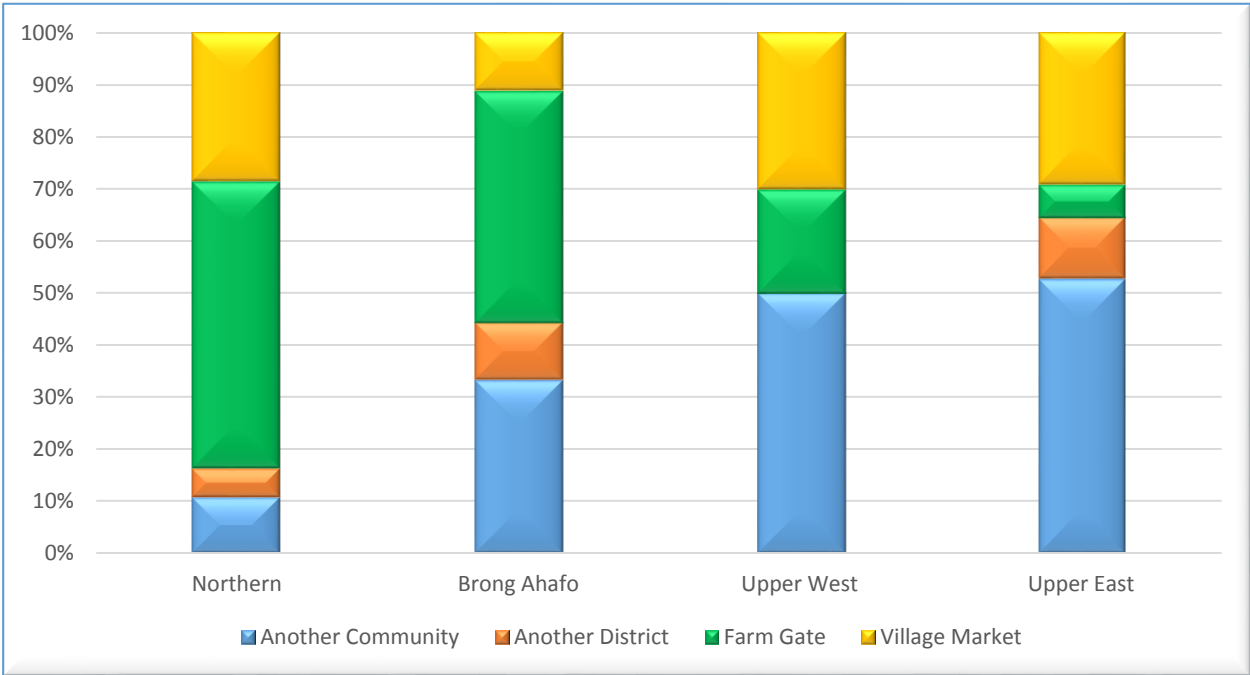
Agricultural Production Activities in 2013

Unlike the results from the 2012 production activities presented above, which asked respondents to provide information on all their crop production activities, information about 2013 focused specifically on the three focus crops – maize, rice and soybeans. About 24 percent of plots (356) in 2012 were not included in the 2013 plots, probably because of the restricted crop focus. This would suggest that compared to 2012, where about 69 percent of plots were allocated to the three focus crops, nearly 76 percent of plots were allocated to focus crops in 2013, accounting for 1,114 of the original 1,470 plots.[7] About 58 percent of the plots (641) were planted to maize while approximately 16 percent and a little over 26 percent was planted to soybeans and rice respectively.

Commercial Intention for Focus Crops and Planted Area

It makes sense to assume that commercial intention affects producer behavior. Producers' commercial intention influence enterprise selection and resources acquisition, allocation and utilization. In the light of the foregoing, respondents were asked to indicate whether they planted focus crops for commercial purposes in 2013. Exhibit 18 shows that only 21 percent of the 641 plots planted to maize were for commercial purposes. On the other hand, 74 percent of soybean's 177 plots and more than 58 percent of the 292 plots allocated to rice were for commercial purposes. Thus, maize presented the lowest commercial motivation for production. This is not unexpected given that maize is a major staple food crop for the majority of the people in the study area. The cash opportunity presented by soybeans, a relatively new crop in the study area, presents a potential of enhancing respondents' incomes and providing a market risk management solution to producers who have for many years been dependent essentially on rice as their principal storable commodity.

Exhibit 18: Proportion of Plots Allocated to Commercial Production by Crop
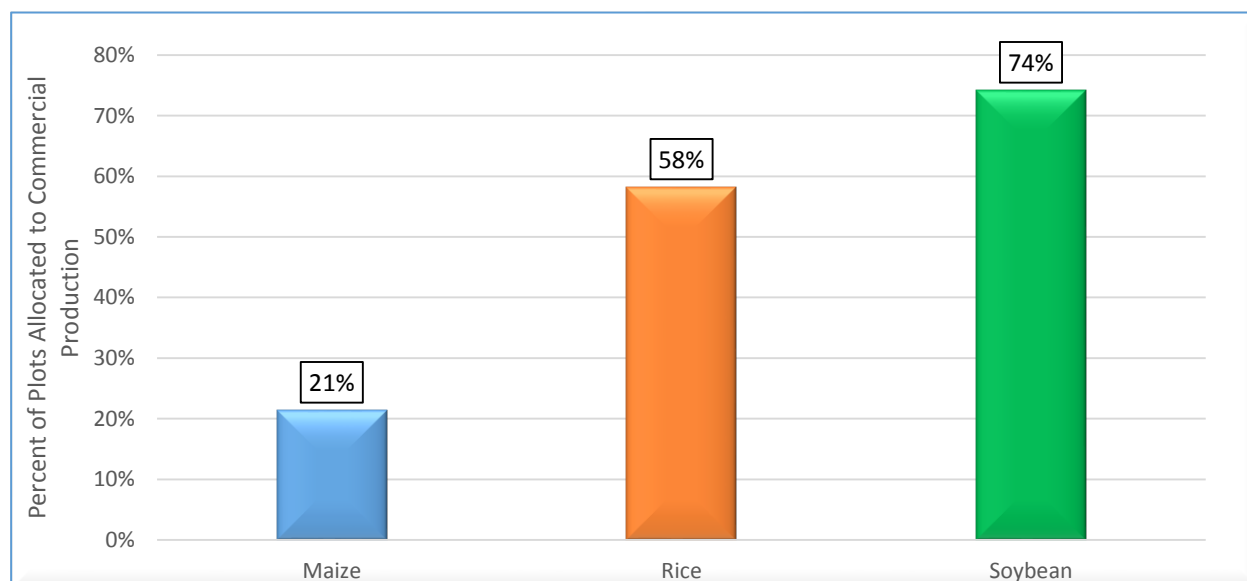
Average plot size in 2013 was about 0.9 ha, about 17 percent smaller than the average plot size in 2012 (Exhibit 19). On average, the average maize plot size was about 1.1 ha across the study area in 2013

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[7]   We are assuming that plots were not taken out of agriculture between 2012 and 2013.

compared to 1.3 ha in 2012, a 20 percent decrease. Rice and soybean had average plot sizes of 0.6 ha and about 0.8 ha respectively in 2013, lower by 27 percent and 2 percent respectively from 2012 average area. However, there was no statistical differences between the plot sizes between the two years for rice and soybean, but the difference for maize was statistically significant at the 1 percent level. Likewise, the difference in the overall (total) average plot size between the two years was also statistically significant at the 1 percent level.

Exhibit 19: Average Plot Area by Crop and Year in Hectares
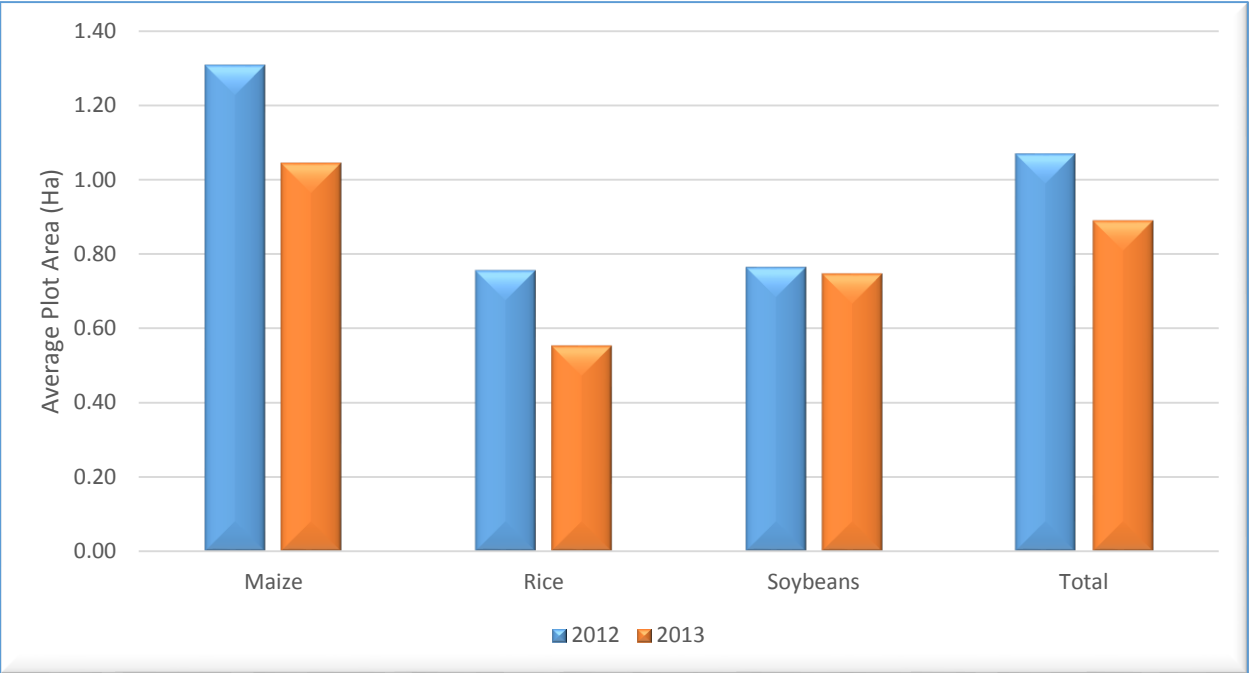
We found a positive correlation between plot sizes and commercial intention for focus crops. For example, the correlation coefficients for rice and soybeans, while relatively low at 0.25 and 0.17, were respectively statistically significant at the 1 percent level and the 5 percent level. This is to be expected since the intention to produce for commercial purposes would demand a focus on producing more, and holding all things constant, demand a higher proportion of farmland. The correlation coefficient between commercial intention and the allocated area for maize was 0.07. It was not statistically significant.

Exhibit 20 shows the proportion of plots in each of the plot size region and crop. We found that the proportion of maize plots across the study area under 1 ha increased from about 52 percent in 2012 to almost 78 percent in 2013. There was about a 10-percentage point increase in the share of plots smaller than 1 ha allocated to rice production in 2013 compared to 2012. Exhibit 20 shows that this was due principally to the increases in Northern Region, with the share of plots that were the less than 1 ha rising from 61 percent to almost 84 percent. Soybeans did not exhibit many differences between the two years. However, the share of plots under 1 ha decreased slightly while that of plots between 2 ha and 4 ha increased by about 2 percent. The foregoing support the earlier observation that the proportion of total land area allocated to the focus crops increased.

Exhibit 20: Distribution of Plots in 2013 by Average Plot Size, Crop and Region in Percent

Area Range	Brong Ahafo	Northern	Upper East	Upper West	Total
Maize					
Under 1 ha	80.0	70.4	93.5	84.1	77.6
1 ha - 1.99 ha	10.0	22.4	4.7	13.6	17.0
2 ha - 3.99 ha	10.0	5.7	1.8	2.3	4.5
4 ha or Larger	0.0	1.4	0.0	0.0	0.9
Total	100	100	100	100	100
Rice					
Under 1 ha	45.5	83.6	97.0	90.3	87.4
1 ha - 1.99 ha	45.5	11.2	3.0	9.7	9.5
2 ha - 3.99 ha	9.1	5.3	0.0	0.0	3.1
4 ha or Larger	0.0	0.0	0.0	0.0	0.0
Total	100	100	100	100	100
Soybean					
Under 1 ha		75.9	100	100	80.9
1 ha - 1.99 ha		15.6	0	0	12.4
2 ha - 3.99 ha		7.1	0	0	5.6
4 ha or Larger		1.4	0	0	1.1
Total		100	100	100	100

Crop Output and Yield in 2013

Reported crop output across the study area varied broadly among the focus crops. This is not surprising given the wide variation in plot sizes. For example, maize output ranged from about 23 kg to 9,000 kg while rice output ranged from 5 kg to 16,800 kg.[8] Soybean output, on the other hand, ranged from 5 kg to only 1,500 kg in 2013. Although there are "outliers" in the data, there is no reason to believe they are erroneous and are, therefore, included in the analyses. To help the reader appreciate their effect on the measures of central tendency presented in this report, the Kernel density graphs for output of the three focus crop are presented (Exhibit 21; Exhibit 22; and Exhibit 23).

Across the study area in 2013, the average reported output for maize was about 670 kg, 444 kg for rice and almost 412 kg for soybeans. The respective standard deviations were approximately 532 kg, 411 kg and 321 kg. The wide ranges are no surprise given the structure of farmers' land and production intentions. However, the consolidated output from household land holdings is what is ultimately of interest in this analysis. We discuss that later in this section.

We provide an illustration of the effect of the foregoing distribution by dividing crop output into seven categories – with under 150 kg at the one end and over 900 kg on the other end. Exhibit 24 shows that nearly 26 percent of maize farmers were in the 900-plus kg category compared to about 14 percent and 11 percent for rice and soybean farmers respectively. On the other hand, only about 10 percent of maize farmers were in the less than 150 kg category, compared to about 25 percent and 24 percent of rice and soybean farmers respectively. The figure shows about 35 percent of maize farmers reported producing 750 kg or more in 2013 compared to 25 percent and about 17 percent for rice and soybeans.

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[8] Plots with zero output are assumed not to have been used for the production of the crop under consideration.

The foregoing distribution suggests that we exercise care in using the estimated means for performance tracking if the makeup of the sample changes over time. This is because the "outliers" can have significant impact on the estimated means and dropping them from the sample in future can present false outcomes.

Exhibit 21: Maize Output Kernel Density

kernel = epanechnikov, bandwidth = 96.4840
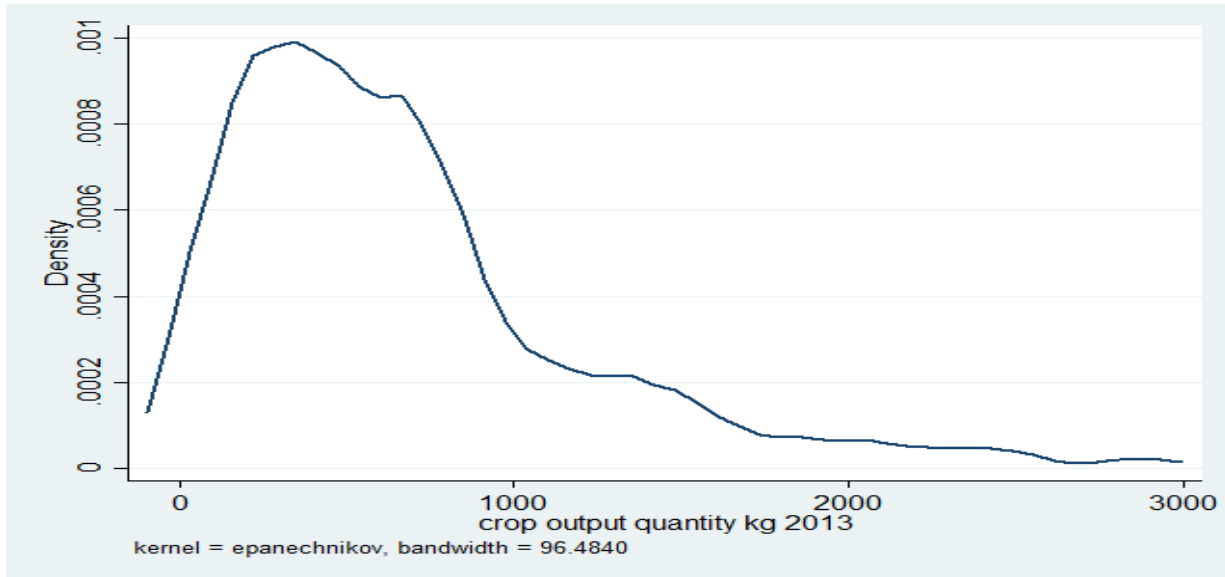
Exhibit 22: Rice Output Kernel Density

kernel = epanechnikov, bandwidth = 105.8506
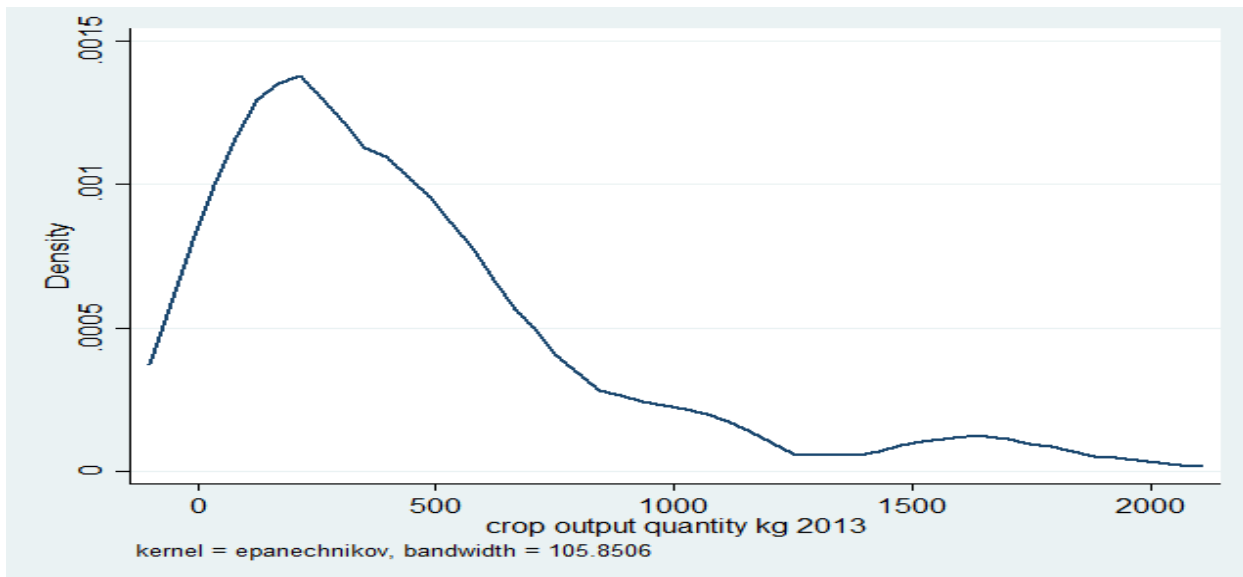
Exhibit 23: Soybean Output Kernel Density
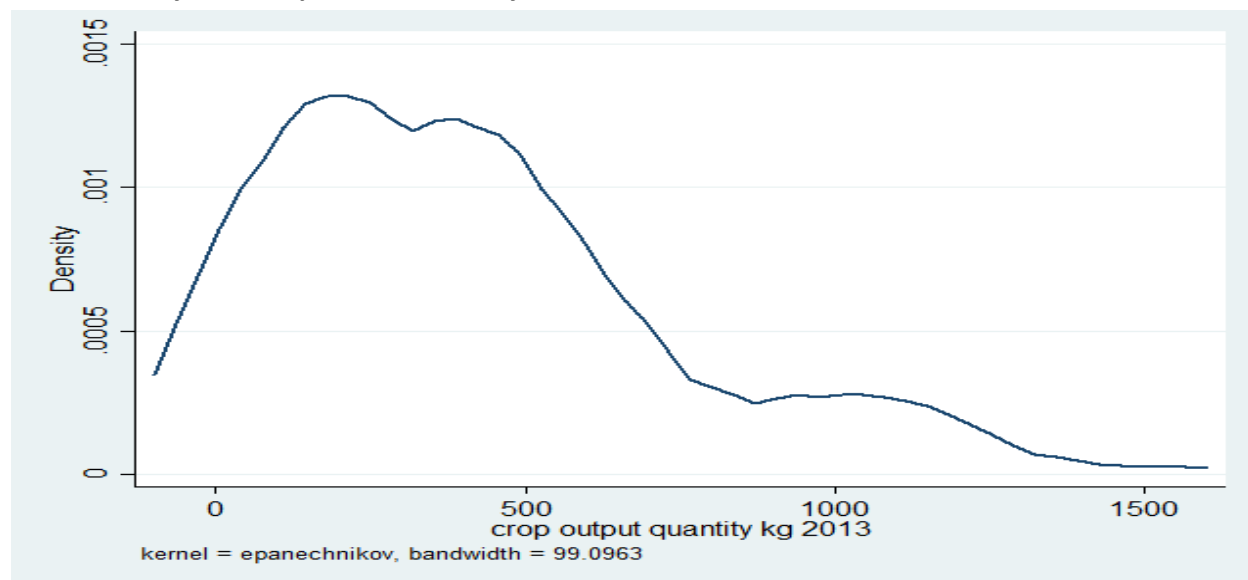
Yield provides a standard for assessing the productive use of land for each of the crops. It is defined as crop output from each parcel of land divided by the area of that parcel of land. It is assumed that zero yield was equivalent to failed production. As such, we dropped them from the analysis since there was no information on why the failure occurred. On this basis, the mean yield for maize was about 945 kg/ha in 2013, with a standard deviation of approximately 1,122 kg/ha. For rice and soybeans, the average yield was respectively 977 kg/ha and 756 kg/ha (Exhibit 25). The standard deviations were almost as large as the means, 934 kg/ha and 715 kg/ha respectively. These were equivalent to more than doubling the 2012 yields for these crops. Average maize yield in Upper East Region was estimated at about 1,177 kg/ha compared to 897 kg/ha in Northern Region and about 617 kg/ha and 577 kg/ha in Brong Ahafo and Upper West respectively. Compared to 2012, average maize yield in Brong Ahafo declined by about 15 percent and increased in Upper West by close to 167 percent, in Upper East by about 160 percent and in Northern Region by a little under 139 percent. Average rice yield in Brong Ahafo Region was estimated at about 1,481 kg/ha in 2013 compared to 1,014 kg/ha in Upper East Region and about 909 kg/ha and 641 kg/ha in Northern and Upper West respectively. Average rice yield nearly doubled in Brong Ahafo Region between 2012 and 2013 and increased by 137 percent, 145 percent and 132 percent in Northern Region, Upper East Region and Upper West Region respectively. Average soybean yield in Upper East Region was approximately 887 kg/ha in 2013, about 290 percent increase from 2012. Upper West Region's average soybean yield in 2013 was about 549 kg/ha, and although the lowest among the three soybean growing regions, experienced about 183 percent increase compared to 2012.[9] Northern Region's average soybean yield was about 711 kg/ha in 2013, more than double what was obtained in 2012.

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[9]   Please note that there was only one respondent producing soybeans in Upper West Region.

Exhibit 24: Distribution of Output by Crop
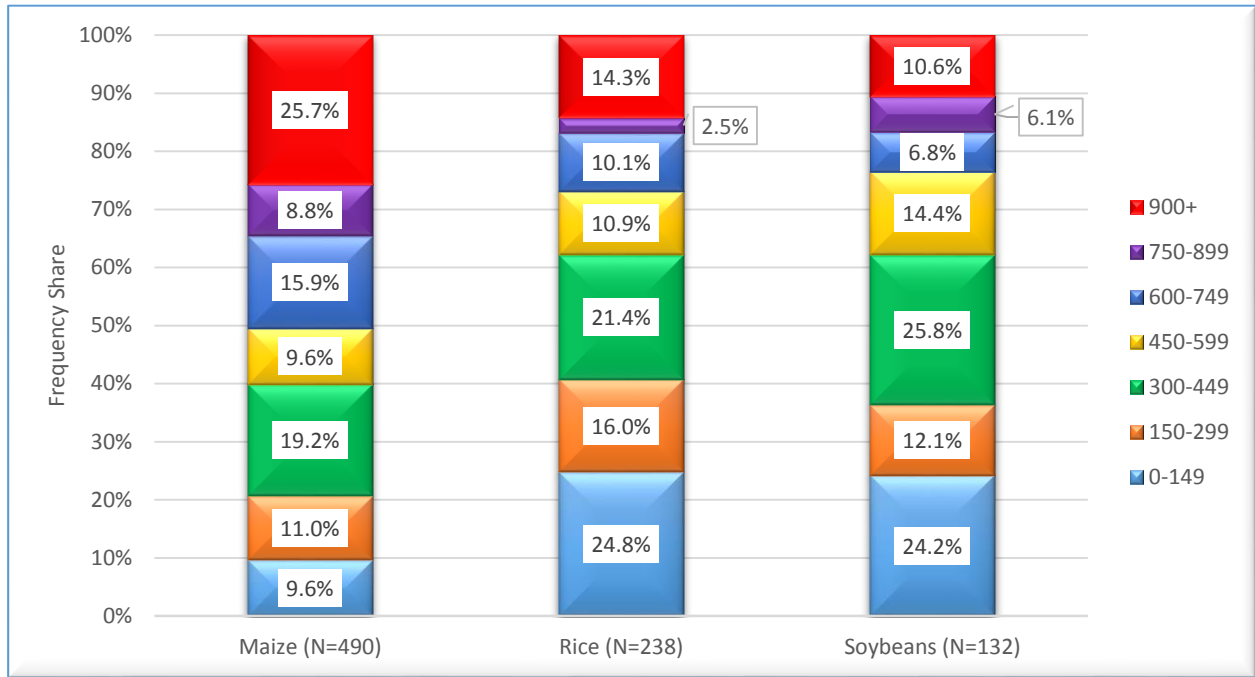
Exhibit 25: Average Yield by Crop and Region in 2013 in Kilograms per Hectare
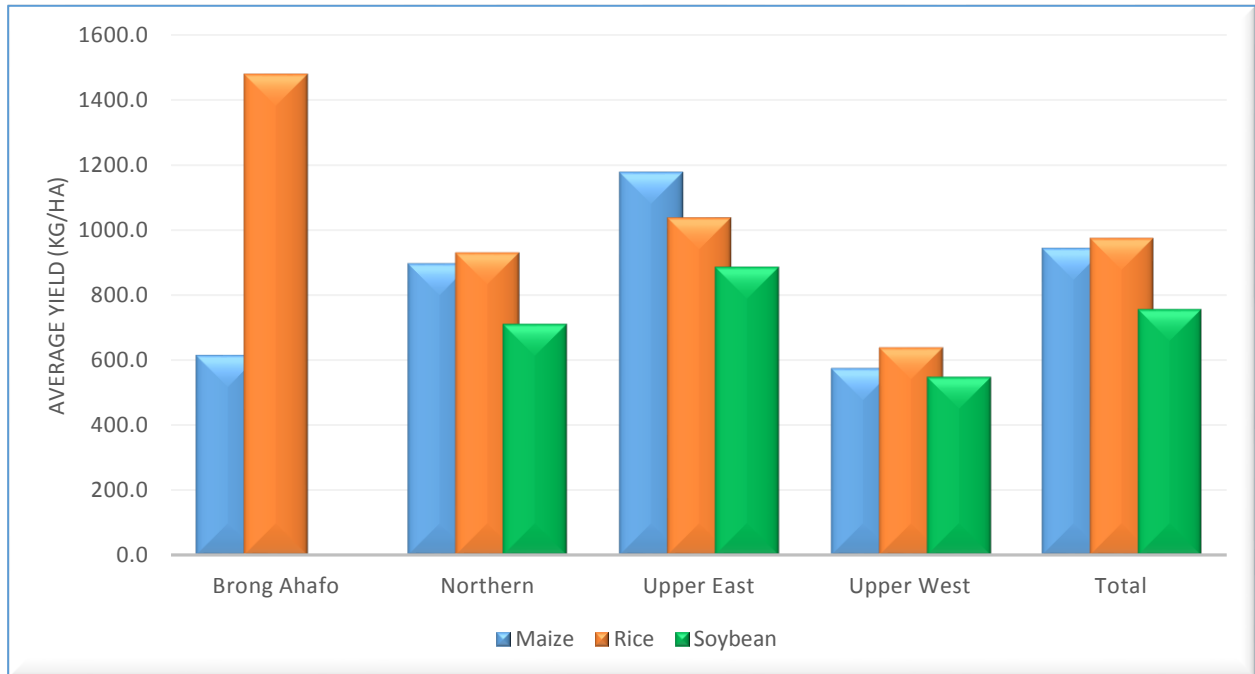
Varieties and Seed Types in 2013

As seen in 2012, Obatanpa remained the dominant maize variety planted, accounting for just under 76 percent while Okomasa remained in the second position with under 12 percent of the 642 plots. Local variety was about 4 percent while Mamaba accounted for about 2 percent of plots. The remaining varieties were all about 1 percent of smaller. The average area planted to Obatanpa was about 0.8 ha compared to over 0.9 ha for Okomasa. It is important to note that for plot areas 4 ha or more, the variety of choice was Obatanpa. Panar, while accounting for under 1 percent of total maize plots, had an average planted area of almost 1.4 ha, the largest among all the varieties.

For rice, Jasmine, while still the dominant named variety, dropped from 23 percent of the plots in 2012 to 21 percent in 2013 while Nerica increased to nearly 18 percent from its 2012 share of 14 percent. The average planted area to Jasmine and Nerica was 0.6 ha and about 0.7 ha. They were not statistically different. Molga lost about a point in 2013, accounting for 12 percent of rice plots while local variety accounted for about 11 percent. The average planted area to Molga was just above 0.3 ha. GR18 was the rice variety with the highest planted area of 0.7 ha in 2013. However, it was planted on only 13 of the 294 plots.

The order at the top for soybeans was reversed in 2013 compared to 2012, with Jenguma accounting for 84 of the 178 soybean plots (about 47 percent) and Anidaso coming in at just under 36 percent. Thus, while Jenguma gained nearly 7 percentage points, Anidaso lost about 10 points. Local variety's share increased from under 0.5 percent of plots in 2012 to more than 2 percent in 2013 and the share. The average area planted to Jenguma was about three-quarters of a hectare compared to approximately 0.6 ha for Anidaso. Jenguma was the variety choice of those with average plot area of 4 ha or more. The average planted area for local variety was over 1 ha. The distribution of the top two seed varieties for each of the focus crops by the plot size is presented in Exhibit 26. It summarizes the foregoing information on how different size operators are choosing their varieties.

Exhibit 26: Distribution of Top-2 Seed Varieties by Focus Crop and Size of Planted Area
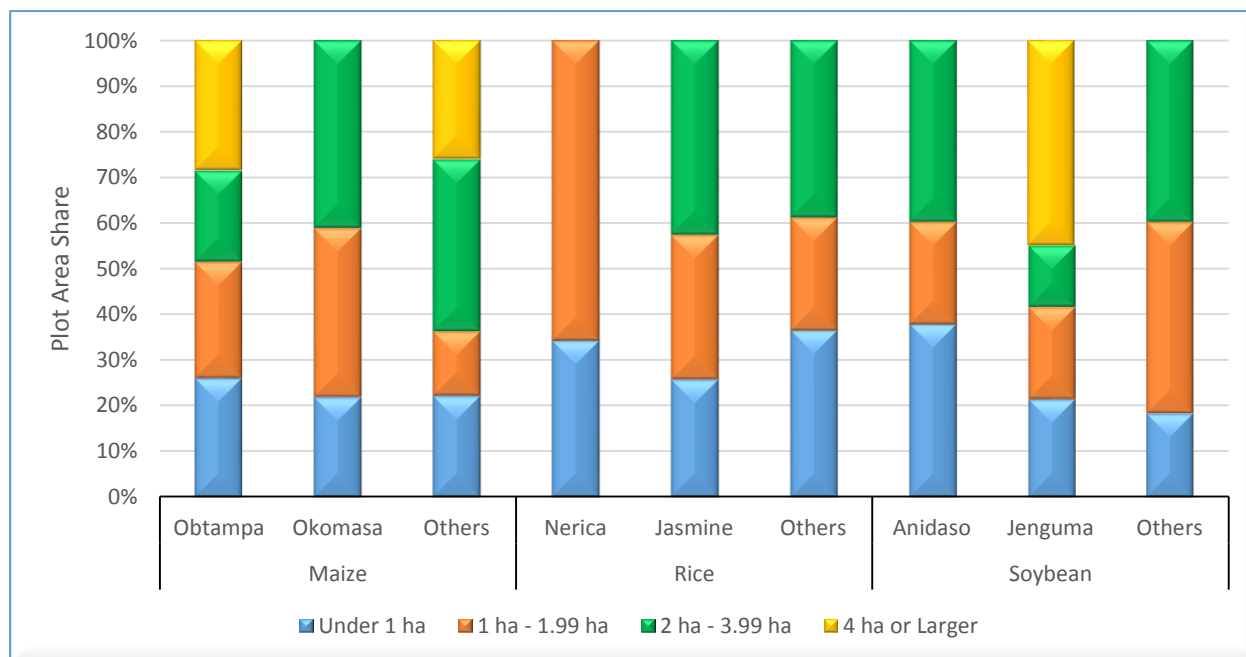
There are different types of seeds in each of these varieties that were planted in 2013. Exhibit 27 shows that the most popular seed type by far is retained open pollinated variety (OPV). Thus, retained OPV was used on about 62 percent of the 1,111 plots for which responses were received while improved OPV seeds were used on only 15 percent of these plots. While 20 percent of plots were treated to traditional seeds, only 3 percent of them were treated to hybrid seeds. Exhibit 28 shows that 66 percent of maize plots were planted to retained OPV seeds compared to 53 percent for rice. However, while 21 percent soybeans plots were planted to improved OPV seeds, only 13 percent and 14 percent of rice and maize plots were planted to improved OPV seeds. Contrarily, 31 percent of rice plots were planted to traditional seeds compared 16 percent and 15 percent of maize and soybean plots.

The dominant seed type in all the regions was retained OPV seeds (Exhibit 29). More than 70 percent of plots in Brong Ahafo Region compared to about 55 percent of plots in Upper East and Upper West receive these seeds. Upper West is the dominant user of traditional seeds: 40 percent of its plots compared to 10 percent of Brong Ahafo's plots and 14 percent of Northern Region's plots. Based on the sample, Northern Region is the most popular user of hybrid seeds, allocating 4 percent of its plots to it compared to only 1 percent in Upper West Region.

Exhibit 27: Distribution of Plots by Seed Types Used by Respondents (N = 1,114)
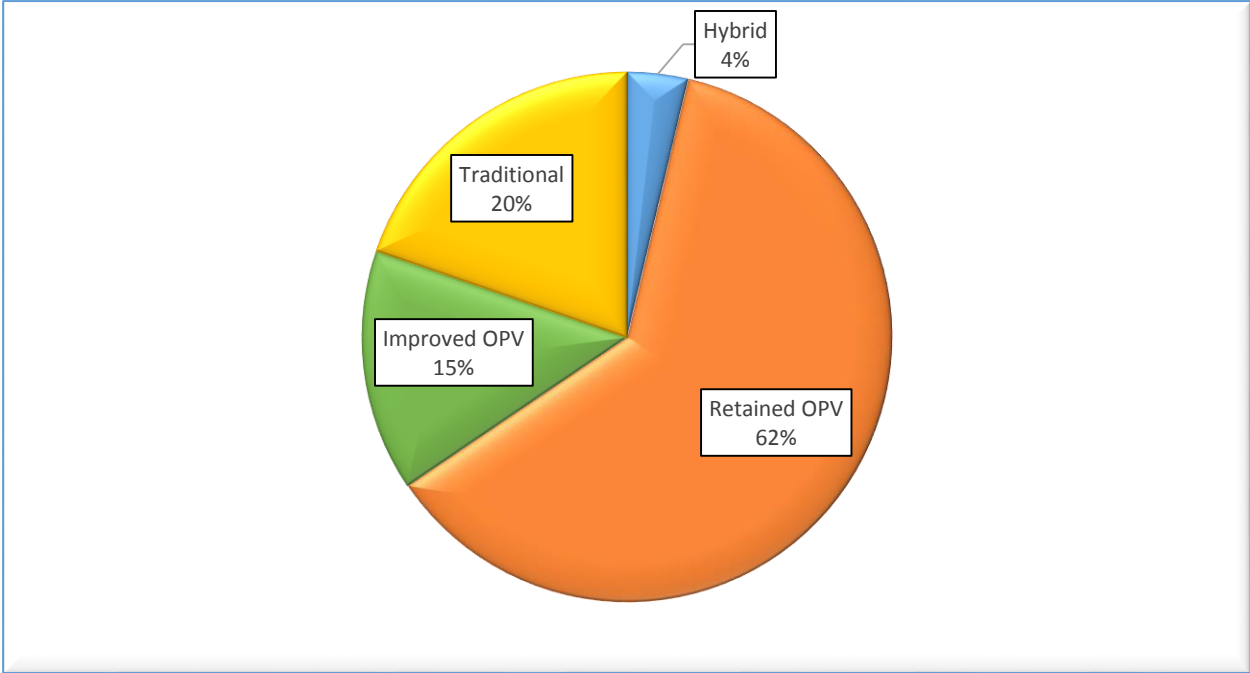
Exhibit 28: Distribution of Plots by Type of Seed by Crop

Type of seed	Maize	Rice	Soybean	Total
Hybrid seeds	4%	3%	3%	4%
Retained OPV seeds	66%	53%	61%	62%
Improved OPV seeds	14%	13%	21%	15%
Traditional seeds	16%	31%	15%	20%
Total (N)	642	294	178	1,114

Exhibit 29: Distribution of Plots by Type of Seed by Region

Type of seed	Brong	Northern	Upper East	Upper West	Total
Hybrid seeds	0%	4%	3%	1%	4%
Retained OPV seeds	71%	65%	55%	55%	62%
Improved OPV seeds	19%	16%	14%	4%	15%
Traditional seeds	10%	14%	28%	40%	20%
Total	100%	100%	100%	100%	100%

It would be expected that the production objective would influence selection of seed types used on different plots. Exhibit 30 shows that the differences between commercial and non-commercial plots based on the type of seed planted was negligible in the study area. For example, while 66% of commercial plots were treated to improved OPV seeds, 59% of non-commercial plots were treated to the same type of seeds. Where we see an obvious difference is in the use of traditional seeds: while only 16% of commercial plots were treated with this type of seeds, 22% of non-commercial plots received traditional seeds. Although the difference is not statistically different, it is interesting to note that 4% of non-commercial plots received hybrid seeds compared to 3% of commercial plots.

Exhibit 30: Distribution of Plots by Seed Type by Commercial Production Intention

Type of seed	Commercial	Non-Commercial	Total
Hybrid seeds	3%	4%	4%
Retained OPV seeds	66%	59%	62%
Improved OPV seeds	14%	15%	15%
Traditional seeds	16%	22%	20%
Total	100%	100%	100%

Farmers' seed came from numerous sources – retained seed, purchased from local farmers, certified seed dealers or local market. They may also obtain seeds from Non-Governmental Organizations (NGOs), research stations or government extension agents. By far the most popular source of seed among the farmers in the study area, based on their plots, was extension agents, dominating all other sources for all crops. It accounted for 77 percent of maize plots, 72 percent of rice plots and 55 percent of soybean plots (Exhibit 31). The next most popular source of seeds for all three focus crops was purchases from local markets. Other farmers was the third-most important source of seeds for rice and soybean farmers, accounting for respectively 4 percent of plots. Farmers in the study areas were neither retaining seed for planting nor procuring them from certified seed dealers for the three focus crop in 2013. This may be due to the significant presence of extension support services currently being directed to these farmers because of the focus on the study area for numerous intervention initiatives by both the Government of Ghana and development agencies.

Exhibit 31: Sources of Seed by Focus Crops
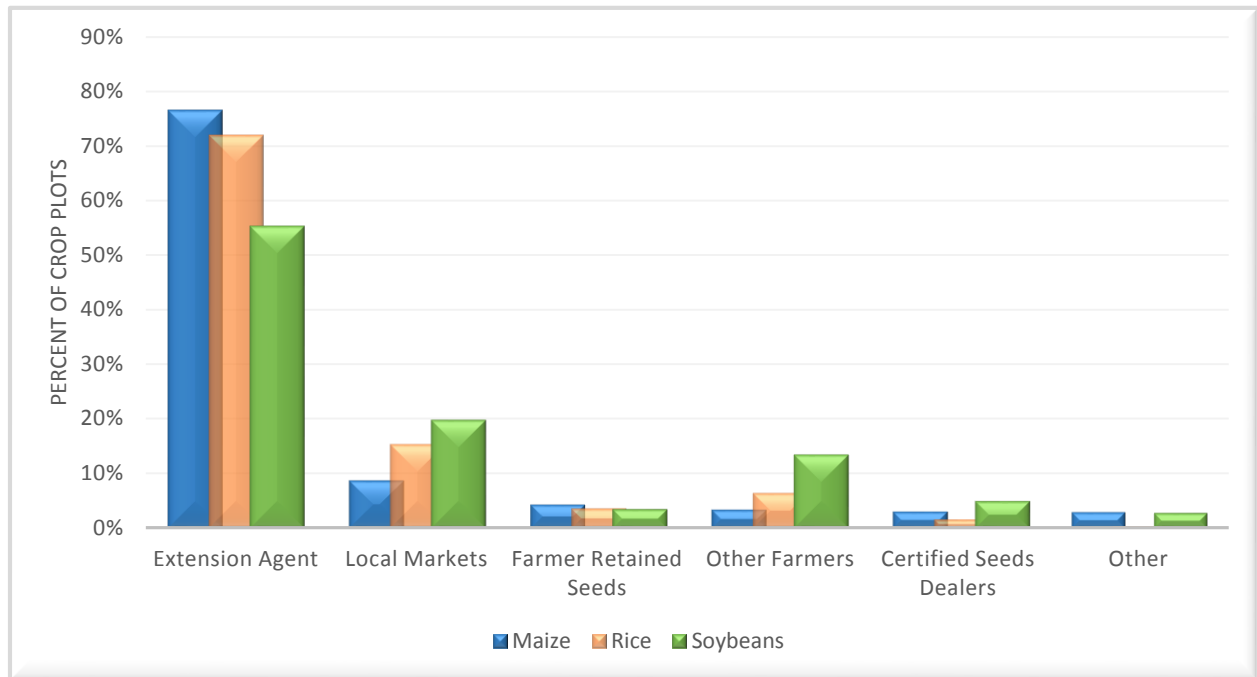
Chemicals and Fertilizer Use in 2013

Herbicides were applied to 499 of the 1,100 plots while insecticides were applied to only five of the plots. Inorganic fertilizer, mainly compound NPK (nitrogen, phosphorus, potassium) fertilizer was applied to about 58% of 1,101 plots. Sulfan was applied to only 2 percent of the plots while human manure, animal manure and local fertilizers each were applied to one plot each. The organic fertilizers (manure) were used only on maize. Of the 15 plots that received sulfan, 13 were rice plots and two were maize plot. Nearly 100 percent of soybean and maize plots, therefore, received compound fertilizers, but only 90 percent of rice plots were treated with compound fertilizers.

On average, maize plots received about 84 kg of fertilizer compared with about 36 kg to rice and only about 6 kg to soybeans. The average quantity of fertilizer applied to soybeans in Upper East Region was 18 kg compared with a little above 2 kg in Northern Region and none in Upper West Region. In addition, while the average fertilizer applied to rice was about 43 kg and 34 kg in Northern Region and Upper East Region, none of the 11 rice farmers in Brong Ahafo or the seven rice farmers in Upper West indicated using any fertilizer on their rice crop in 2013. The foregoing is summarized in Exhibit 32.

Exhibit 32: Average Quantity of Fertilizer Applied on Plots by Crop and Region in Kilogram (2013)
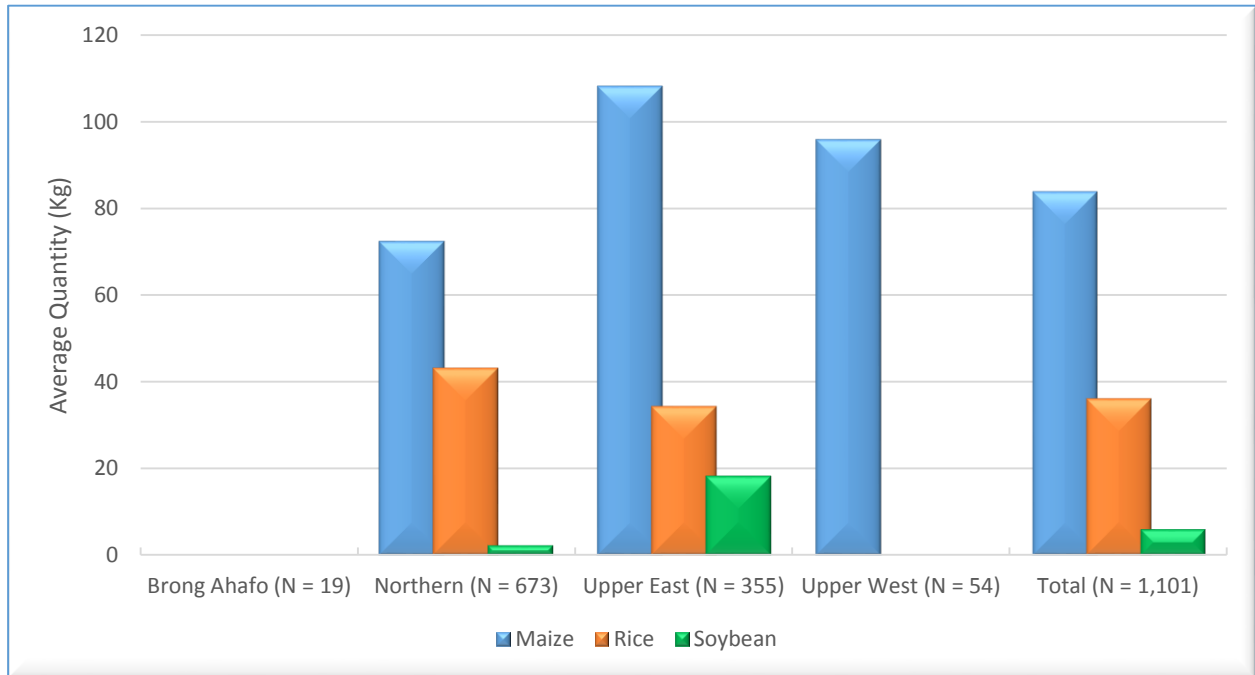
Land Preparation Methods

Three principal land preparation or tillage methods are used by farmers in the study area: tractor, animal and manual. Exhibit 33 shows that they differed across the focus crops. Machine or tractor tillage is most popular on soybean plots, used on about 74 percent of them, but lowest on rice plots, used only on 48 percent. While manual labor in land tillage is used on only a small proportion of plots, it is most popular on rice plots but least popular on soybean. In absolute number of plots on which specific tillage methods were applied, maize dominated in the use of tractor tillage, with 374 plots using this method. Interestingly, maize was also the crop on which manual tillage was used most frequently, with 103 plots using it.

Exhibit 33: Tillage Methods by Focus Crops
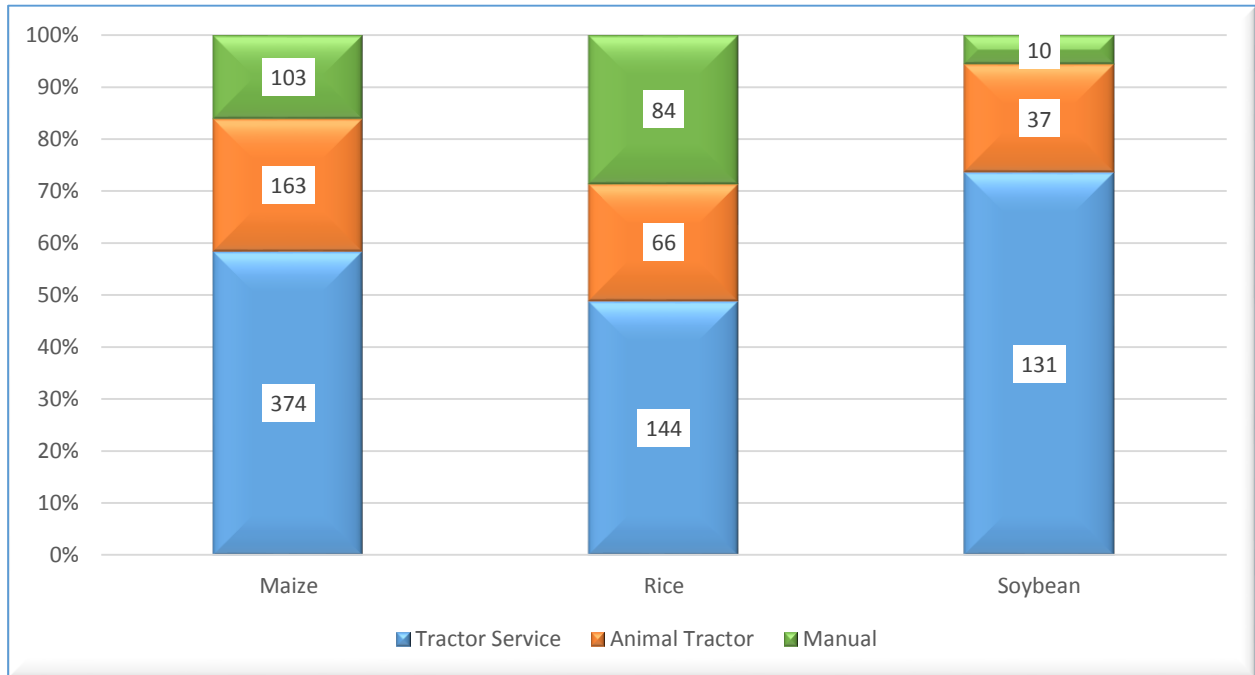
Land Ownership Structure

Exhibit 34 shows that farmers had different tenural arrangements for the land they farmed. While farmers indicated owning the majority of plots (72 percent), a significant proportion was owned by the farmer's family (24 percent). Only 3 percent of plots was owned by the farmer's community. This distribution of control over land is counter to mainstream perceptions about land ownership in Ghana, where the majority of land is thought to be communal-owned. It is important to recognize, though, that outright ownership of land in the study area does not necessarily imply unfettered ability to dispose of that land through sale because of the intense traditional relationship people have with land.

Exhibit 34: Distribution of Plots by Ownership Structure (N = 1,120)
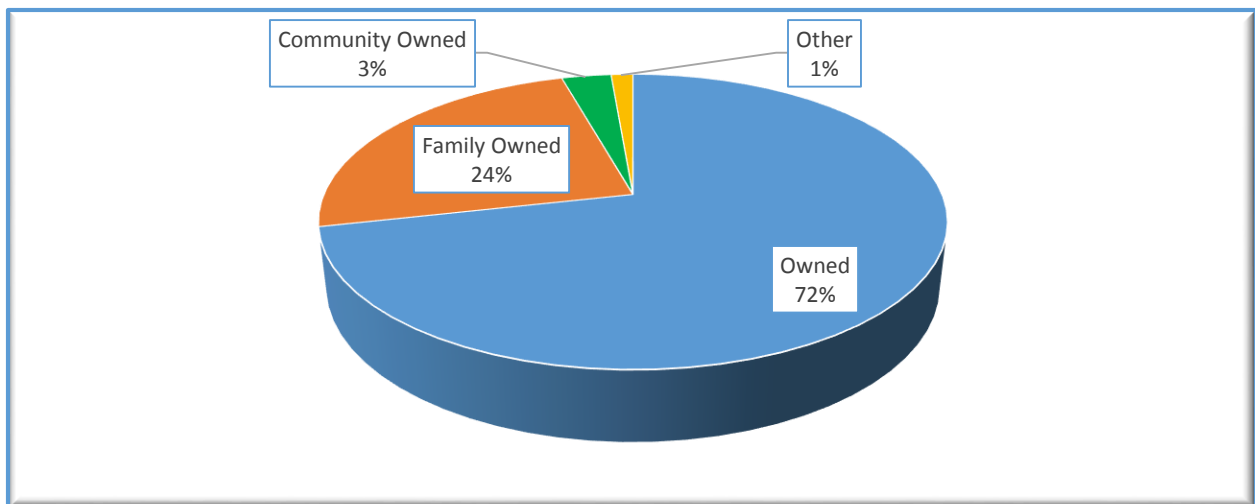
Producer Assets and Support Services

In this chapter, we present the summary information on the assets and support services that farmers cultivating maize, rice and soybeans reported were available to them during 2013. These assets covered production tools. The survey sought to know the number and age of these assets as well as their use.

Producer Assets

Farmers were asked to identify the equipment and other assets they use to support their production activities. Exhibit 35 shows that virtually every one of the 527 respondents owned a cutlass/machete or a hoe. These are basic production implements and necessary for everyday operations on the farm. Assets that are not directly used in production or used as frequently as hoes and cutlasses, such as motor bicycles, pumping machines or shovels, are not as popular. From Exhibit 35, it is observed that there were 493 hoes and 468 cutlasses/machetes across the study area. The third most popular production asset was sickle, with 375 of them across the study area, followed by axe with 334 units across the sample. There were 307 of all other assets, including donkey carts, bicycles, rain coats, shovels, watering cans, etc., across the sample.

Exhibit 35: Distribution of Number of Principal Production Agricultural Assets
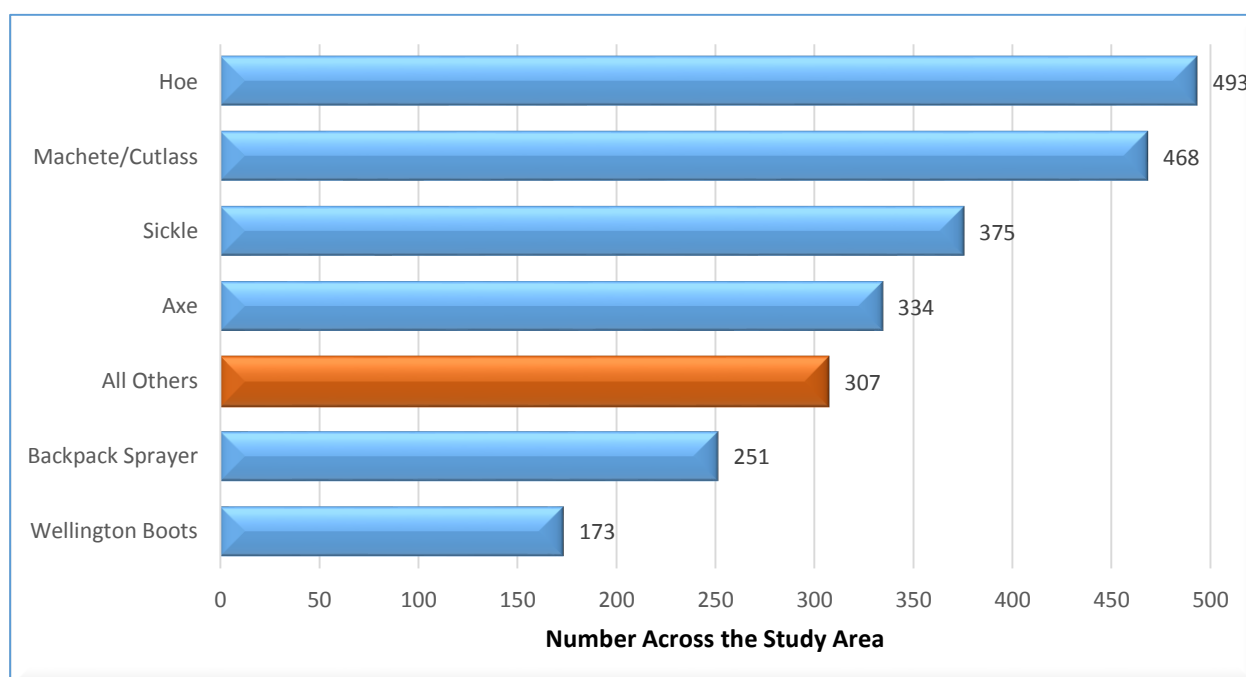
Exhibit 36: Distribution of Age of Principal Farm Production Assets
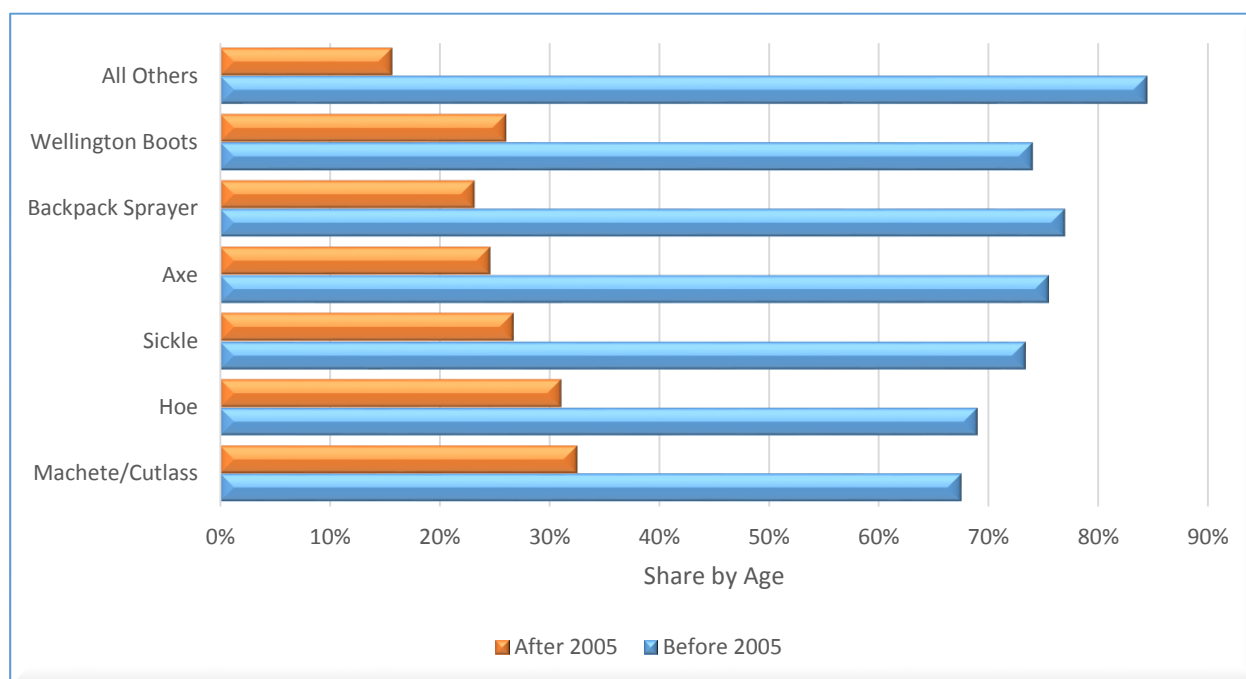
Assets are generally used across all the crops. For example, 404 of 493 respondents used their hoes on all crops compared to eight not using it on any of the focus crops. Similarly, 174 of 334 respondents indicated using their backpack sprayers on all crops compared to 49 saying they did not use them on any of the crops under consideration in the study. The only exception to using a particular asset in the production of all crops is sickle, which is used essentially in the production of rice (Exhibit 37). It is, however, surprising to observe that 42 of the 57 tractors owners indicated that they did not use their tractors in the production of any of these focus crops. This may be due to the size of the plots they have to deal with since tractor use is scale determined. Seven indicated using their tractors in the production of all crops.

Exhibit 37: Crops on Which Specific Assets are Used

Asset	None of the crops	Maize only	Rice only	Soy only	Maize & Soy only	Maize & Rice only	Soy & Rice only	All crops	Total
Machete/Cutlass	23	25	3	1	5	15	30	366	468
Hoe	8	24	0	2	15	13	27	404	493
Sickle	46	2	278	0	0	9	7	34	376
Axe	103	10	12	0	4	6	15	184	334
Backpack Sprayer	49	5	1	0	4	7	11	174	251
Wellington Boots	51	6	1	1	1	2	9	103	174
Tractor	49	0	0	0	0	0	1	7	57

Organizational Support Services

Organizational resources available to farmers in the study area may be grouped into government agencies and organizations, non-governmental organizations (NGOs) and farmer-based organizations. One hundred and sixty-seven respondents indicated receiving some level of support or technical assistance from one or more of these organizations. There were eight unique farmer-based organizations and nine respondents had received some technical assistance from of them. Six government organizations and organizations were identified by the respondents and 108 (approximately 65 percent) of the respondents indicated receiving some technical support from them. The 14 identified NGOs provided service or technical support to 38 of the respondents. The Ministry of Food and Agriculture (MOFA) was identified by about 48 percent of respondents as having provided them with technical assistance.[10] This was far ahead of the Millennium Development Authority (MIDA), which was identified by 15 (about 9 percent) of the qualifying respondents. The Adventist Development and Relief Agency (ADRA) was the third-most identified organization, accounting for about 7 percent of respondents. The foregoing is summarized in Exhibit 38.

Of the 167 people responding to the question whether they are participating in any agricultural production technical assistance training in 2013, about 40 percent indicated in the affirmative. Almost 40 percent of the 66 respondents who indicated participating in training programs said they do so on monthly basis. This contrasts with only four (6 percent) selecting their attendance frequency as annual or weekly and about 8 percent indicating semi-annual attendance. Almost 17 percent of them indicated attending their training program fortnightly. The total number of respondents were evenly split in their response to obtaining agricultural production assistance through electronic media.

Exhibit 38: Sources of Technical Support Identified by Respondents (N = 167)

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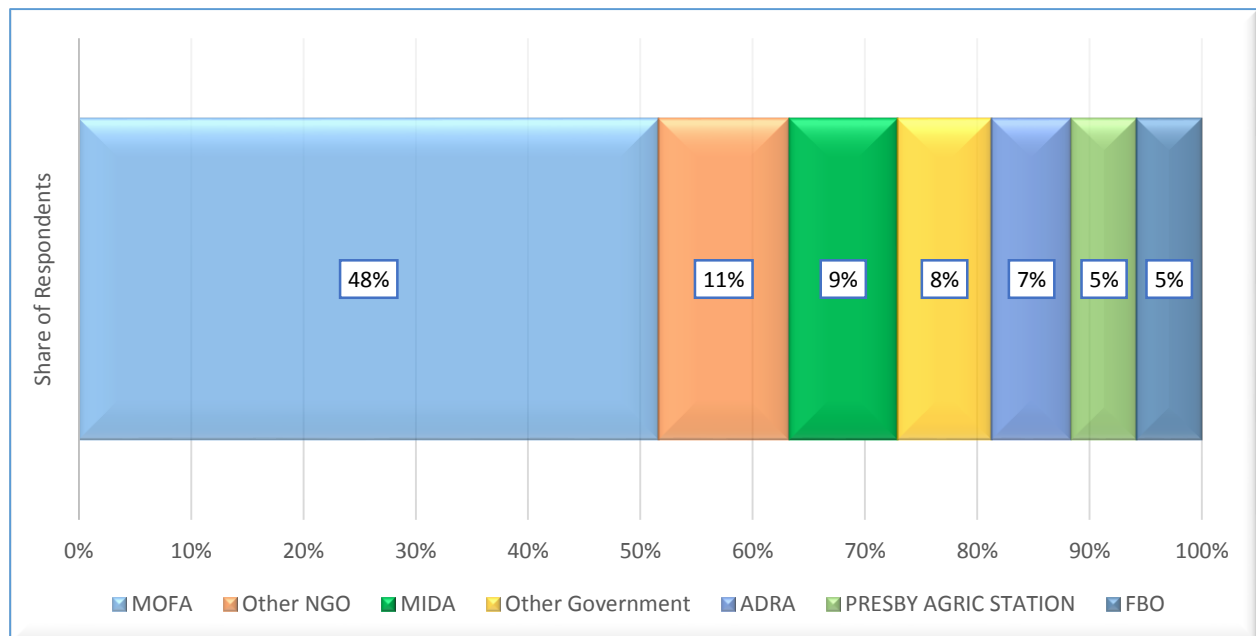
10   We have reported organization names as presented by respondents. This may cause a miscount of these organizations that may have the same name but have been presented with different names by respondents.

Labor Analysis

Labor is the most critical resource in agricultural production in most developing countries, and this region was no exception. This is because it determines the allocation and utilization of other resources. Production has the unique effect of determining the output that is produced on the farm, regardless of the availability of other production assets. Given that the manual labor is a primary production method in the study area, understanding the nature and use of labor is important.

Production Labor

Labor, we noted, comes from three main sources: family, communal and hired.[11] With the exception of hired labor, the explicit cost of labor is in-kind or residual. For example, farmers would draw on communal labor and pay for it by participating in communal labor themselves as well as providing meals for the participants who are often neighbors. Family labor is generally paid for with residual income. Therefore, it is very rare for adult females and males working on the family farm to be paid explicitly in cash or even in kind. On average, hired labor accounted for 22 percent of total labor in the study area while communal labor accounted for about 15 percent during the 2013 production year. As expected, the largest contributor to labor in the study area is family labor, accounting for about 63 percent.

Labor-days is the product of the number of adults working the land and the number of days worked. Total labor-days is estimated as the sum of family labor, communal labor and hired labor. We explore two labor productivity measures: (i) Output per labor input, which is the reported output from the land divided by the number of labor-days reported; and (ii) Land per labor input, which is the reported land area divided by the labor-days respondents indicated reported using on that land.[12]

The average output per labor input is 38.5 kg, with a standard deviation of 105.7 kg. There was an increasing average labor productivity with increasing plot size even though the variability within each group of plot sizes remained large. Exhibit 39 shows that the average labor productivity increased from about 27 kg/labor-day for those whose plots were under 1 ha to 136 kg/labor-day for those with plot sizes in excess of 4 ha. The correlation between size and labor productivity was 0.17 and statistically significant at the 1 percent level. Similarly, the correlation between yield and labor productivity is low at 0.10 but statistically significant at the 1 percent level.

Exhibit 39: Labor Productivity by Plot Size in Kilogram per Labor Unit

Plot Size	Mean	SD	Minimum	Maximum
Under 1 ha	26.6	65.0	0.1	1000.0
1 ha - 1.99 ha	50.1	157.2	0.5	2000.0
2 ha - 3.99 ha	54.4	99.9	3.0	833.3
4 ha or Larger	136.0	197.5	8.1	866.7
Total	38.5	105.7	0.1	2000.0

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[11] Although we collected data on labor provided by children under 18 years of age, they have not been included in these analyses.

[12] Although there is a significant amount of intercropping practiced by the farmers in the area, they were able to provide information on their labor allocation to different crops. Therefore, the analysis also assesses the labor productivity by crop.

The average total hired labor was 13.5 labor-days compared with 19.2 labor-days for adult male family labor (Exhibit 40). Communal labor and adult female family labor averaged about 7.8 labor-days and 7.4 labor-days respectively. The adult male family labor was statistically different from the others, but there was no statistical difference between female adult family labor and communal labor. The maximum labor-days for hired labor was 420 compared to 410 for adult male family labor. However, the maximum labor-days for adult female labor was 352 compared to 270 for communal labor.

Exhibit 40 shows the average labor-days by crop and labor type. For maize, adult male family labor averaged about 24 labor-days, which was the highest for any crop and any labor type. This illustrates the relative labor intensity in maize production, using an average of about 57 labor-days across all labor types. Maize also used the most hired labor on average, almost 15 labor-days in 2013, but this was comparable with the 14.3 labor-days of hired labor under rice. The two were not statistically different. Soybean production was the least labor intensive, using only 29.2 labor-days on average in 2013, about 43 percent lower and 52 percent lower than the average used in rice and maize production respectively. This is aligned with the observation made under the type of land preparation method used among the crops. Soybean had the least manual application.

Exhibit 40: Average Labor-days by Labor Type and Crop
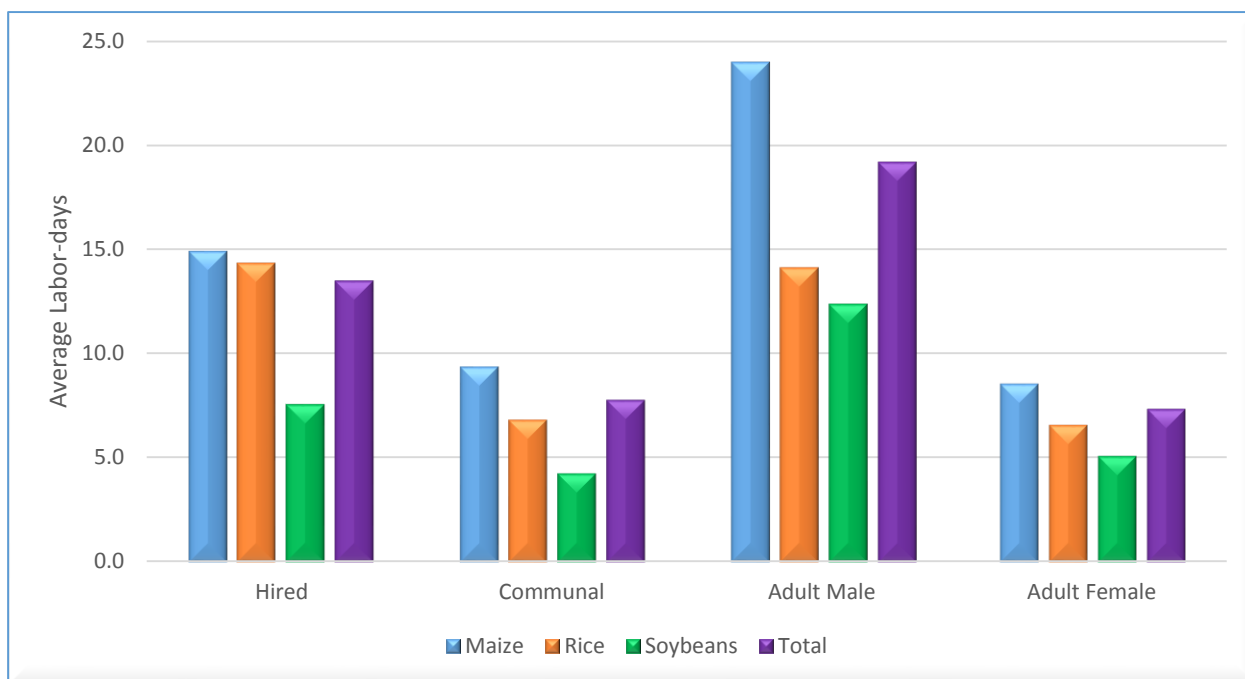
Exhibit 41 shows the average labor-days by region and labor type. Upper East had the highest average hired labor-days across the study area. For communal labor, Upper West posted the highest average labor-days, about 17 labor-days, about 113 percent higher than the average in Northern Region and 16 times more than used in Brong Ahafo. Indeed, respondents in this survey from Brong Ahafo did not use communal labor in their production process, given that it only accounted for less than three percent of their average total production labor-days in 2013. Adult male family labor averaged 16.3 in Brong Ahafo and 16.1 in Upper East, a difference that was found not to be statistically significant. Upper East, however, dominated the adult female labor use with an average of 12 labor-days in 2013 compared with 4.7 in Brong Ahafo and 5.3 ion Northern Region.

Exhibit 41: Average Labor-days by Labor Type and Region
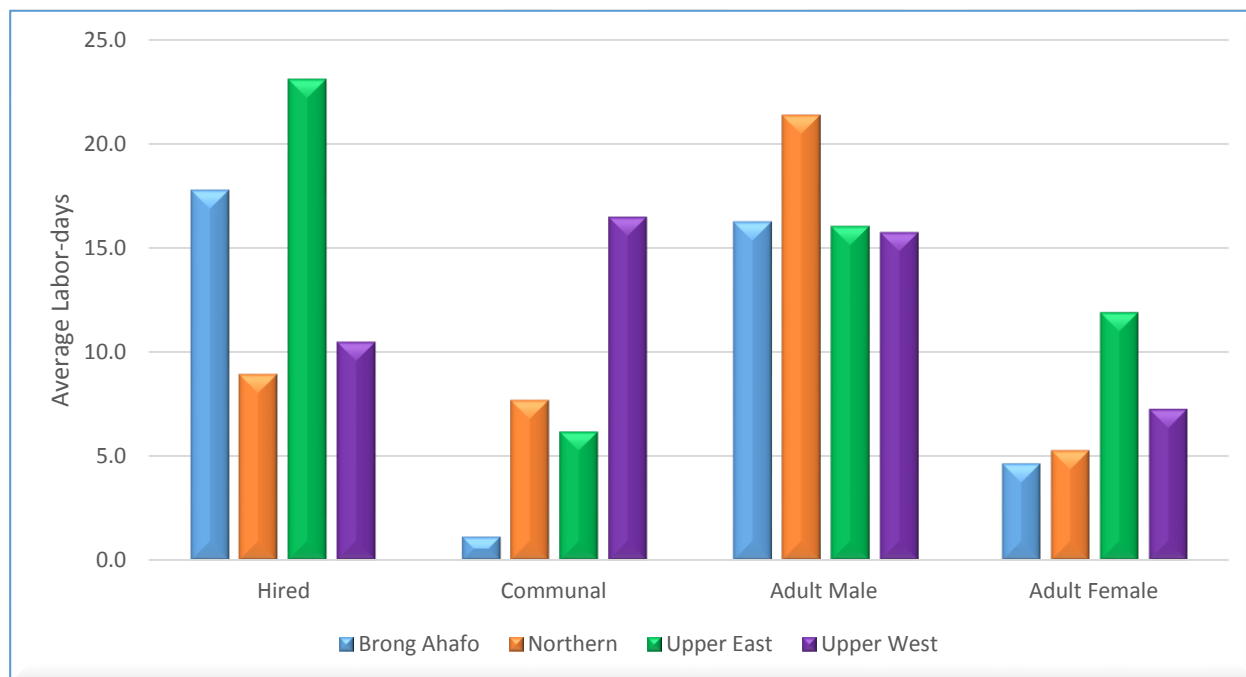
At about 34 kg/labor-days, the average labor productivity for maize was the lowest across the study area (Exhibit 42). The highest labor productivity was estimated for rice, nearly 46 kg/labor. As expected, labor productivity (kg/labor-days) generally increases by plot size. However, the progression is not uniform across the crops. For example, while the average labor productivity for maize and soybeans increased as plot size increased, that of rice increased for the first two plot size categories and then declined in the third to less than half of the labor productivity in the second category before rising again in the fourth category to more than five times the average productivity in the third. Despite these inconsistencies in the average labor productivities, one thing is clear: productivity is generally higher with larger plot sizes. This is not surprising because of the lumpiness of labor. Against this backdrop rises the need to consider innovative policy alternatives to enhance incomes and reduce the poverty in the study area. New experiments need to be conceived against the metrics of the labor productivity in the different crops in the study area.

Exhibit 42: Labor Productivity by Focus Crop in Kilogram per Unit Labor
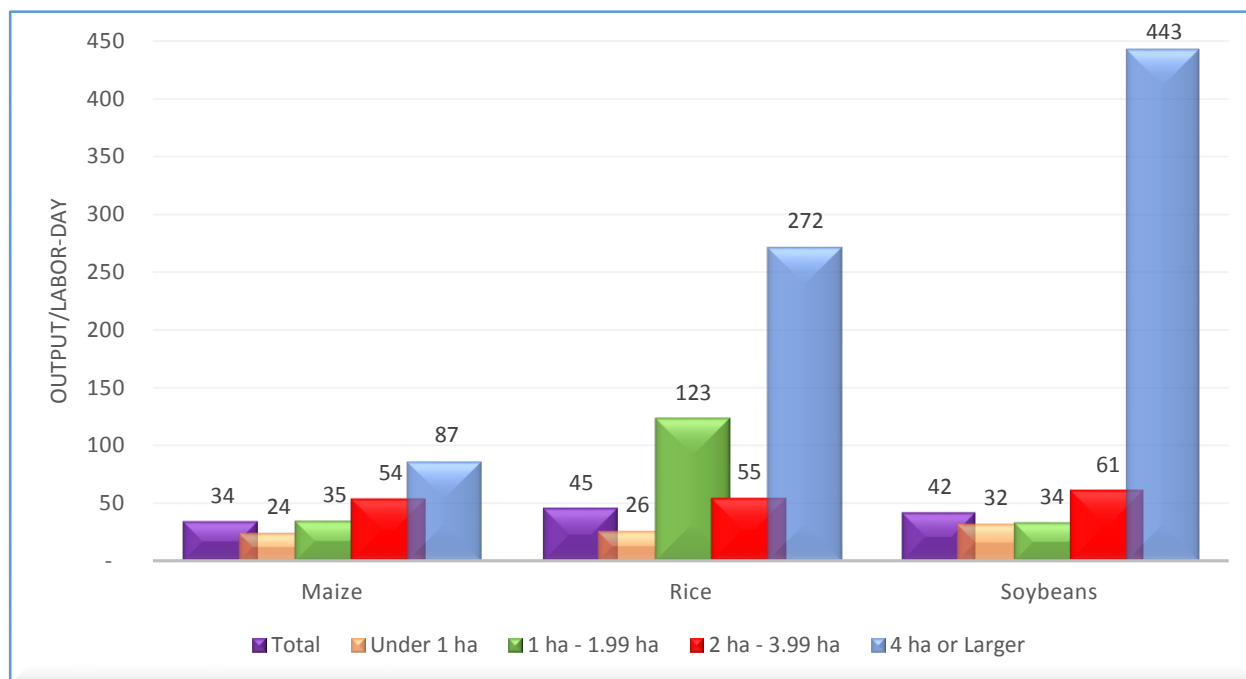
The foregoing points to a need to explore actively opportunities to develop alternative livelihoods for the very small farmers low productivity so that they can voluntarily exit agriculture. Such a move would allow their plots to be consolidated within their families (if they do not want to or cannot sell such plots) or rented to others who would be able to exploit the land more economically. This would engender scale economies and create a solid foundation for the emergence of a sustainable pathway towards commercialization and away from subsistence. Lessons from US and European development policies in the post-World War II era provide ample evidence that this approach works. Therefore, the Government of Ghana and its development partners should *seriously* engage each other in active conversations about strategies to facilitate these developments if Ghana's agriculture in general and the agriculture in the study area in particular are going to achieve the ambitious objectives being planned and discussed.

Each unit of labor in this study is, on average, working only 0.06 ha! Although the range for the land area per labor-day is from very near zero to 12.5 ha, only one respondent has a land per labor-day productivity rate in excess of 0.06 ha/labor-day. The low land-labor productivity rate underscores the importance of the foregoing discussion. If sustainable enhancements in incomes and reduction in poverty are going to be attained, carefully orchestrated interventions in enhancing the foregoing productivity metrics must be aggressively discussed and alternative strategies evaluated. Without these changes, the aspirational targets set for the projects will be unsustainable in the aftermath of the intervention programs.

Harvesting and Post-Harvesting Labor

Labor is used during the production process and in the harvesting and post-harvest activities. This section focuses on the labor in these harvesting and post-harvest activities reported by survey respondents for 2013. Harvesting and post-harvesting activities included harvesting, shelling, threshing, winnowing, bagging and transportation to storage facilities.

Unlike production, where hired labor featured prominently, harvesting and post-harvest labor needs of the household were predominantly addressed with family labor. On average, 46.6 labor-days went into harvesting and post harvesting activities, only 3 percent lower than the average total labor-days that went into production activities. Adult male accounted for 19.3 labor-days (37 percent) of the total average harvest and post-harvest labor-days while adult females accounted for 41 percent. This supports the general perception that there is division of labor in agricultural production, with males being responsible for production activities and females for harvesting and post-harvest activities belong in the female domain. This is consistent across crop (Exhibit 43) but more prominent in soybean harvesting and post-harvest activities. Adult female labor accounted for 46 percent of total labor supply on average compared to 36 percent for adult male for soybeans. The distribution was about the same for rice, with 35 percent of adult male and 34 percent of adult female.

Exhibit 43: Average Labor-days Used in Harvesting and Post-Harvest Activities by Crop and Labor Type
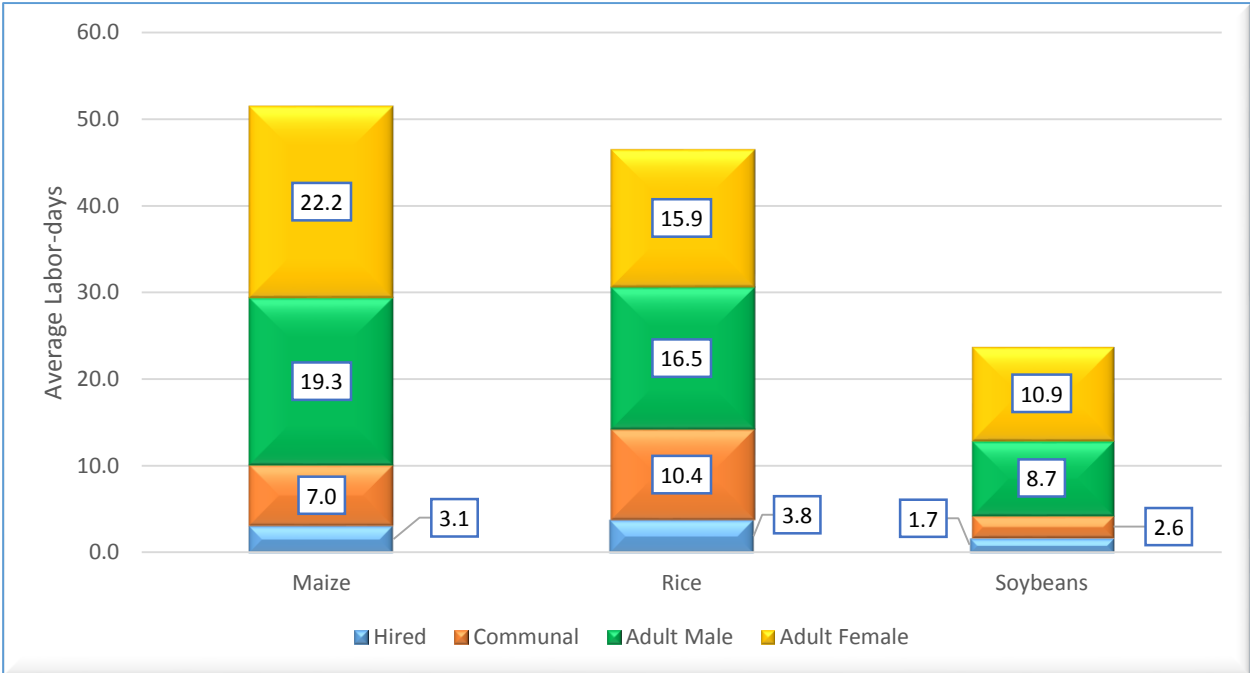
By region, the average harvesting and post-harvest labor-days in Brong Ahafo Region for 2013 was 78.5 labor-days, higher than Northern Region by about 30 percent and by about 62 percent for both Upper East and Upper West regions (Exhibit 44). As observed by crops above, adult female contribution was higher in all regions with the exception of Brong Ahafo and Northern Region. The difference in Northern Region was not statistically significant, however, the one in Brong Ahafo was. Another interesting observation is that hired labor was the dominant harvesting and post-harvest labor type used in Brong Ahafo, ahead of both adult male and adult female family labor.

Exhibit 44: Average Labor-days Used in Harvesting and Post-Harvesting Activities by Labor Type and Region
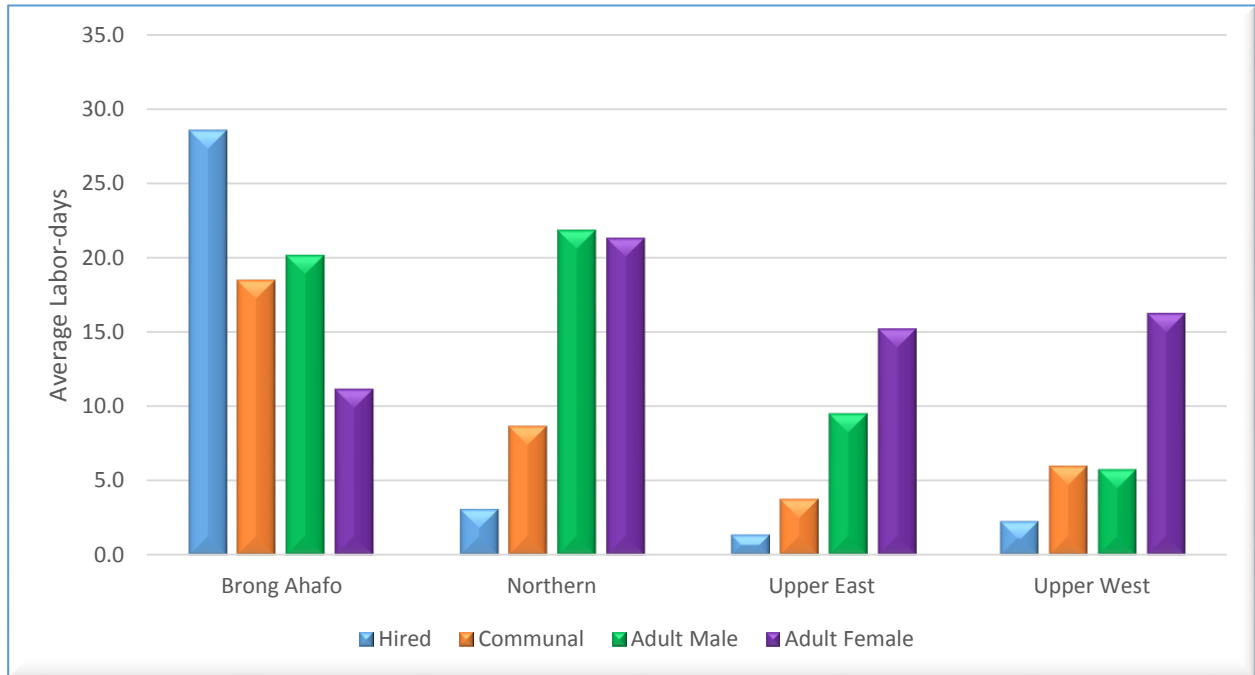
Marketing and Product Utilization

Recall that the agricultural production data were collected using the diary approach. It involved enumerators visiting participating farmers every fortnight over a period of nine months, from June 2013 to March 2014, and collecting and recording specific information. They collected information on the marketing, consumption and storage of harvested output from the eighth visit onwards. Respondents were asked to provide information on the quantity of the focus crops sold, consumed and used for other purposes during each of the visits. This chapter provides a summary of the respondent stated marketing and product utilization activities.

The commercial production intention, we noted in Chapter IV, defines how resources are used and enterprises are selected. Of the 438 respondents who indicated having commercial production intention (Exhibit 15), only 407 of them indicated selling some or all of their production during 2013. Thus, intention does not necessarily translate into action. Selling (and timing of selling) of production are influenced by financial needs as well as the food needs of the farming household. Changes in either of these may influence how much and when particular products are sold. Based on farmer statements, none of the respondents in Brong Ahafo indicated selling any of their production. They, therefore, are excluded from this section of the analyses.

Principal Buyers

Farmers may sell their products directly to consumers, incurring all the marketing and distribution costs and risks but also taking all the benefits. They may also sell to aggregators, processors and/or other buyers. Exhibit 45 shows that equal proportion of farmers in the study area sold their production to consumers and aggregators (about 43 percent) and only 13 percent of them indicated selling to processors. This is not surprising given the current low presence of processors in the study area. Most processors would use purchasing agents to do their procurement for them and, therefore, would not be in direct contact with smallholder producers. The National Food Buffer Stock Company (NFBSC) is a government parastatal charged with, among other things, the management of food product prices by purchasing and selling food commodities at the right time to minimize the effect of adverse market conditions on farmers' incomes and food security. The organization, thus, provides an alternative channel to market for farmers. However, as shown in Exhibit 45, farmers in the study area are not using the services of the NFBSM, with only 1 percent of respondents indicating that they sell directly to the NFBSC.[13]

As noted earlier, soybean is the most commercial of all the crops. As such, it sold a higher proportion through the identified channels than the other two crops. For example, Exhibit 46 shows that about 40 percent of soybean farmers sold to aggregators compared to 18 percent of maize farmers and about 17 percent of rice farmers. Similarly, about 23 percent of soybean farmers sold directly to consumers compared to about 21 percent of rice farmers and 20 percent of maize farmers. About 14 percent of soybean farmers sold to processors. This was more than 35 percent higher than for rice farmers and 78 percent higher than for maize farmers. Only maize farmers used the NFBSC as a marketing channel in 2013 but it accounted for just under one-half of a percent of maize farmers.

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[13] It is possible that the NFBSC uses procurement agents who may be perceived as aggregators by farmers.

Exhibit 45: Distribution of Respondents by Customer (N = 407)
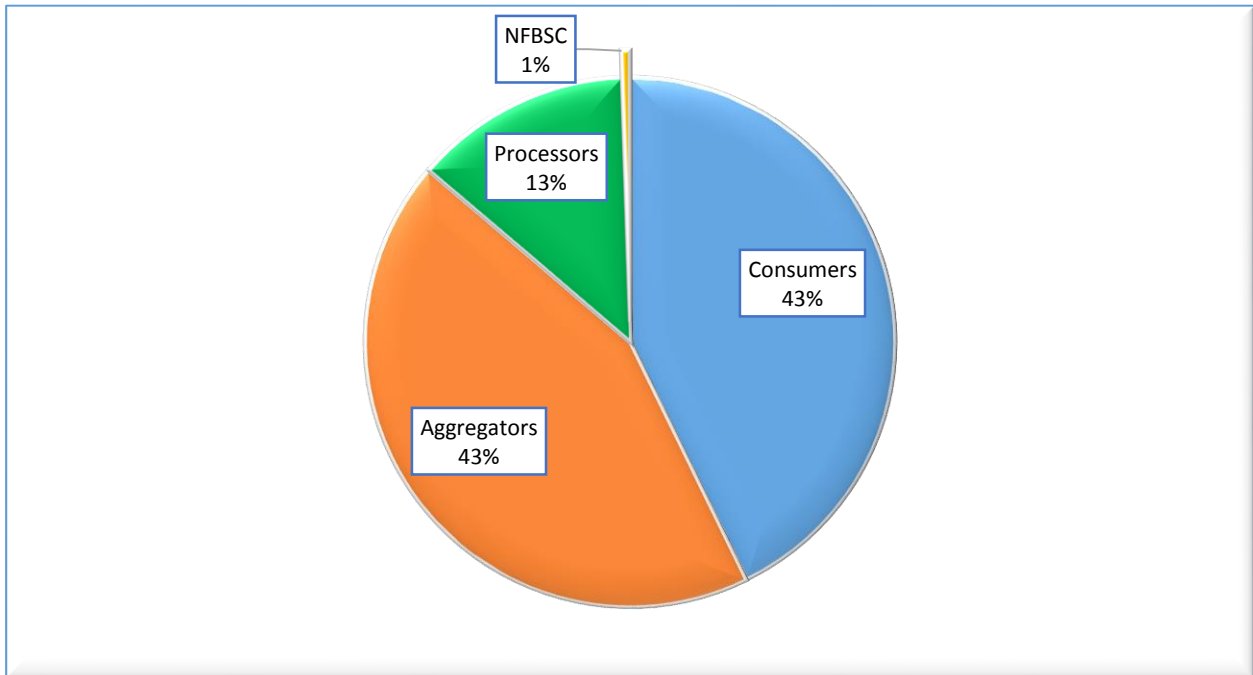
Exhibit 46: Distribution of Customers by Crop (N = 407)
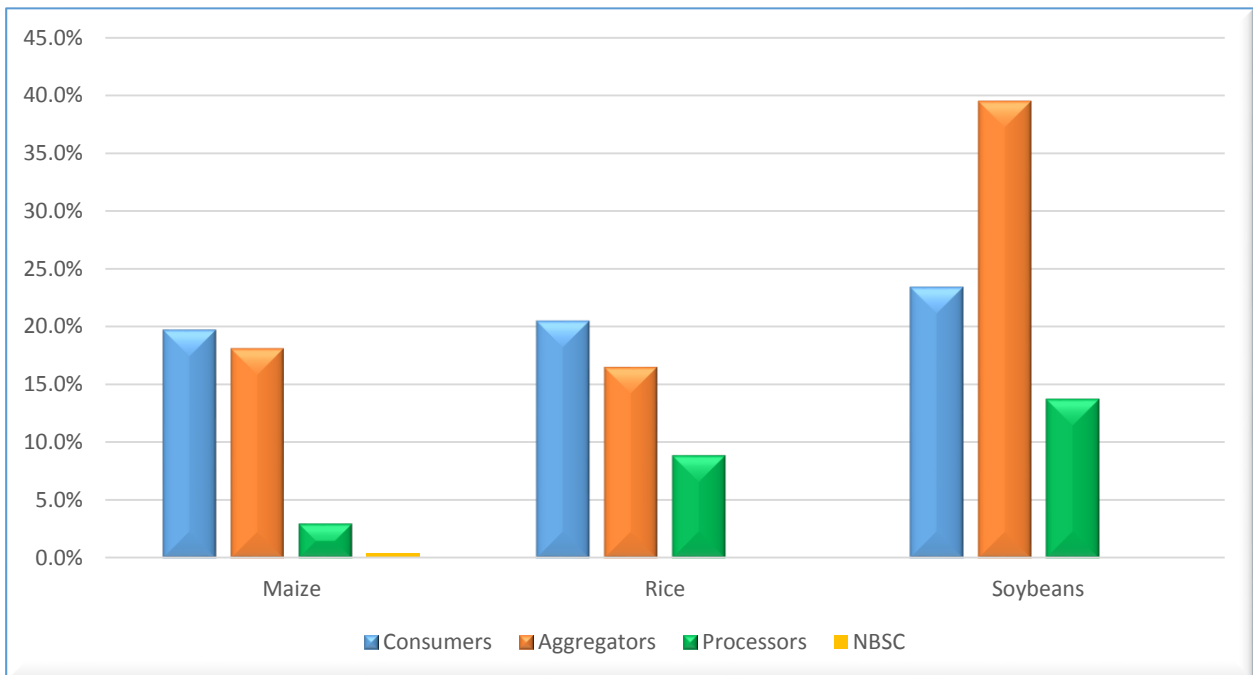
Exhibit 48 shows that almost 36 percent of farmers in Upper East Region indicated selling directly to consumers, compared to approximately 14 percent in Northern Region and 15 percent in Upper West Region. On the other hand, Northern Region's farmers used aggregators the most, with nearly 26 percent of them selling to aggregators. This proportion of farmers was higher than the proportion in

Upper East and Upper West selling to aggregators by about 49 percent and 64 percent respectively. The proportion of farmers selling to processors in Northern Region and Upper West Region was about equal but the proportion in Upper East Region selling to processors was less than half of the proportion in Northern Region. NFBSC services were not used by farmers in Upper West Region. The proportion of farmers using these services was 0.4 percent in Upper East Region and half of that in Northern Region.

Exhibit 47: Distribution of Customers by Region (N = 407)
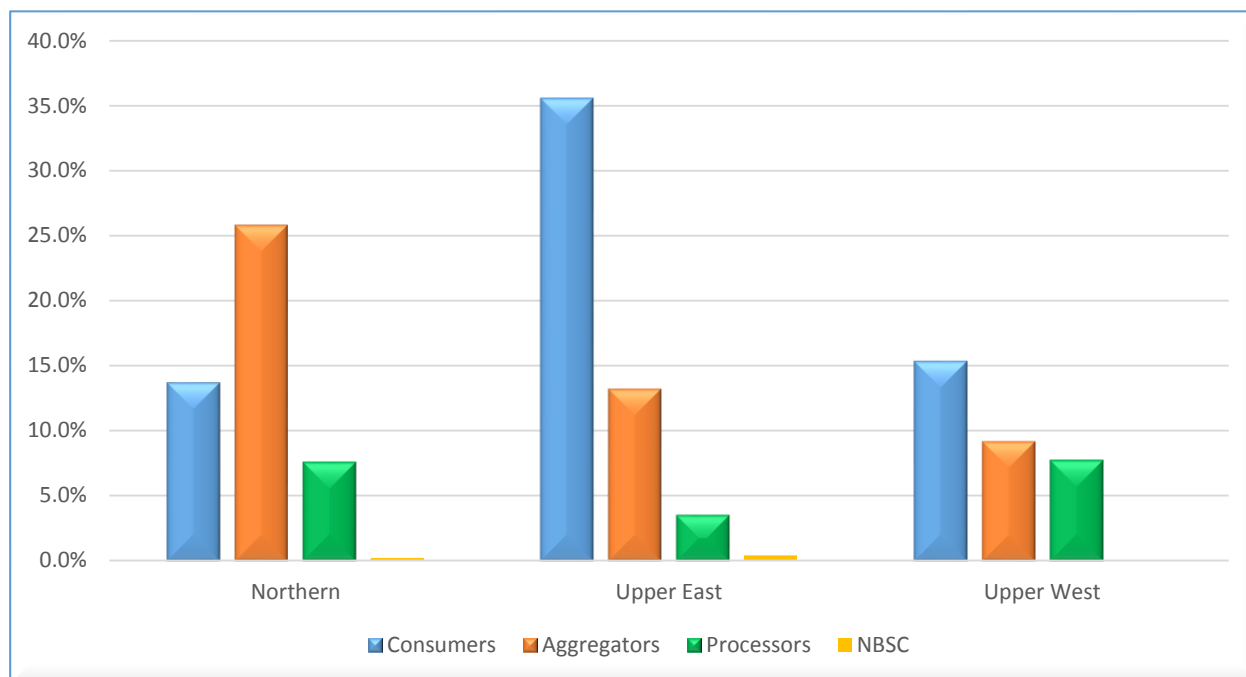
While we observed a negative correlation between selling to consumers and selling to aggregators – about -0.1 and statistically significant at the 1 percent level – there was a positive correlation between selling to consumers and selling to processors – about 0.24 and significant at the 1 percent level. This would suggest that farmers selling to consumers were more likely to sell to processors too. This raises the question of exploring the characteristics of these farmers a little more because often farmers who are too small to engage with alternative channels choose to sell directly to consumers and that processors often choose to engage larger farmers to minimize their transaction costs. Males were more likely than females to sell to aggregators, with the correlation coefficient between the gender variable and selling to aggregators being 0.1 and significant at the 1 percent level.

Product Sale by Month and Distance to Market

The harvest season starts around October and farmers' willingness to sell their output is often determined by their cash needs, availability of storage, prevailing prices and their expectations about future prices. Exhibit 48 shows that few farmers participated in the market in November, with one of the maize farmers in the sample selling anything that month and only between 1 percent and 2 percent of farmers of the other crops selling anything. About 28 percent of soybean farmers sold product in December 2013 compared with 18 percent of rice farmers and only 15 percent of maize farmers. The highest of proportion of maize (38 percent) and rice (32 percent) farmers sold product in January 2014.

A declining proportion of farmers in each of the crop enterprises sold product in the remainder of the marketing year, when between 1 percent and 3 percent of farmers were selling any product.

Exhibit 48: Proportion of Farmers Selling Product in Month
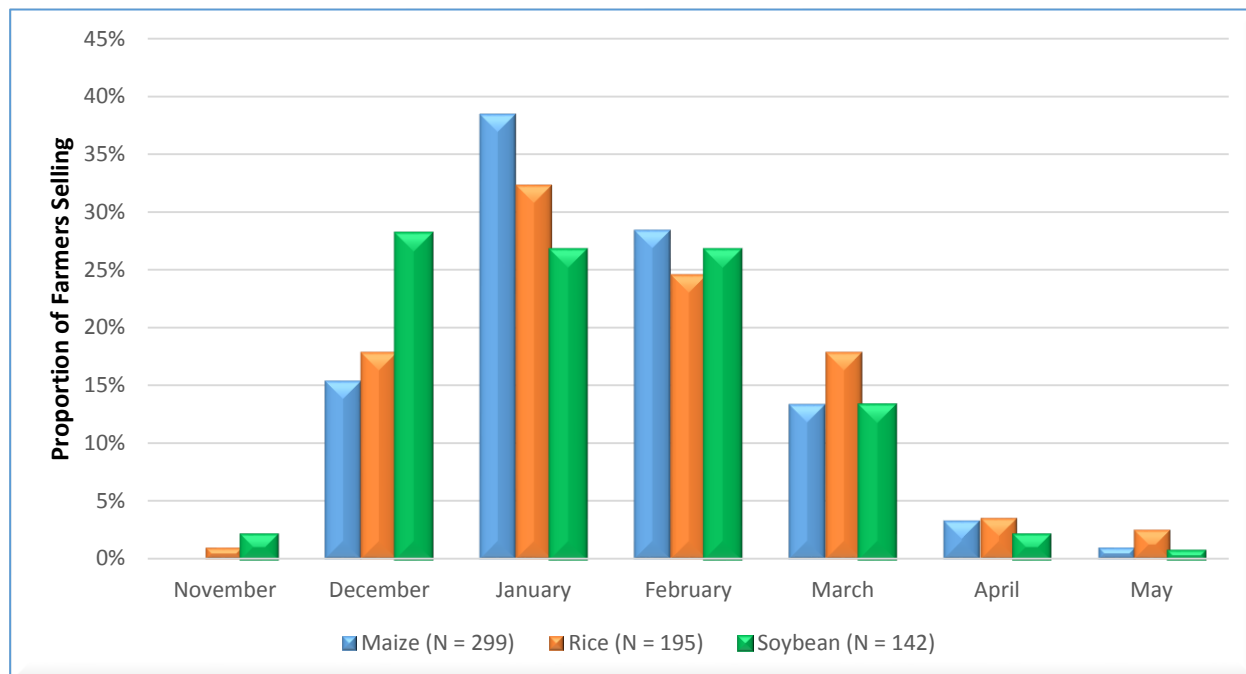
Farmers indicated that they were, on average, about 1.4 km from the markets they could use to sell their produce directly to consumers. As expected because it is the least rural of the three regions in which marketing information were received, the average distance to market in Northern Region was about 0.8 km compared to 2.4 km in Upper East Region and 2.3 km in Upper West Region. Although crop plots also differed in their distance to market – with the average distance for maize, rice and soybeans being 1.5 km, 1.3 km and 1.3 km respectively – the differences between the distances for the focus crops were not statistically different.

For farmers who physically transport their produce to market to sell them to consumers, aggregators or others, the most popular transportation means in 2013 was by motor bicycle or "Motor King", accounting for about 46 percent of farmers' responses. Animal drawn carts accounted for about 25 percent while bicycles were used in about 13 percent of the cases. People carrying products on their head accounted for about 9 percent of the transportation modes selected by respondents. Exhibit 49 shows the transportation means broken down by crop. It shows that motor bicycles and "Motor Kings" were the dominant choice for all three crops. This was followed by animal drawn carts for maize and soybean but bicycle for rice. Trucks and tractors were the least chosen option for all crops.

Just as it differed across crops, the transportation mode used differed across regions. Exhibit 50 shows that while motor bicycles or "Motor King" were used by 67 percent of farmers taking produce to market in Upper East Region, no one in the sample used it in Upper West Region. Indeed, 58 percent of Upper West farmers used human portage to get their products to market, the most across all the regions. Interestingly, however, 42 percent of Upper West farmers used truck or tractor compared to only 4 percent and 5 percent in Upper East Region and Northern Region. Animal drawn transportation was

most popular in Northern Region, with 51 percent of farmers taking produce to market indicating they used it in 2013.

Exhibit 49: Transportation Mode Used to Take Produce to Market by Crop
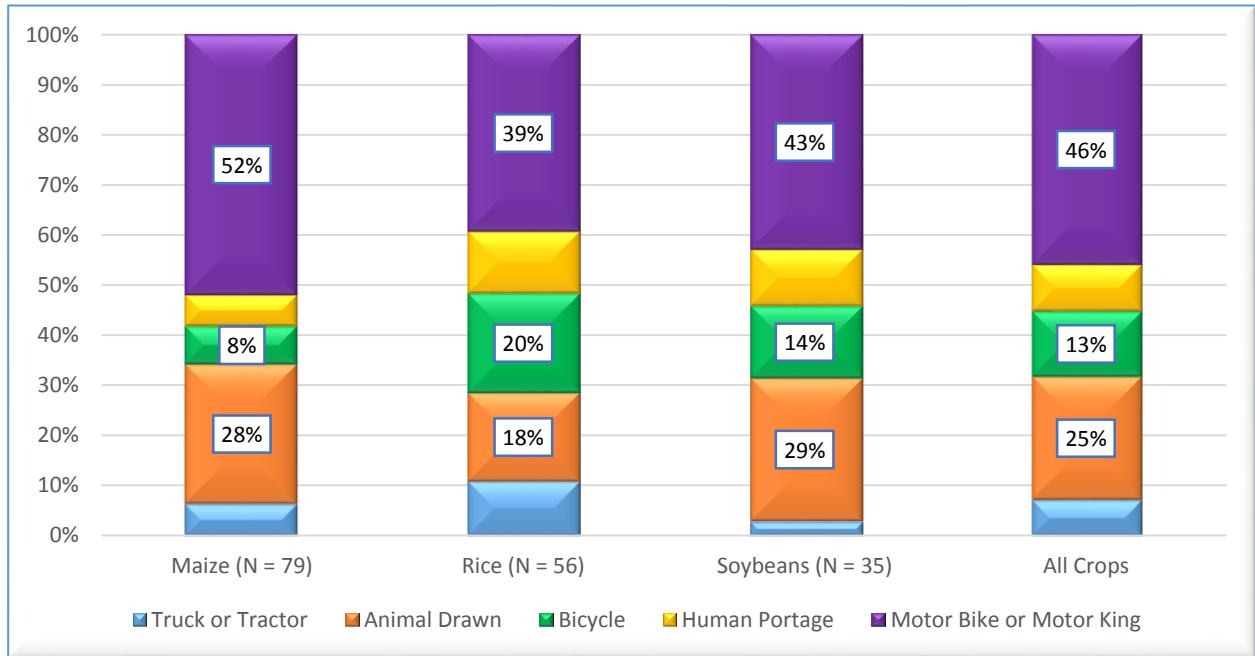
Exhibit 50: Transportation Mode Used to Take Produce to Market by Region

45
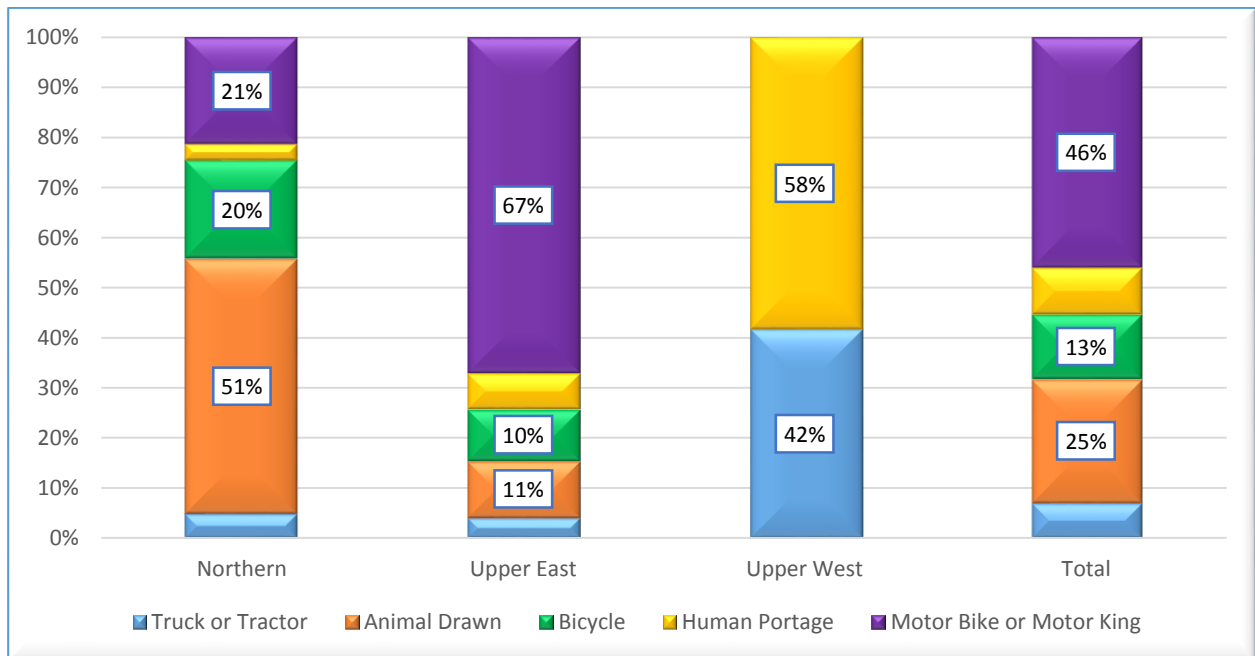
Quantity Sold, Consumed and Stored by Visit

Enumerators collected information about the quantity of crop that farmers sold, stored and consumed at harvest and at four intermittent periods after harvest. Total quantities were checked by ensuring that the quantity sold, stored and consumed on the five occasions data were collected did not exceed quantity harvested in 2013 plus any quantity stored in 2012 production year.

As observed with production output in Chapter IV, there were very wide ranges in the sale information. For example, the average quantity of maize sold at harvest was about 440 kg but the standard deviation was 2,736 kg, and ranged from 1 kg to 30,000 kg. The average quantity of rice and soybeans sold at harvest was 193 kg and 191 kg respectively. They ranged from under 2 kg for rice to 5,000 kg and about 8 kg to 1,200 for soybeans. Their standard deviations were 535 kg and 199 kg respectively.[14] For the remaining four visits, the average quantities of maize, rice and soybeans sold were approximately 334 kg, 336 kg and 253 kg respectively. The standard deviations were approximately respectively 496 kg, 777 kg and 217 kg. Exhibit 51 shows the Kernel density function for three crops and reveals that the underlying assumption of normality for the statistical estimates does not hold. Thus, we must exercise caution when comparing these results across time or with other studies.

Exhibit 51: Kernel Density Estimates for Additional Quantity Sold by Crop

From top left, clockwise: Additional quantity of maize, rice and soybeans sold after harvest sale. The range for maize was 7.5 kg to 6,000 kg while that for rice was 5 kg to 8,400 kg. For soybeans, the range was 5 kg to 981 kg.

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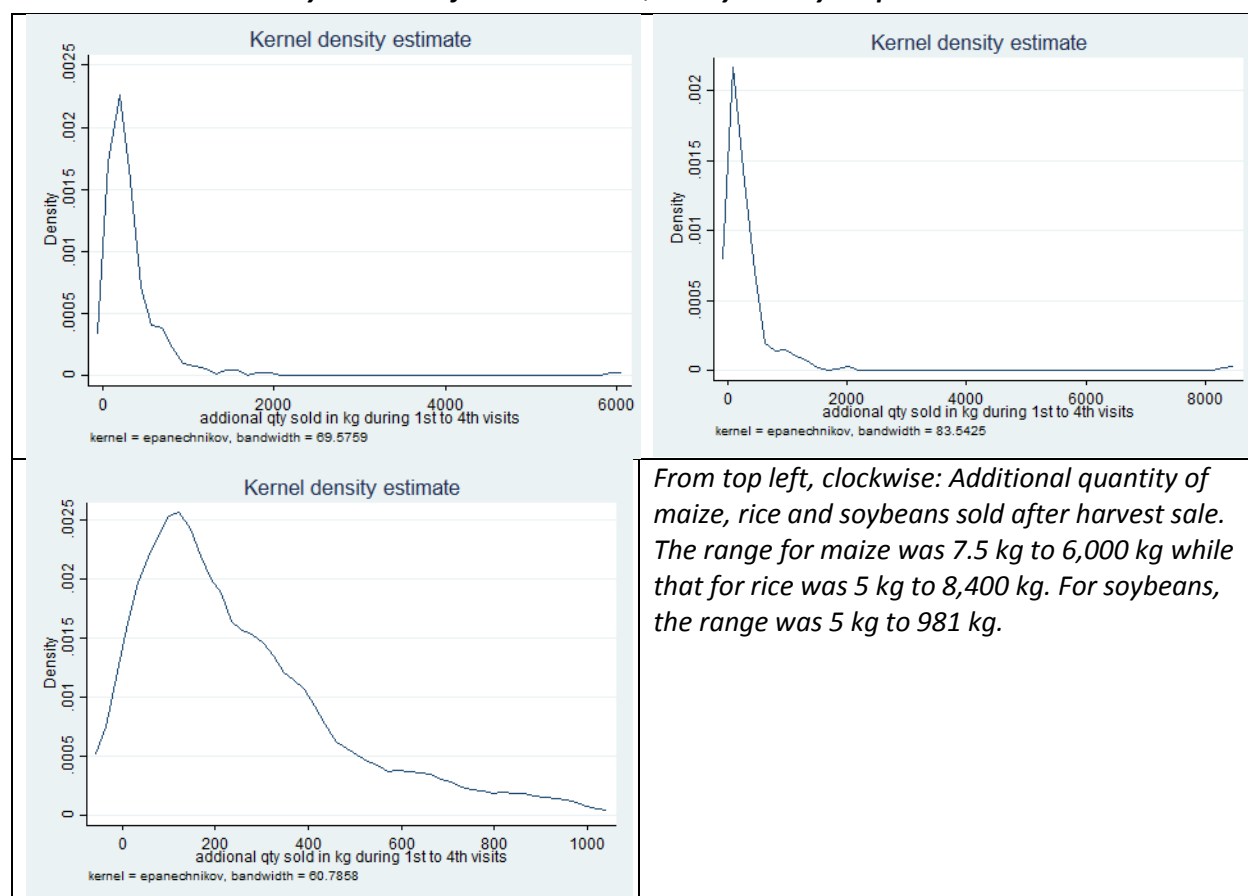
[14] We excluded farmers who did not sell any produce at harvest from these analyses. Thus, only 120 maize farmers sold produce at harvest compared to 91 and 57 rice and soybean farmers.

Thus, total maize, rice and soybean sold averaged approximately 774 kg, 529 kg and 444 kg. Total average consumption of the three crops was respectively 231 kg for maize, 98 kg for rice and 87 kg for soybeans. Given available storage at harvest, the average of other uses was estimated as 526 kg for maize, 437 kg for rice and 289 kg for soybeans. Other uses are defined in this estimation to include stored grain at the end of the fourth visit and grain given away as gifts and used as seed or feed as well as post-harvest losses.

The share distribution of total production and prior storage across consumption, sale, current storage and other uses for each of the focus crops is presented in Exhibit 52. It shows that more than 66 percent of soybeans was sold by the end of the survey compared to 27 percent and 45 percent for maize and rice respectively. The proportion of maize output consumed was much higher than that for rice and soybeans. At 21 percent, it was twice as high as rice and three times as high as soybeans. This further confirms the role of maize in ensuring household food security and the other crops' role in ensuring cash needs are met.

Exhibit 52: Distribution of Total Output by Use and Crop
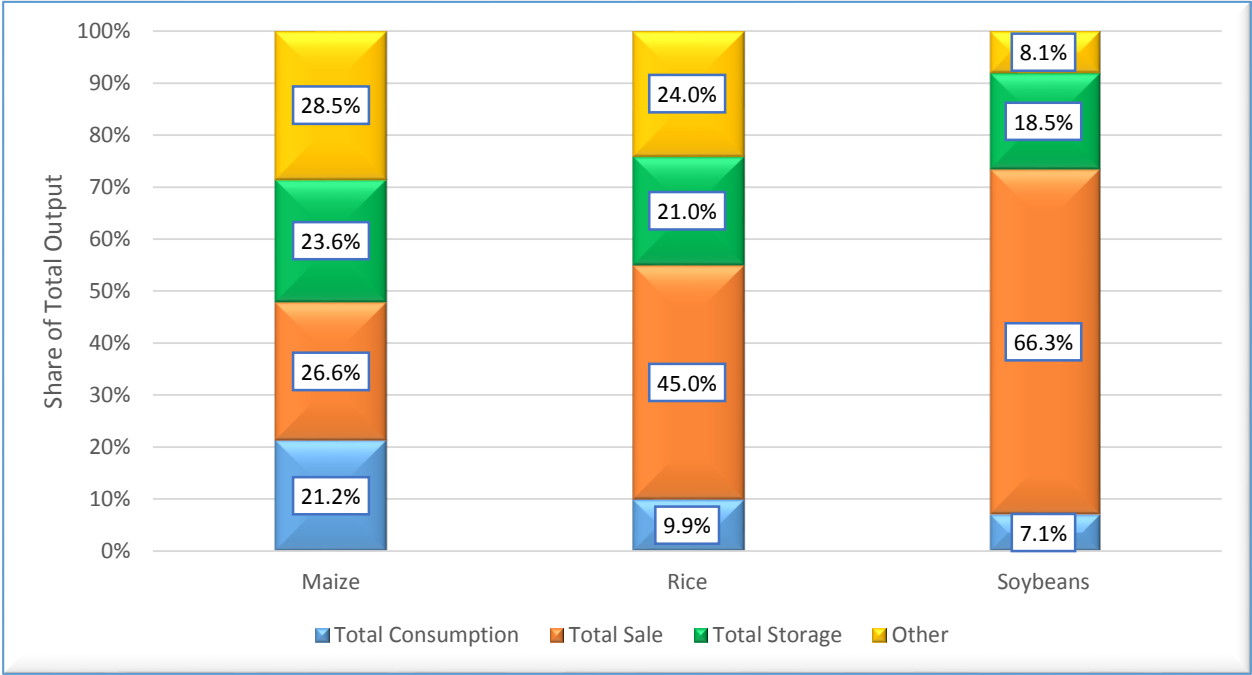
Exploring the above distribution at the regional level reveals that Upper West sold its entire soybean crop while Northern Region sold about 73 percent, consumed 15 percent and used 13 percent for other purposes (Exhibit 53).[15] Upper West Region also consumed the most of its maize and rice output: 44 percent of maize and 30 percent of rice. This compares with 38 percent and 17 percent of maize and 19 percent and 29 percent of rice in Northern Region and Upper East Region. About 60 percent of soybeans, 22 percent of rice and 49 percent of maize in Upper East were in storage by the end of the survey period. Northern Region had only 28 percent of maize and 24 percent of rice in storage; it had sold or consumed its entire soybean output by the end of the survey.

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[15]   Please note that Upper West Region had only one respondent who sold soybeans in 2013.

Exhibit 53: Distribution of Total Output by Use, Crop and Region
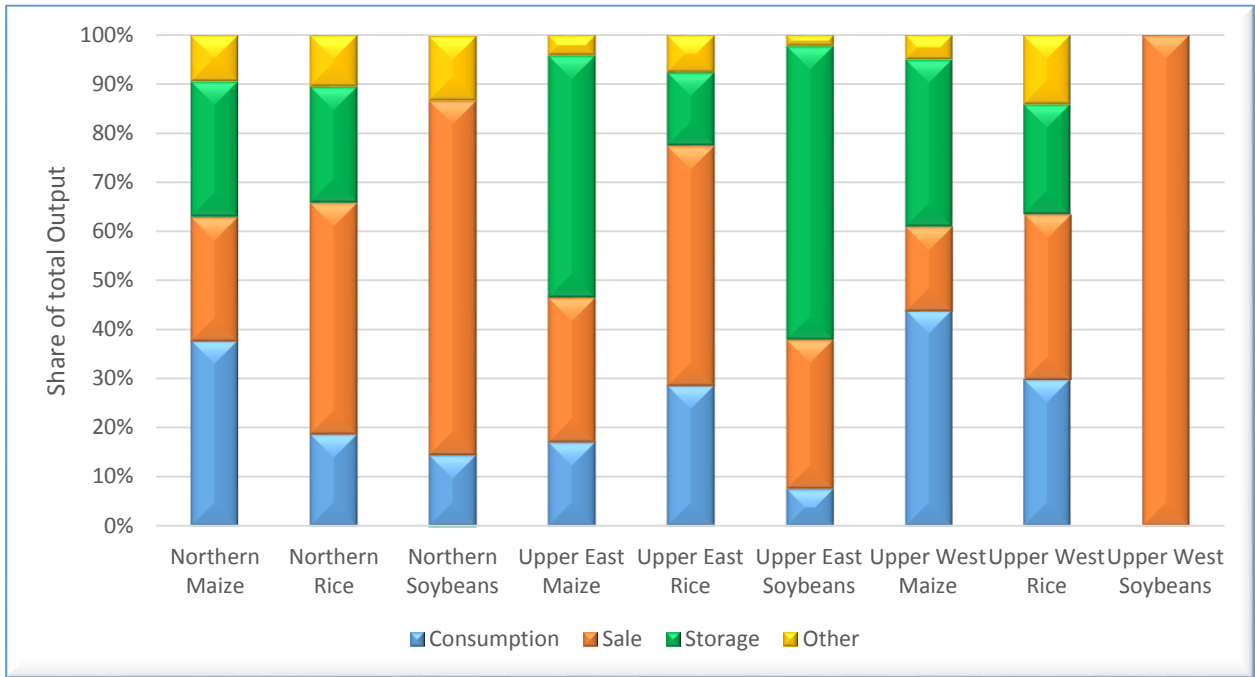
Economic Performance

The results from the preceding section confirm that smallholder farmers do not sell their total production. For example, we estimated that farmers in the study area sold about 27 percent of their 2013 maize crop, 26 percent of their rice crop and almost 30 percent of their soybeans. The economic performance associated with the production activities of these smallholder producers can, therefore, not be evaluated only on the proportion of production that was sold for cash. We need to recognize the non-pecuniary value from production. This brings the proportion of product consumed, gifted, stored and used for seed into the assessment. Without this, we risk underestimating the economic value of production by limiting it only to marketed surplus.

In this light, the economic performance of farmers in the study area is evaluated using their realized prices for sales completed and the implicit price on production that was not sold in the estimation of revenue, actual cost of hired labor and implicit or imputed prices for communal labor. Family labor is treated as a residual claimant on net revenues and is, thus, not included in the cost estimations. Farm profitability is measured in terms of gross margin, which is defined here as the difference between revenues and variable costs of production. Gross margin per hectare is used as the comparative economic metric across crops and locations.

Revenue

Revenue, R, from a particular crop, I, is the product of the quantity of that crop, q_i, and its price, p_i. That is, $R = p_i q_i$. While both quantity and price may be difficult to track, it is often more difficult to solicit for price most developing countries in interviews because of how it is determined. Prices are discovered through very complex processes of haggling and bargaining and are influenced by time, kinship, relationships and historical arrangements. Therefore, numerous prices may be received for the same product within a given day that it is sold given the types of customers to whom the product is sold. For example, across most of Sub-Saharan Africa, a seller will conclude a sale regardless of the price for the first customer of the day because of the belief that not completing that first sale will lead to very poor sales for the day. This presents the time effect on price discovery.   "Customers", people with whom the seller has had multiple interactions in the past, may receive different prices from those with whom such historical relationships are absent. Settling on prices through bargaining and haggling is a function of the need to complete the sale and other interaction products (respect, affinity, perceived potential for future business, etc.) that emerge through the exchange process. Price, therefore, is not a very simple variable to extract in an interview.

To get around this challenge, respondents were only asked for their *best price* for produce sold at harvest and the best price for the rest of the marketing season. Revenue for each crop is calculated by multiplying the quantity of crop sold at harvest by the reported *best price* at harvest plus the product of quantity sold during the rest of the marketing season and the *best price* received over the season. In estimating the potential revenue from non-pecuniary uses, we assumed that if crops were not consumed or given away as gift or kept for seed, they will be sold at the reported *best price*. Thus, quantity under the "other uses" category is multiplied by the higher of the two reported best prices.[16]

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[16]   Because we are unable to extract post-harvest losses in this analysis, we assume them zero. If downward adjustments to revenues are needed, published loss rates may be applied.

We were able to generate total revenue information on 521 of the 526 households in the survey using the foregoing approach. The average total revenue for these households in 2013 was GHS684.42, with a standard deviation of GHS573.37. As expected from our previous analysis, the range was very wide, from a low GHS16.79 to GHS3,835.39. The average revenue for the 431 households producing the focus crops was about GHS628.91, with a standard deviation of GHS554.35 and ranges from zero to GHS3,292.20.

Exhibit 54 shows the average total revenue by region. The highest average revenue of GHS771.12 was posted by Brong Ahafo and it was followed by Northern Region's GHS755.44. The difference between these two were statistically significant. The average total revenue for Upper West was GHS363.88, which was just about 60 percent of the GHS612.94 average total revenue in Upper East Region. The difference between these two was also statistically significant.

Exhibit 54: Average Total Revenue by Region in New Ghana Cedis (GHS)
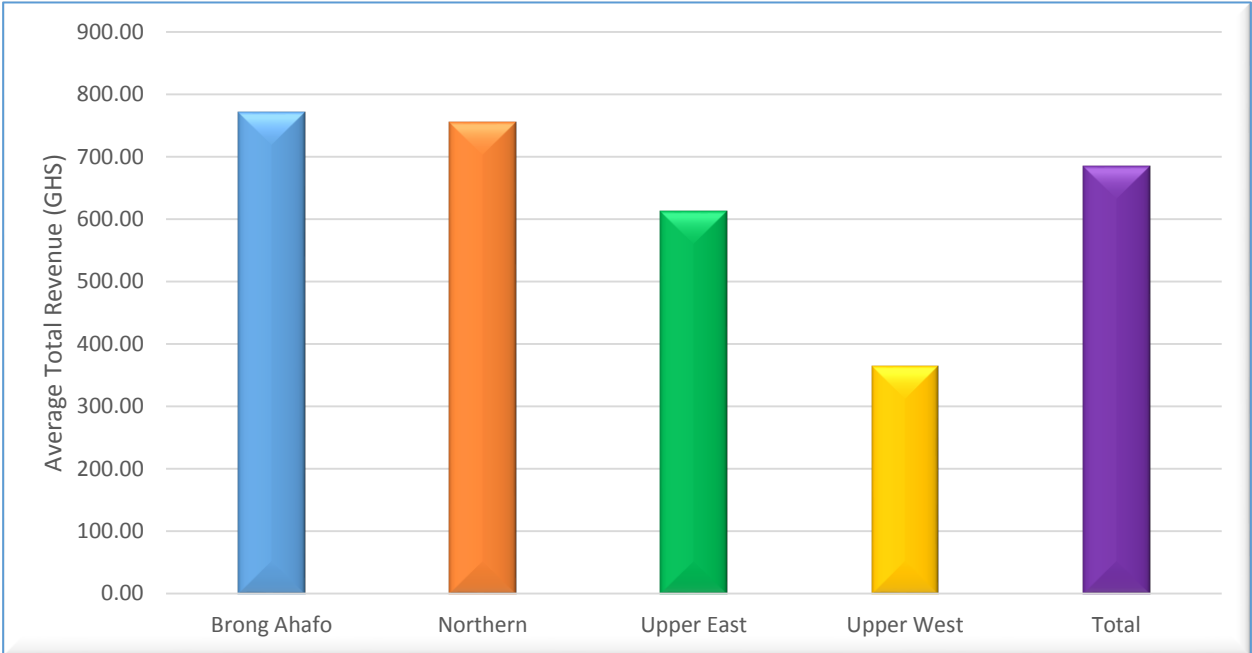
The average total revenue by crop is presented in Exhibit 55. It shows an average total revenue for soybeans of GHS770.57 compared to GHS675.88 and GHS605.63 for rice and maize. While the difference between the average revenue for soybean and maize was statistically significant, that between maize and rice was not.

Exhibit 55: Average Revenue by Crop in New Ghana Cedi (GHS)
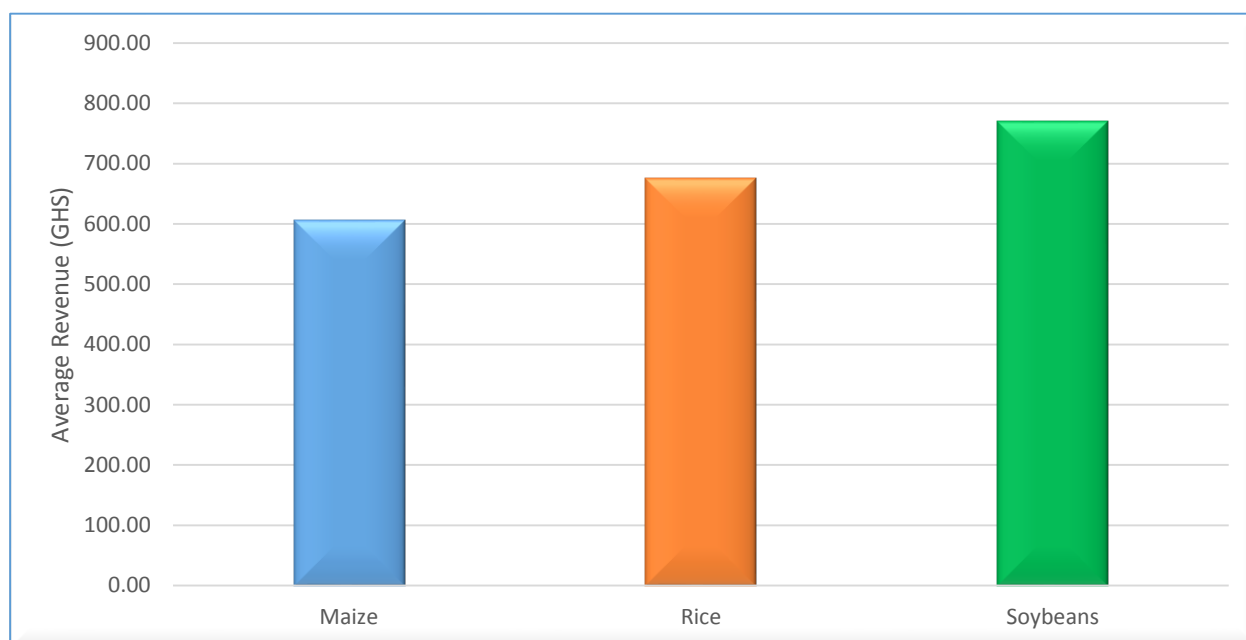
Total Variable Cost

Total variable costs in this research was defined to comprise all seed cost, land rent, land preparation cost, fertilizer and chemicals acquisition and transportation costs as well as hired and communal labor costs.[17] Total variable cost in 2013 averaged GHS323.51 across 521 households, with a standard deviation of GHS396.96. Exhibit 56 shows that land preparation accounted for 43 percent of total variable costs while fertilizers and chemicals (including their transportation) accounted for 47 percent. Seed accounted for only 4 percent of total variable costs while other contracted services and land rent made up the remainder. A slightly higher proportion of total variable costs was allocated to fertilizers and chemicals and seed for the three focus crops (48 percent and 6 percent respectively). The average total variable cost of production for maize, rice and soybeans was GHS299.77. The share of total variable cost allocated to land preparation was the same for the focus crops as for all crops but allocation to other contracted services and land rent was slightly lower.

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[17] Household labor is treated as a residual claimant on the farm operations and is, therefore, not included in the estimation of total variable cost.

Exhibit 56: Distribution of Variable Cost for All Crops and for Focus Crops
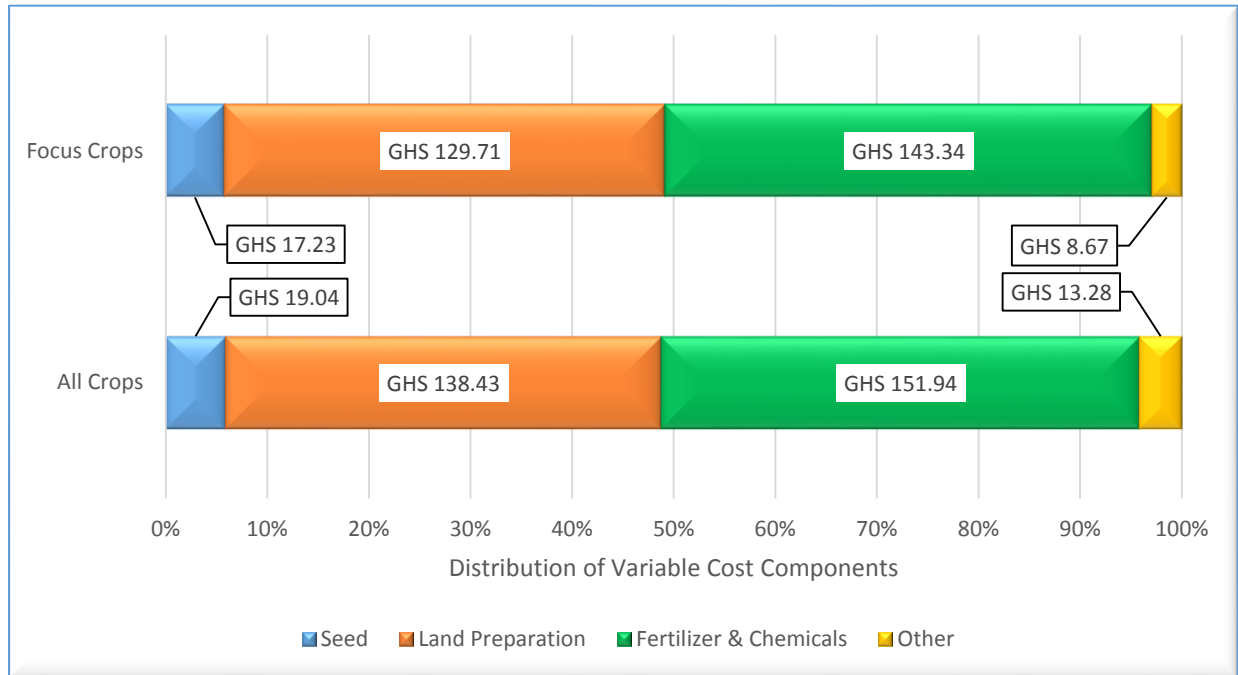
The average variable cost of production for maize in Northern Region was the highest across all crops and regions – GHS225.13. At GHS214.64, rice production in Brong Ahafo posted the second highest average variable cost across all crops and regions. Average variable cost of production for soybean in Upper East and Upper West was GHS22.46 and GHS22.75 respectively but that for Northern Region was more than three times that at GHS77.16. The average variable cost for soybeans in Upper East and Upper West were not significantly different from each other but both differed significantly from the variable cost of soybean production in Northern Region. For rice, the only statistically significant differences between variable costs was the ones between Brong Ahafo Region's on the one hand and those of the other regions on the other. Finally, the difference between the average variable cost of production in Brong Ahafo and Northern Region was statistically significant as was the difference between Northern Region and Upper West Region. No other difference was statistically significant.
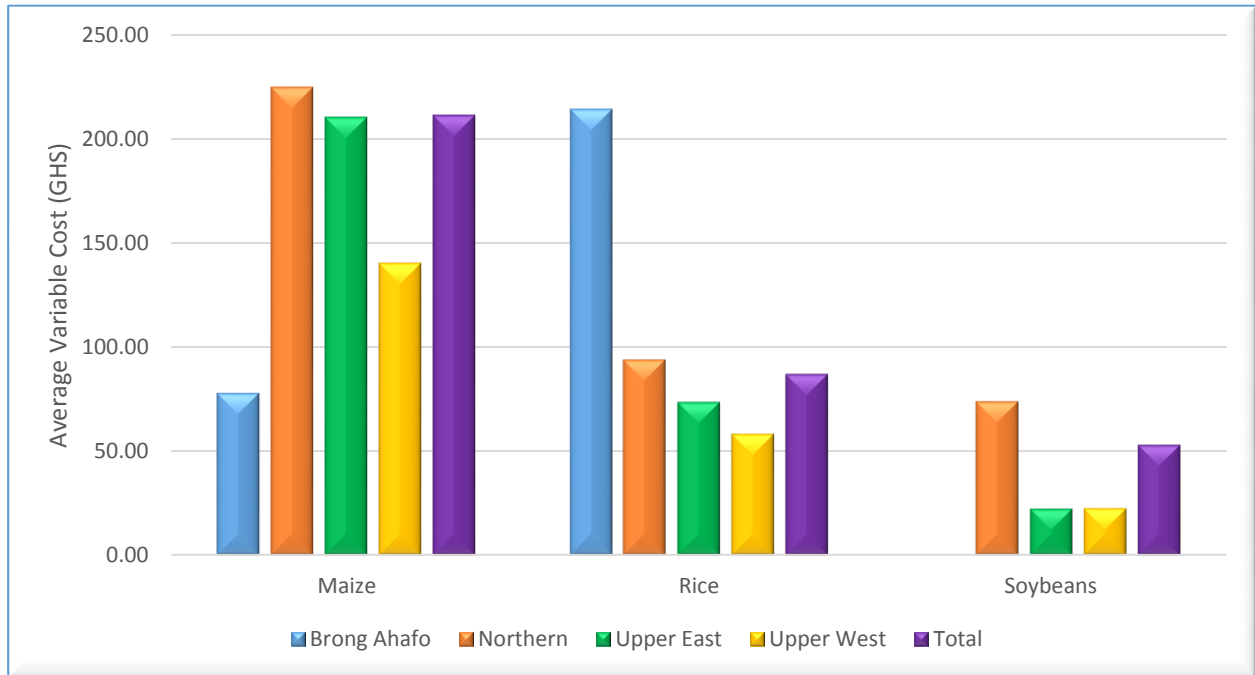
Gross Margin Comparisons

Gross margin is the difference between total revenue and total variable cost of production. For all households in the study that produced any crop, i.e., crop output is greater than zero, the average gross margin was GHS401.76.   Exhibit 58 shows the regional ranking of average gross margins. The highest gross margin of GHS549.50 was posted by Brong Ahafo Region followed by Northern Region with GHS438.37 respectively. Despite the near GHS110 difference, there was no statistical difference in the average gross margins in these two regions. The average gross margin in Upper East Region was GHS352.93 compared to GHS190.59 in Upper West Region. The difference between the gross margins in these two regions was statistically different at the 1 percent level.

The average gross margins for the focus crops across the study area are presented in Exhibit 59. They were about GHS307.75 for maize, GHS529.21 for rice and GHS485.85 for soybeans. The average gross margin for maize differed statistically from the other two crops at the 1 percent level but there was no statistically significant difference between rice and soybean's average gross margin across the study area.

The average gross margin by crop and regions is presented in Exhibit 60. On average, the gross margin for maize in Brong Ahafo Region of GHS658.42 was the highest across all crops in all regions. The lowest average gross margin across all crops in all regions was maize in Upper West Region. It was GHS209.70. Although the average gross margin for rice was highest among the crops at the aggregate area level, it was true only in Northern Region and Upper East Region when the analysis is disaggregated to the region and crop level. Soybean gross margin was the highest Upper West Region.

Exhibit 58: Average Gross Margin by Region in New Ghana Cedi (GHS)
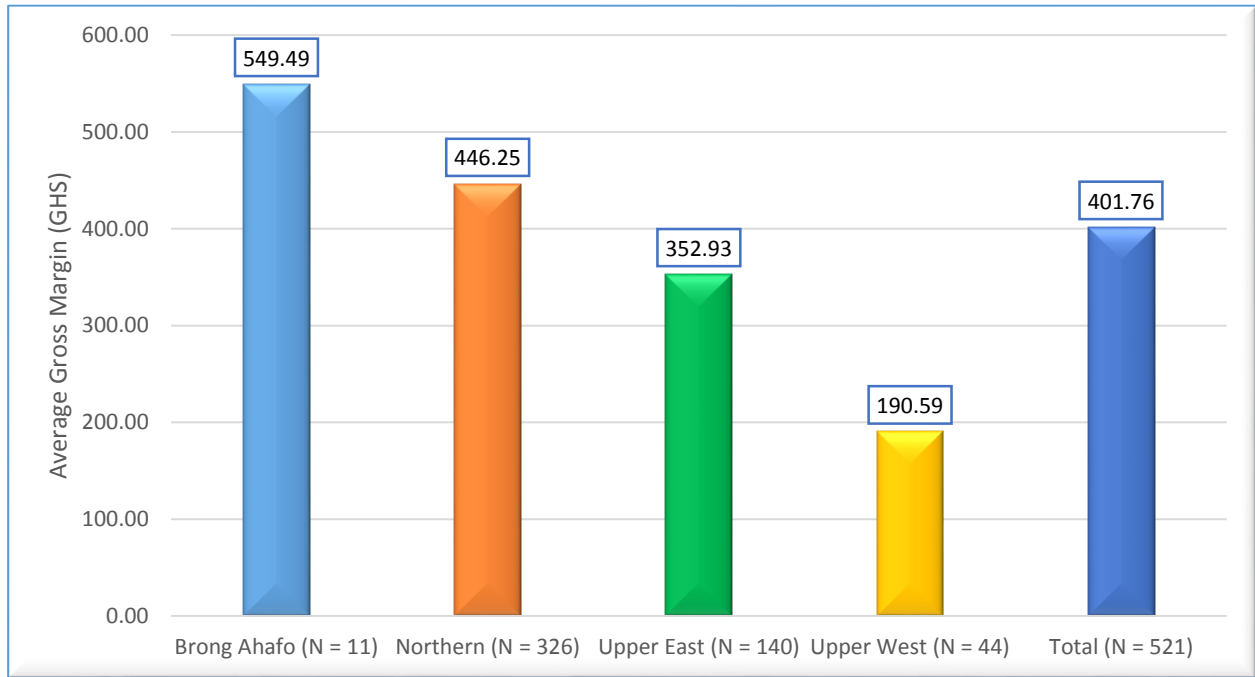
Exhibit 59: Average Gross Margin by Crop in New Ghana Cedi (GHS)
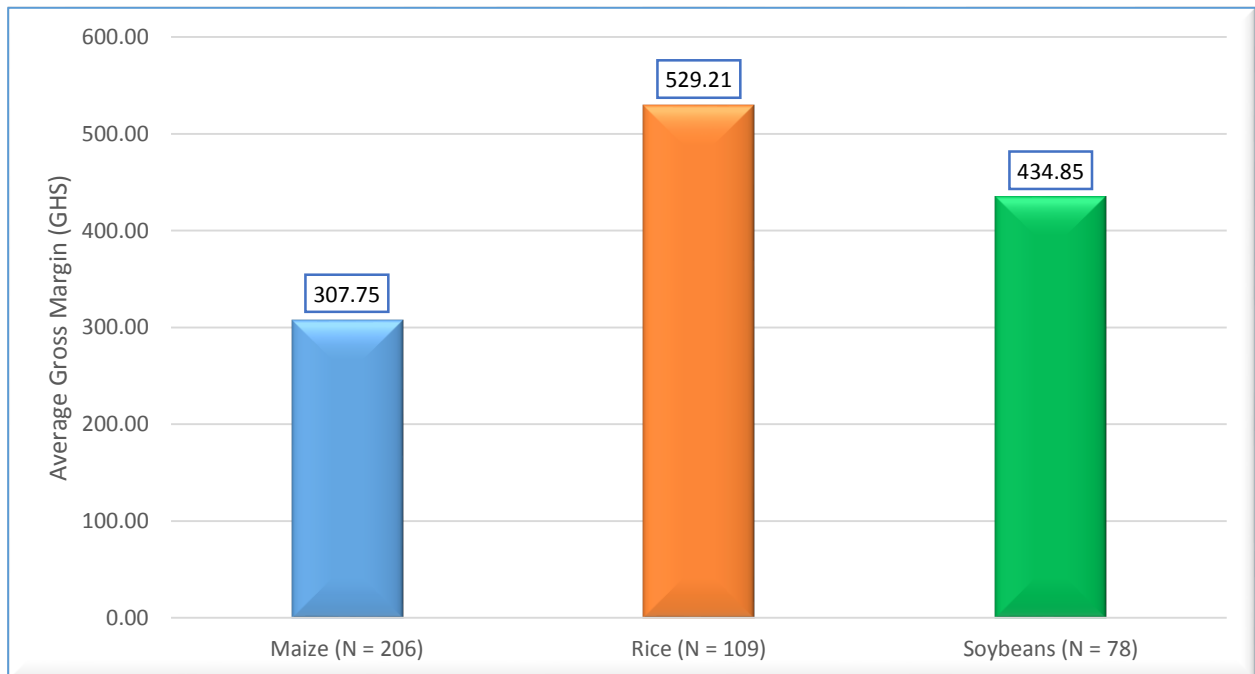
Exhibit 60: Average Gross Margin by Region and Crop in New Ghana Cedi (GHS)
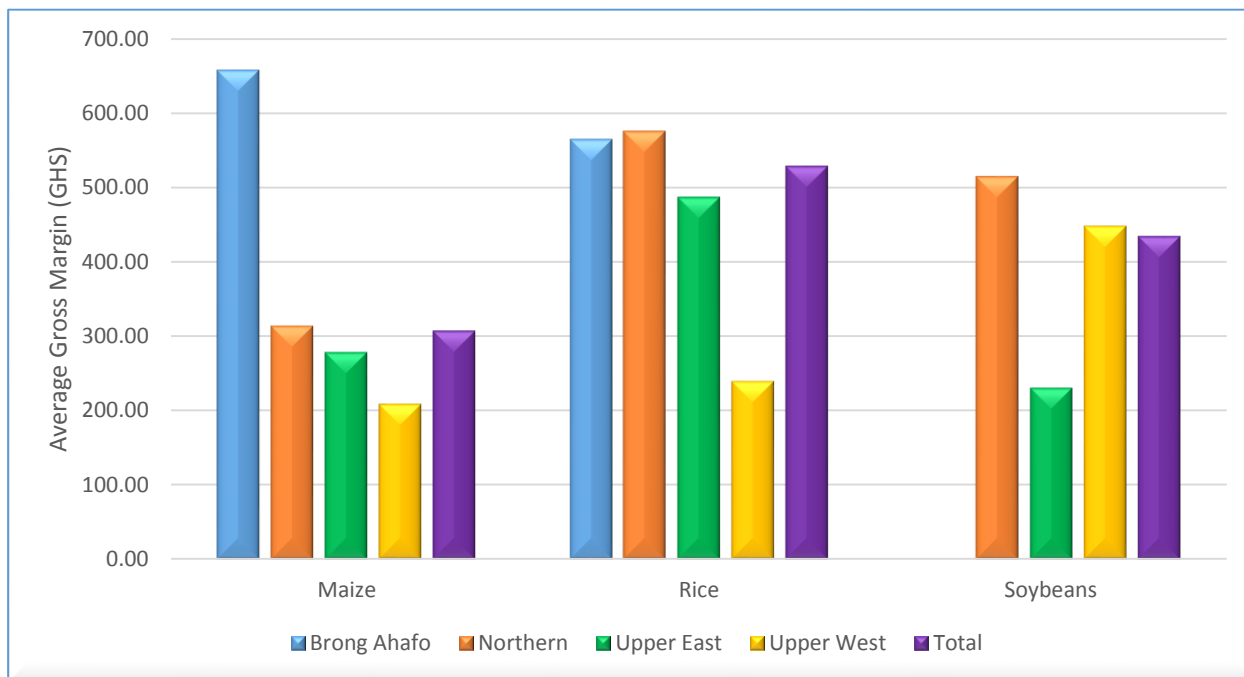
Gross Margin by Gender

Of the 388 respondents for whom we were able to estimate gross margins, only 11 percent were female, matching the total sample distribution. The distribution of the female farmers by their crops was 63 percent maize, 24 percent rice and the remaining 12 percent produced soybeans. For males, 51 percent produced maize, 28 percent rice and about 21 percent produced soybeans. This confirms research that shows that females tend to produce the staple food crops for household food needs while cash crops are often the domain of males in smallholder agricultural economies.[18]

Overall, the gross margin for males was just a little lower than twice that of females. It averaged about GHS 401.87 compared to females' average gross margin of GHS207.79. The average gross margin of females producing soybeans was negative GHS29.92 compared to GHS460.50 for males. Rice was the most profitable crop for both males and females, with the gross margin for males being about 61 percent higher than that for females. A similar proportional difference was seen between the genders for the average gross margin of maize.

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[18]   See Chaudhury et al.'s 2012 paper titled "Participatory gender-sensitive approaches for addressing key climate change-related research issues: evidence from Bangladesh, Ghana, and Uganda," CCAFS Working Paper, Issue 19.

Exhibit 61: Average Gross Margin by Crop and Gender in New Ghana Cedi (GHS) and the Number of Participants Gender
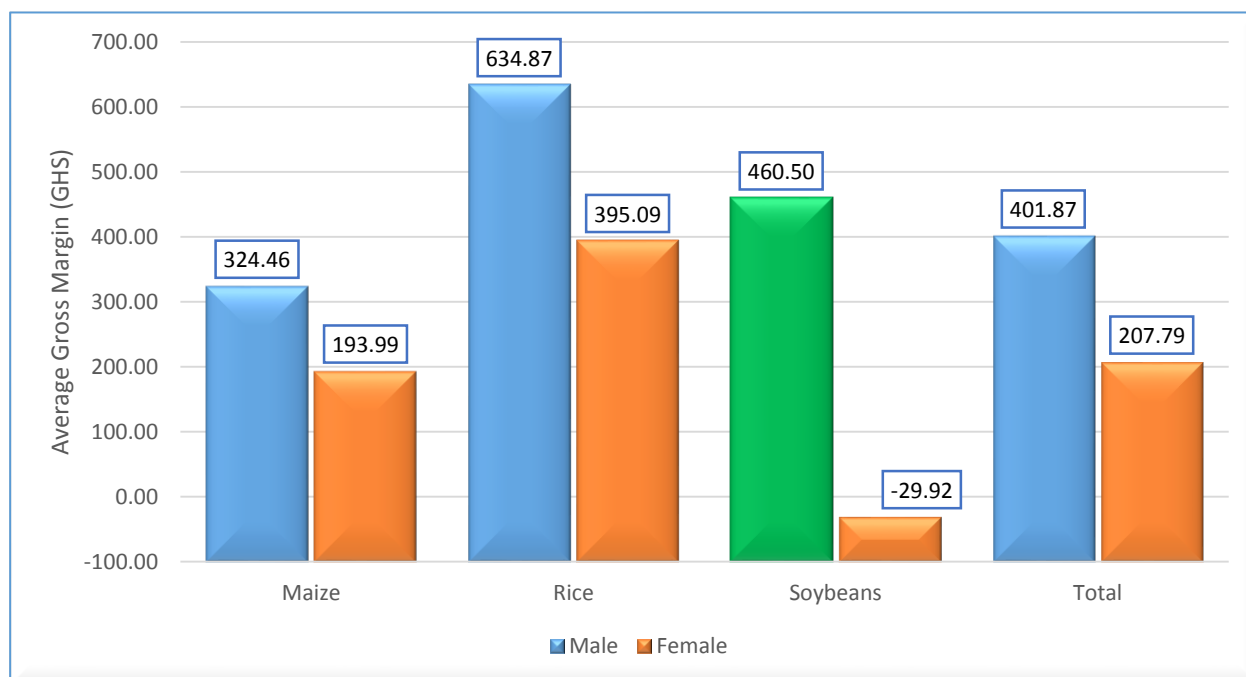
Productivity Measures

The significant differences in average household land holding across regions, crops and gender may skew the comparative outcome of the foregoing analysis. In this section, we attempt to eliminate this potential bias by assessing gross margin on a per hectare basis across regions, crops and gender. Overall, the average gross margin per hectare is GHS553.63 for 431 households that produced focus crops[19]. The gross margin per hectare for the focus crops across the study area ranged from GHS493.37 for maize to GHS816.24 for rice (Exhibit 62). Average gross margin per hectare for soybeans across the study area was GHS633.01 in 2013. The difference between the average gross margin per hectare for maize and that for rice was statistically significant at the 1 percent level but the difference between maize and soybeans average gross margin per hectare was not. Neither was the difference between rice and soybeans' average gross margin per hectare. Despite the absence of statistically significant difference, the foregoing shows that soybeans performed better than maize in terms of gross margin per hectare but rice was an economically superior crop in the study area.

Exhibit 63 presents the disaggregated gross margin per hectare by crop and region. The most economically productive area in rice production is Upper East Region, where the average gross margin per hectare is GHS1160.51. On the other hand, Upper West Region was the lowest economically productive area to produce rice, generating an average gross margin per hectare of GHS382.74, which was only about 33 percent of the performance that prevailed in Upper East Region in 2013. For maize production, the average gross margin per hectare estimated for Brong Ahafo was more than three times

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19   For all crops and all farmers in the survey, the gross margin per hectare was GHS635.76 in 2013.

higher than was estimated for Northern Region's GHS416.21. As found for rice, Upper West Region presented the lowest average gross margin per hectare for maize and also for soybean.

Exhibit 62: Average Gross Margin per Hectare by Crop in New Ghana Cedi (GHS)
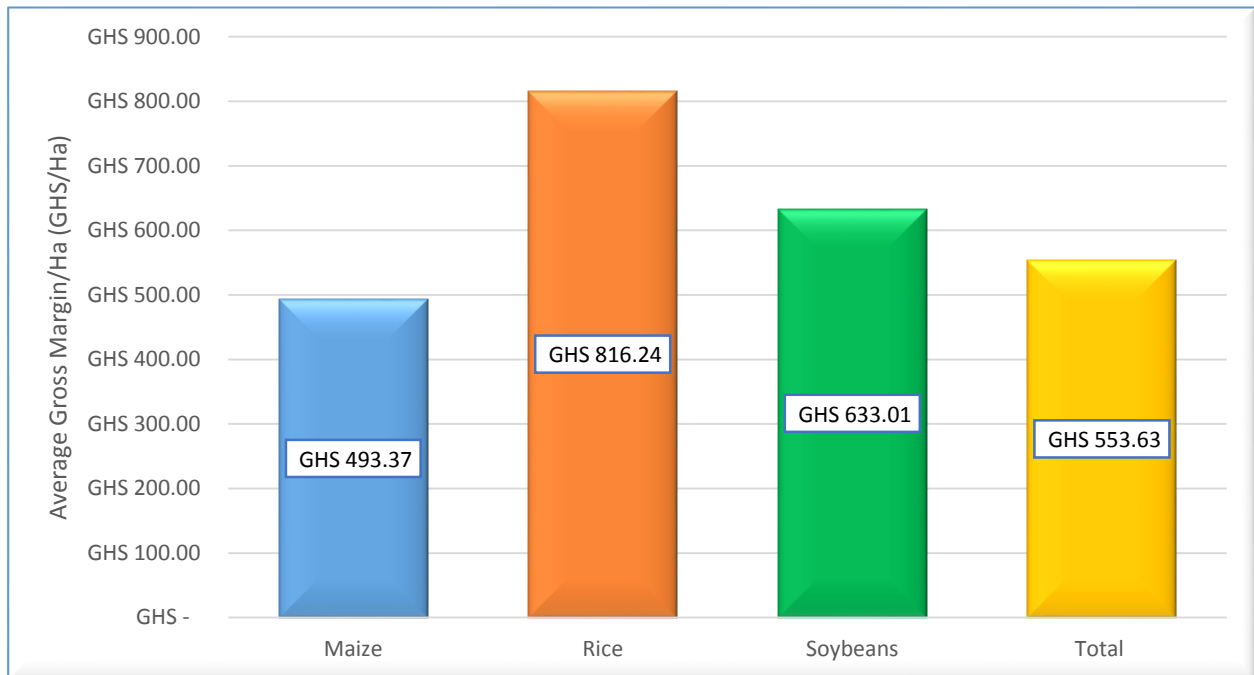
Exhibit 63: Average Gross Margin per Hectare by Crop and Region in New Ghana Cedi (GHS)
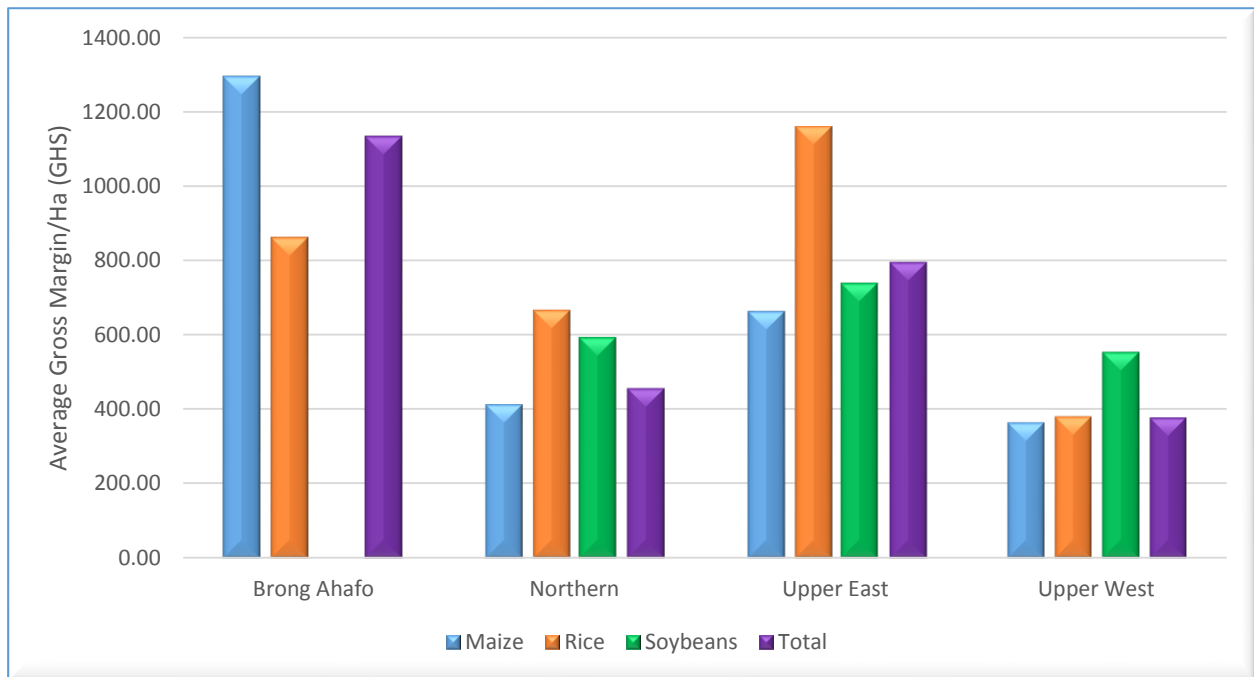
To what extent does gender present any differences to economic productivity? Average gross margin per hectare was lower for females in maize and soybeans but higher in rice. However, none of the

gender differences by crops was statistically significant. This suggests that in 2013 in the study area, there was no *statistical difference* between males and females in their economic performance as measured by gross margin per hectare in the production of all three crops. This notwithstanding, there is a need to explore some of the factors that may contribute to enhancing the *raw* economic performance of females in the production of these focus crops, especially in the production of cash crops, i.e., rice and soybeans.

Exhibit 64: Average Gross Margin per Hectare by Crop and Gender in New Ghana Cedi (GHS)
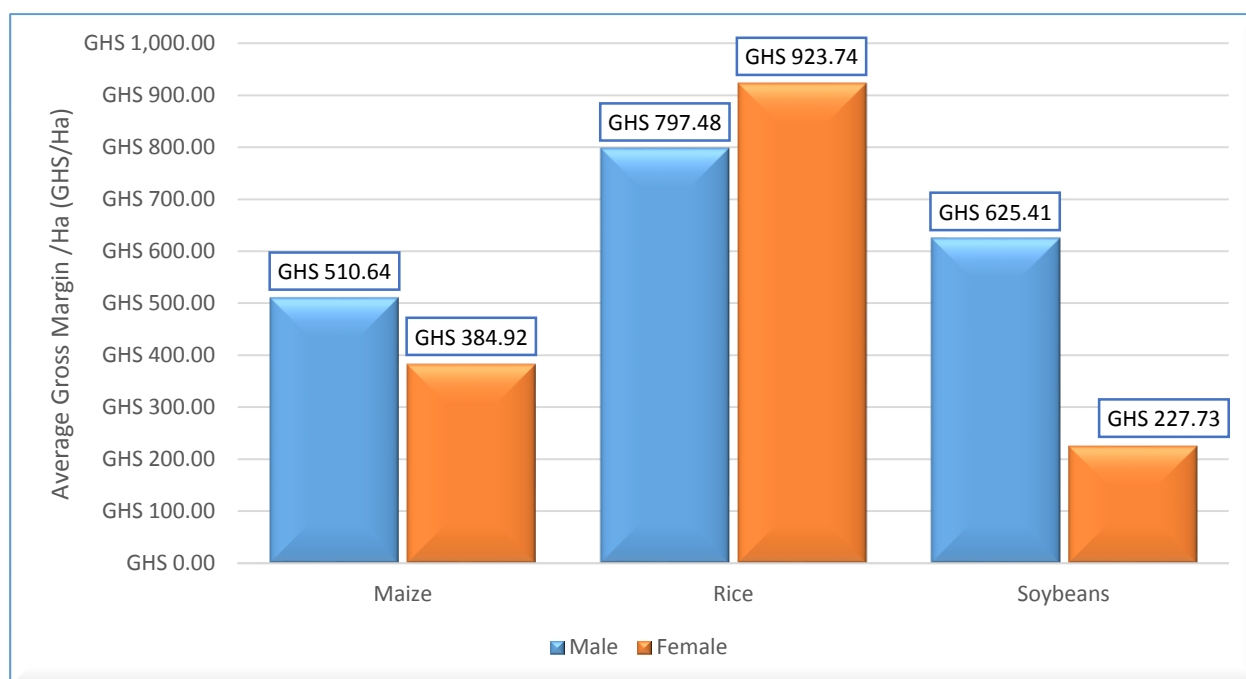
Finally, the economic productivity of labor is explored using average gross margin per labor as the metric. Across the study area, the average gross margin per labor-day was GHS 11.48. It was GHS10.07 for maize, GHS17.88 for rice and GHS6.47 for soybeans. Thus, one labor-day produced, on average, almost GHS18.00 in rice production in the study area but only about GHS6.50 in soybean production. This suggests that the highest use of labor across the region, on average, was in rice production. However, the differences in the economic productivity of labor was found to be statistically zero.[20] The average gross margin per labor-day for females across all crops was GHS5.43 compared to GHS 12.75 for males. The difference between them was statistically significant at the 1 percent level. This would suggest that a male labor-day produced about 43 percent more gross margin than a female labor-day. The differences in asset ownership and control over assets may explain this lower productivity of female labor compared to male labor.

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[20]   The difference between the average gross margin per labor-day in rice and soybean production was statistically significant only at the 10 percent ($|t| = 1.71$; $P>|t|=0.089$).

Exploring the average gross margin per labor-day by gender and crop showed that the value for males exceeded that for females across all crops (Exhibit 65). However, none of the differences between male and female average gross margin per labor-unit was statistically significant at the 5 percent level.[21]

Exhibit 65: Average Gross Margin per Labor-Day by Gender and Crop

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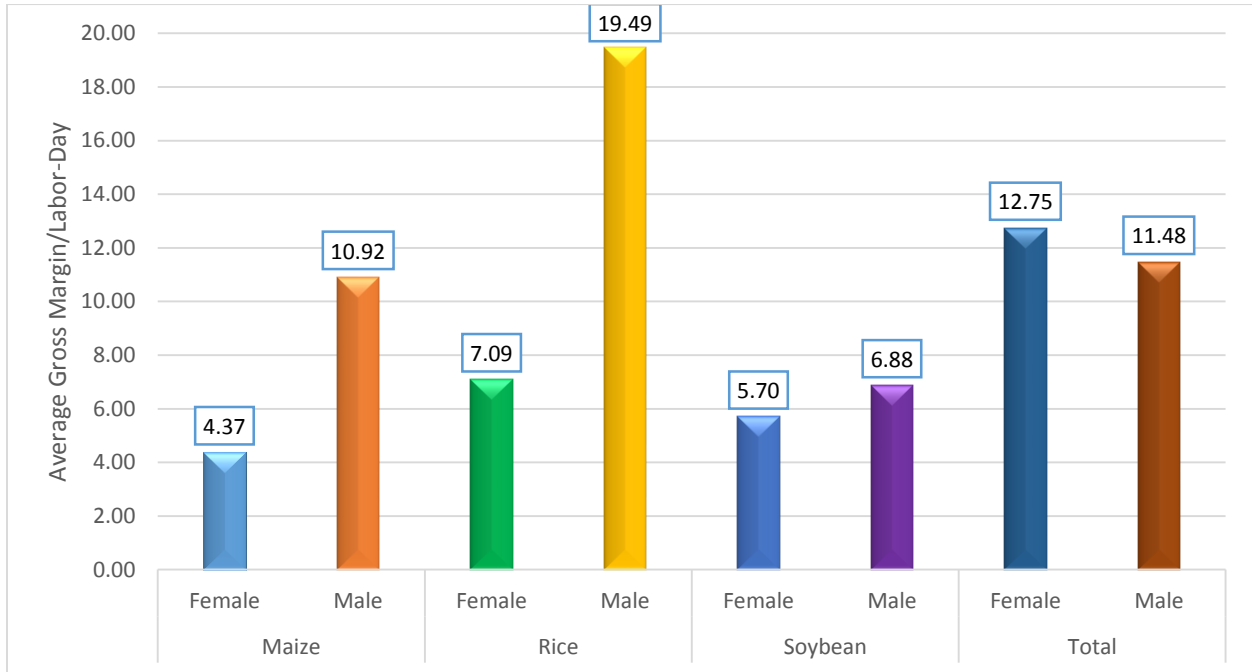
[21]   The difference between male and females for maize was statistically significant but at the 10 percent level.

Summary and Conclusions

Summary

This research sought to provide a baseline for tracking the performance intervention activities in the study area defined to encompass the area above Ghana's 8th Parallel in four regions: Brong Ahafo; Northern; Upper East; and Upper West. The total number of respondents involved in the study was 527. The study covered agricultural production and marketing activities in 2013 through 2014 as well as background information on agricultural production activities in 2012.

The major observations from the study are as follows:

- Average household hand holding was smallest in Upper East Region, about 1.0 ha, and largest in Northern Region, about 2.3 ha, which was lower than the national average land holding for smallholders. This means the farmers in this sample were very small on average.
- Average maize yield of 1,168 kg/ha in Upper East Region was the highest among the regions. It was also the region with the highest average soybean yield, posting 887 kg/ha. Brong Ahafo posted the highest average rice yield of 1,481 kg/ha.
- The most popular seed varieties planted in the study area were Obatanpa and Okomasa for maize, Jasmine and Nerica for rice and Anidaso and Jenguma for soybeans. These were not always the highest yielding varieties.
- Farmers in the study preferred retained open pollinated varieties (OPV) seeds more than any other type of seed. It was used on about 62 percent of all plots in 2013. Traditional seeds are most commonly used on rice plots. The primary source of seeds for farmers in the study area was the Ministry of Food and Agriculture's Extension Service.
- About 29 percent of the study area's farmers did not participate in the market. Of those who did, about 43 percent sold produce to consumers directly. About the same proportion sold their produce to aggregators. Only a small proportion of these farmers dealt with processors. The low proportion selling to processors is not because of an unwillingness to sell to that segment but the absence of processors to sell to. This may it be a result of the current fragmented agricultural production system.
- Maize is treated as a staple crop while rice and soybeans are essentially commercial crops. This is because about 21 percent of maize was consumed compared to about 10 percent of rice and 7 percent of soybeans. On the other hand, more than 66 percent of soybeans and 45 percent of rice were sold compared to only about 27 percent of maize.
- The estimated average revenue was GHS684. Brong Ahafo Region presented the highest average revenue and Upper West Region presented the lowest. This correlated with their average land holdings. On crop basis, soybeans had the highest average revenue, about GHS771, and maize had the lowest, about GHS606.
- Yet, maize received the most fertilizer application, averaging about 84 kg per plot, compared to about 34 kg for rice and 6 kg for soybeans. Fertilizers and chemicals accounted for about 47 percent of total variable costs in the production of the focus crops, followed by land preparation costs, which accounted for about 43 percent of total variable costs, on average.
- The average gross margin was GHS402 for the study area across all crops. However, the average gross margin for males was almost twice as high as for females. Brong Ahafo had the highest

average gross margin across all crops and rice produced the highest average gross margin across all regions. The average gross margin for Brong Ahafo and rice was GHS549 and GHS529 respectively. However, when average gross is segmented on both crop and region basis, the highest gross margin by crop and region was maize in Brong Ahafo Region, coming in at nearly GHS658.

- The highest average gross margin per hectare was for rice, about GHS816/ha. Maize posted the lowest gross margin per hectare at about GHS493. However, gross margin per hectare for maize in Brong Ahafo Region was the highest across all crops, about GHS1,300. As found in the absolute gross margin measures, females performed lower than males in all categories of gross margin per hectare with the exception of rice, where the average for female farmers was higher. However, the difference was statistically significant.

Conclusions

Food and Agriculture Organization's estimates of Ghana's national average yield for maize and rice between 2010 and 2013 were 1,782 kg/ha and 2,560 kg/ha.[22] Brazil, the latest country to set a vision of becoming a global agricultural powerhouse, has average yields of 4,706 kg/ha and 4,704 kg/ha over the same period. The estimated average yields for the study area for maize and rice in the study area were only 53 percent and 37 percent of the estimated national averages above. The study area's yields were only 20 percent of Brazil's and 21 percent and 39 percent of the world's average. This provides a backdrop for thinking about increasing productivity and sustaining livelihoods in the study area and across the country. To achieve these and sustain any gains made by investments in interventions, it is important to think broadly about socio-economic development in very broad and concrete terms. For example, we noted the study area's low literacy level. Amanor-Boadu has estimated that the likelihood of a resident in the study area moving from low-income into the middle-income increases by about 16 fold with some education compared to no education.[23] This would suggest that focusing solely on agricultural technology transfers without long-term investments in the education infrastructure could jeopardize the sustainability of any gains in the principal income indicators. In the same study, Amanor-Boadu shows how investments in built infrastructure could reduce transaction costs and improve accessibility of these smallholders to markets. This improvement would enhance their net revenues and contribute in no small way to an in their productivity.

It is imperative that discussions about enhancing farm income and performance as measured by indicators such as gross margin per hectare or gross margin per labor-day be constructed within the context of the high cost and lumpiness of climate-smart agricultural technologies. The study showed that average performance was low in the study area regardless of the metric used and the crop considered. A major source of the poor performance is the small agricultural land holdings, which makes the adoption of the necessary technologies difficult and expensive on cost per hectare basis. There is no way significant sustainable progress is going to be made by focusing on such metrics as enhancing gross margins if the fact that the high relative number of people in agriculture as evidenced by the very low average land holding is not radically addressed. In other words, it is not enough to set

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[22]   FAOStat has no data on soybean yield as of February 26, 2015. The point we seek to make is possible with the data on maize and rice.

[23]   Amanor-Boadu, V. "Securing Africa's Middle Class: The Case of Northern Ghana," *African Journal of Food, Agriculture, Nutrition and Development,* forthcoming, 2015.

productivity goals without seriously considering the factors that influence the sustainability of those goals over the long run. Given the increasing internationalization of Ghana's economy, any improvements in agricultural productivity that are not benchmarked against the world's best is not going to be sustainable. These challenges are already visible in the competitiveness woes facing the Ghana rice industry with respect to imports.[24]

How do we tackle this challenge? The results from this study provide a foundation to begin thinking more strategically about post-intervention than about *just* meeting intervention objectives. We argue, based on the results presented in this study, that there is a need to develop a systems perspective about agriculture in Ghana (and in the study area). This perspective must be broader than reducing poverty and focus on enhancing Ghana's competitiveness in the global agricultural trade environment. This is a necessary focus because of the increasing trade liberalization policies and increasing incomes across the country. As incomes increase and trade is liberalized, a non-competitive agriculture and food sector will lose market share in the domestic market and fail to compensate for this loss in the export market.

On the surface, it may seem politically dangerous (and even socially unacceptable) to discuss policies that seriously consider increasing land holding for farmers by initiating managed exit strategies from farming for farmers who are too small to be active players in the industry. Yet, when the average land holding per labor-day is only 0.06 ha, it is not difficult to see how current interventions would fail to achieve sustained income growth without finding a sustainable pathway to reduce labor in production agriculture and increase average land holding in the process. The analyses showed that while gross margin per hectare on farms with more than 4 ha was not significantly different for those on farms with less than 4 ha, the average gross margin for the 4 ha plus farms was more than GHS2,200 higher. By focusing attention on the needs and challenges of the high gross margin farms, it will be possible to enhance their productivity and begin to accelerate their economic performance.

This is the impetus for thinking about this initiative boldly, strategically and creatively. The most effective approach to this outcome is to take a long-term look and use education as the vehicle to achieve aggressive growth in agricultural productivity. We can envisage education in two broad forms: formal education of young people through an aggressive encouragement of parents to make the requisite investment; and informal education of adults through formal adult education programs that improve their decision-making and choice frameworks.

These efforts will contribute directly to improving average incomes, help current adults develop an appreciation of the underpinnings of their productivity increases and help younger people embark on a journey to escape the poverty cycle. In doing this, development partners and policymakers would also initiate an escape from failure to engender sustainable solutions to economic development efforts over the past six or decades. There are successful examples of this in various countries around the world, e.g., the US, Europe, and Japan – where emphasis on long term progress was channeled through education, infrastructure development and similar built and investment initiatives. Why do we not just copy them?

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[24]   See Amanor-Boadu, V. "Rice Price Trends in Ghana (2007-2011)," USAID|Ghana, Monitoring, Evaluation and Technical Support Service (METSS), www.agmanager.info, June 2012. Also, see Angelucci, F., A. Asante-Poku and P. Anaadumba. Analysis of incentives and disincentives for rice in Ghana. Technical Notes Series, MAFAP, FAO, Rome, 2013.

Appendix 1: District Summary Statistics Tables

Land size (hectare) allocated to Maize in 2013 by District

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	0.73	0.21	0.00	0.32	1.14	3.52	10
East Gonja	1.23	0.16	0.00	0.9	1.55	7.46	22
Kpandi	0.38	0.09	0.00	0.21	0.55	4.42	11
Nanumba South	0.35	0.08	0.00	0.19	0.5	4.39	7
Nanumba North	0.85	0.27	0.00	0.31	1.38	3.12	11
Zabzugu/Tatale	0.81	0.12	0.00	0.58	1.04	6.8	30
Yendi	2.21	0.5	0.00	1.23	3.19	4.41	21
Tamale Metro	0.97	0.12	0.00	0.73	1.22	7.86	10
Tolon Kumbungu	1.06	0.09	0.00	0.89	1.23	12.17	61
Savelugu Nanton	1.46	0.2	0.00	1.07	1.84	7.43	21
Karaga	1.56	0.15	0.00	1.26	1.85	10.39	31
Gusheigu	1.39	0.17	0.00	1.06	1.72	8.3	41
Saboba	0.77	0.13	0.00	0.52	1.02	6.06	11
Chereponi	0.74	0.06	0.00	0.61	0.86	11.64	22
Mamprusi West	1.19	0.18	0.00	0.85	1.54	6.77	11
Builsa	0.71	0.19	0.00	0.34	1.08	3.74	9
Kassena Nankana West	0.79	0.22	0.00	0.35	1.23	3.53	10
Bawku West	0.71	0.1	0.00	0.52	0.91	7.12	30
Garu Tempane	1.09	0.6	0.07	-0.09	2.27	1.82	41
Bawku Municipal	0.81	0.07	0.00	0.67	0.94	11.88	42
Wa West	0.74	0.08	0.00	0.58	0.9	8.98	9
Wa Municipal	0.49	0.08	0.00	0.32	0.65	5.85	11
Wa East	0.97	0.27	0.00	0.45	1.5	3.64	11
Jirapa	0.69	0.09	0.00	0.52	0.86	7.96	10

Land size (hectare) allocated to Rice in 2013 by District

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	1.27	0.25	0.00	0.78	1.76	5.07	11
East Gonja	0.56	.	.	.	.	.	1
Kpandi	1.02	0.60	0.09	-0.17	2.21	1.68	2
Nanumba South	0.5	0.1	0.00	0.31	0.69	5.25	8
Nanumba North	0.41	0.00	.	.	.	.	3
Zabzugu/Tatale	0.32	0.05	0.00	0.22	0.43	6.15	2
Yendi							
Tamale Metro	0.88	0.16	0.00	0.56	1.2	5.4	6
Tolon Kumbungu	0.72	0.09	0.00	0.55	0.9	8.15	21
Savelugu Nanton	0.75	0.13	0.00	0.49	1.01	5.64	14
Karaga	1.27	0.28	0.00	0.72	1.83	4.51	11
Gusheigu	0.73	0.13	0.00	0.47	0.98	5.55	14
Saboba							
Chereponi	0.66	0.25	0.01	0.16	1.16	2.6	8
Mamprusi West	0.28	0.04	0.00	0.2	0.37	6.6	4
Builsa	0.3	0.07	0.00	0.16	0.45	4.13	9
Kassena Nankana West	0.35	0.05	0.00	0.24	0.45	6.58	9
Bawku West	0.27	0.03	0.00	0.2	0.34	7.8	20
Garu Tempane	0.17	0.02	0.00	0.13	0.22	7.48	25
Bawku Municipal	0.51	0.06	0.00	0.39	0.62	8.49	30
Wa West	0.65	0.39	0.09	-0.11	1.41	1.7	7
Wa Municipal	0.41	0.11	0.00	0.19	0.62	3.65	5
Wa East	0.44	0.06	0.00	0.32	0.56	7.05	6
Jirapa	0.37	0.04	0.00	0.3	0.44	10	11

Land size (hectare) allocated to Soybean in 2013 by District

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	.	.	.	.	.	.	.
East Gonja	0.81	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	1.13	.	.	.	.	.	1
Nanumba North	0.69	0.15	0.00	0.39	0.99	4.54	5
Zabzugu/Tatale	2.03	.	.	.	.	.	1
Yendi	1.59	0.36	0.00	0.88	2.3	4.42	13
Tamale Metro	.	.	.	.	.	.	
Tolon Kumbungu	0.27	0.14	0.05	0	0.54	2	3
Savelugu Nanton	0.9	0.16	0.00	0.58	1.21	5.61	14
Karaga	1.08	0.18	0.00	0.72	1.44	5.9	19
Gusheigu	0.71	0.13	0.00	0.45	0.96	5.47	16
Saboba	.	.	.	.	.	.	.
Chereponi	0.51	0.06	0.00	0.38	0.63	7.8	20
Mamprusi West	.	.	.	.	.	.	
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	0.2	.	.	.	.	.	1
Bawku West	0.17	0.02	0.00	0.13	0.21	7.91	6
Garu Tempane	0.19	0.06	0.00	0.08	0.3	3.36	9
Bawku Municipal	0.41	0.04	0.00	0.34	0.48	11.28	20
Wa West							
Wa Municipal	0.2	.	.	.	.	.	1
Wa East	0.73	.	.	.	.	.	1
Jirapa	.	.	.	.	.	.	.

Total Revenue (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	771.12	122.24	0.00	530.99	1011.26	6.31	11
East Gonja	338.37	76.00	0.00	189.08	487.67	4.45	23
Kpandi	126.09	22.75	0.00	81.39	170.79	5.54	11
Nanumba South	388.58	67.22	0.00	256.53	520.62	5.78	11
Nanumba North	480.99	119.27	0.00	246.69	715.28	4.03	11
Zabzugu/Tatale	591.02	69.62	0.00	454.27	727.78	8.49	34
Yendi	685.59	99.46	0.00	490.2	880.98	6.89	22
Tamale Metro	1050.41	153.23	0.00	749.4	1351.42	6.86	11
Tolon Kumbungu	703.74	78.90	0.00	548.75	858.72	8.92	68
Savelugu Nanton	1048.88	126.35	0.00	800.68	1297.08	8.3	22
Karaga	1300.58	168.99	0.00	968.61	1632.55	7.7	33
Gusheigu	619.4	47.13	0.00	526.82	711.98	13.14	44
Saboba	733.81	203.42	0.00	334.21	1133.41	3.61	11
Chereponi	945.44	104.19	0.00	740.76	1150.11	9.07	22
Mamprusi West	823.11	117.45	0.00	592.38	1053.84	7.01	11
Builsa	148.91	53.09	0.01	44.61	253.2	2.8	11
Kassena Nankana West	652.39	155.37	0.00	347.19	957.6	4.2	11
Bawku West	585.16	99.80	0.00	389.11	781.21	5.86	33
Garu Tempane	607.47	83.11	0.00	444.2	770.74	7.31	43
Bawku Municipal	725.01	72.54	0.00	582.52	867.5	10	46
Wa West	292.3	94.09	0.00	107.46	477.14	3.11	11
Wa Municipal	320.56	73.00	0.00	177.16	463.95	4.39	11
Wa East	267.21	110.19	0.02	50.75	483.66	2.43	11
Jirapa	575.45	67.86	0.00	442.15	708.75	8.48	11

Total Variable Cost (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	285.73	61.73	0.00	164.47	406.99	4.63	11
East Gonja	223.85	31.92	0.00	161.15	286.55	7.01	23
Kpandi	36.82	8.65	0.00	19.82	53.82	4.25	11
Nanumba South	174.05	37.48	0.00	100.43	247.67	4.64	11
Nanumba North	232.68	65.44	0.00	104.12	361.24	3.56	11
Zabzugu/Tatale	130.21	20.98	0.00	89	171.42	6.21	34
Yendi	473.43	121.7	0.00	234.36	712.5	3.89	22
Tamale Metro	253.95	33.74	0.00	187.67	320.24	7.53	11
Tolon Kumbungu	283.61	52.32	0.00	180.83	386.39	5.42	68
Savelugu Nanton	709.02	256.59	0.01	204.97	1213.08	2.76	22
Karaga	421.8	50.98	0.00	321.66	521.95	8.27	33
Gusheigu	257.46	30.08	0.00	198.38	316.55	8.56	44
Saboba	355.18	59.25	0.00	238.78	471.58	5.99	11
Chereponi	376.95	47.61	0.00	283.43	470.48	7.92	22
Mamprusi West	351.91	61.09	0.00	231.89	471.92	5.76	11
Builsa	107.32	34.54	0.00	39.47	175.17	3.11	11
Kassena Nankana West	509.02	135.09	0.00	243.63	774.4	3.77	11
Bawku West	189.54	22.35	0.00	145.63	233.44	8.48	33
Garu Tempane	300.01	42.3	0.00	216.92	383.11	7.09	43
Bawku Municipal	323.28	30.23	0.00	263.9	382.65	10.7	46
Wa West	195.9	93.65	0.04	11.92	379.88	2.09	11
Wa Municipal	190.37	37.11	0.00	117.48	263.26	5.13	11
Wa East	103.94	30.41	0.00	44.19	163.68	3.42	11
Jirapa	267.35	43.61	0.00	181.68	353.01	6.13	11

Gross Margin (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	485.4	165.69	0.00	159.91	810.88	2.93	11
East Gonja	114.53	82.89	0.17	-48.31	277.36	1.38	23
Kpandi	89.27	19.98	0.00	50.01	128.53	4.47	11
Nanumba South	214.53	92.64	0.02	32.55	396.52	2.32	11
Nanumba North	248.3	98.64	0.01	54.53	442.08	2.52	11
Zabzugu/Tatale	460.82	54.96	0.00	352.84	568.79	8.38	34
Yendi	212.16	116.95	0.07	-17.58	441.89	1.81	22
Tamale Metro	796.45	130.16	0.00	540.76	1052.15	6.12	11
Tolon Kumbungu	420.13	83.82	0.00	255.48	584.78	5.01	68
Savelugu Nanton	339.86	231.85	0.14	-115.6	795.32	1.47	22
Karaga	878.78	153.26	0.00	577.7	1179.85	5.73	33
Gusheigu	361.94	46.03	0.00	271.52	452.35	7.86	44
Saboba	378.63	203.31	0.06	-20.77	778.03	1.86	11
Chereponi	568.48	98.98	0.00	374.04	762.93	5.74	22
Mamprusi West	471.2	136.53	0.00	203	739.4	3.45	11
Builsa	41.59	31.37	0.19	-20.04	103.22	1.33	11
Kassena Nankana West	143.37	133.19	0.28	-118.27	405.02	1.08	11
Bawku West	395.62	96.59	0.00	205.87	585.38	4.1	33
Garu Tempane	307.45	74.03	0.00	162.03	452.87	4.15	43
Bawku Municipal	401.73	78.57	0.00	247.38	556.08	5.11	46
Wa West	96.4	21.13	0.00	54.88	137.91	4.56	11
Wa Municipal	130.18	66.65	0.05	-0.74	261.11	1.95	11
Wa East	163.27	87.05	0.06	-7.74	334.28	1.88	11
Jirapa	308.1	46.11	0.00	217.52	398.69	6.68	11

Gross Margin (GHS) per Hectare per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	436	147.28	0.00	146.65	725.34	2.96	11
East Gonja	84.94	70.26	0.23	-53.09	222.96	1.21	22
Kpandi	289	95.79	0.00	100.81	477.19	3.02	11
Nanumba South	608.38	226.22	0.01	163.96	1052.8	2.69	10
Nanumba North	147.1	86.92	0.09	-23.66	317.86	1.69	10
Zabzugu/Tatale	735.58	78.35	0.00	581.66	889.49	9.39	32
Yendi	213.55	62.4	0.00	90.97	336.13	3.42	22
Tamale Metro	680.58	99.04	0.00	486.02	875.15	6.87	11
Tolon Kumbungu	490.55	107.42	0.00	279.52	701.58	4.57	63
Savelugu Nanton	257.91	104.85	0.01	51.92	463.9	2.46	22
Karaga	512.84	157.68	0.00	203.07	822.61	3.25	33
Gusheigu	316.94	50.12	0.00	218.47	415.4	6.32	44
Saboba	646.05	366.1	0.08	-73.18	1365.28	1.76	11
Chereponi	497.09	82.43	0.00	335.16	659.02	6.03	22
Mamprusi West	456.41	178.52	0.01	105.7	807.11	2.56	11
Builsa	16.37	68.76	0.81	-118.72	151.47	0.24	11
Kassena Nankana West	215.55	132.7	0.1	-45.15	476.25	1.62	11
Bawku West	571.38	170.45	0.00	236.52	906.23	3.35	32
Garu Tempane	622.98	165.3	0.00	298.24	947.73	3.77	43
Bawku Municipal	308.93	63.92	0.00	183.36	434.49	4.83	44
Wa West	101.45	31.38	0.00	39.81	163.09	3.23	11
Wa Municipal	28.75	172.13	0.87	-309.41	366.9	0.17	11
Wa East	222.08	90.27	0.01	44.75	399.41	2.46	11
Jirapa	466.03	197.79	0.02	77.46	854.61	2.36	11

Maize Gross Margin (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	179.42	107.65	0.1	-32.1	390.94	1.67	2
East Gonja	321.33	70.85	0.00	182.13	460.54	4.54	22
Kpandi	117.44	18.32	0.00	81.44	153.44	6.41	11
Nanumba South	180.38	40.02	0.00	101.74	259.02	4.51	9
Nanumba North	232.49	57.62	0.00	119.28	345.7	4.03	10
Zabzugu/Tatale	492.13	52.92	0.00	388.16	596.1	9.3	34
Yendi	492.71	70.39	0.00	354.41	631.01	7	18
Tamale Metro	854.06	155.21	0.00	549.11	1159.01	5.5	10
Tolon Kumbungu	424.61	39.25	0.00	347.49	501.74	10.82	64
Savelugu Nanton	553.21	67.73	0.00	420.13	686.29	8.17	22
Karaga	807.91	98.33	0.00	614.71	1001.12	8.22	31
Gusheigu	455.84	32.38	0.00	392.22	519.46	14.08	42
Saboba	399.14	143.48	0.01	117.22	681.05	2.78	11
Chereponi	571.94	55.99	0.00	461.93	681.96	10.21	19
Mamprusi West	649.19	83.87	0.00	484.4	813.98	7.74	11
Builsa	117.62	43.65	0.01	31.85	203.4	2.69	9
Kassena Nankana West	429.64	143.66	0.00	147.37	711.91	2.99	11
Bawku West	378.21	55.62	0.00	268.92	487.5	6.8	30
Garu Tempane	438.29	65.05	0.00	310.48	566.11	6.74	41
Bawku Municipal	547.45	55	0.00	439.39	655.51	9.95	43
Wa West	127.59	19.94	0.00	88.42	166.76	6.4	9
Wa Municipal	173.53	29.64	0.00	115.28	231.77	5.85	11
Wa East	191.76	57.88	0.00	78.03	305.49	3.31	12
Jirapa	499.12	48.5	0.00	403.84	594.41	10.29	11

Maize Variable Cost (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	78.2	31.63	0.01	16.07	140.33	2.47	10
East Gonja	218.76	30.75	0.00	158.35	279.17	7.11	23
Kpandi	32	6.51	0.00	19.21	44.79	4.91	11
Nanumba South	76.86	33.57	0.02	10.91	142.82	2.29	11
Nanumba North	195.75	63.52	0.00	70.96	320.54	3.08	10
Zabzugu/Tatale	122.74	19.9	0.00	83.63	161.84	6.17	34
Yendi	343.89	91.59	0.00	163.96	523.82	3.75	22
Tamale Metro	159.86	19.55	0.00	121.45	198.28	8.18	11
Tolon Kumbungu	183.31	18.71	0.00	146.56	220.05	9.8	68
Savelugu Nanton	513.32	243.25	0.04	35.45	991.19	2.11	22
Karaga	275.44	40.16	0.00	196.54	354.34	6.86	33
Gusheigu	201.69	24.26	0.00	154.04	249.34	8.31	42
Saboba	332.36	55.03	0.00	224.25	440.48	6.04	11
Chereponi	211.86	20.01	0.00	172.56	251.17	10.59	22
Mamprusi West	310.36	49.3	0.00	213.51	407.22	6.29	11
Builsa	82.45	32.62	0.01	18.37	146.53	2.53	10
Kassena Nankana West	333.02	70.99	0.00	193.57	472.47	4.69	11
Bawku West	155.11	19.42	0.00	116.95	193.27	7.99	33
Garu Tempane	233.62	27.07	0.00	180.44	286.81	8.63	42
Bawku Municipal	227.83	27.48	0.00	173.84	281.82	8.29	45
Wa West	57.6	17.97	0.00	22.31	92.89	3.21	9
Wa Municipal	165.37	35.53	0.00	95.57	235.17	4.65	11
Wa East	132.22	56.14	0.02	21.93	242.5	2.36	13
Jirapa	191.89	33.41	0.00	126.26	257.52	5.74	11

Maize Gross Margin (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	140.92	146.15	0.34	-146.24	428.09	0.96	2
East Gonja	98.31	83.33	0.24	-65.42	262.04	1.18	22
Kpandi	85.44	15.91	0.00	54.18	116.71	5.37	11
Nanumba South	86.44	64.29	0.18	-39.87	212.75	1.34	9
Nanumba North	36.74	56.21	0.51	-73.71	147.18	0.65	10
Zabzugu/Tatale	369.39	45.61	0.00	279.79	459	8.1	34
Yendi	110.24	116.43	0.34	-118.52	338.99	0.95	18
Tamale Metro	678.21	156.27	0.00	371.17	985.25	4.34	10
Tolon Kumbungu	229.85	38.46	0.00	154.28	305.42	5.98	64
Savelugu Nanton	39.89	252.44	0.87	-456.11	535.89	0.16	22
Karaga	520.51	89.53	0.00	344.6	696.42	5.81	31
Gusheigu	254.15	33	0.00	189.32	318.98	7.7	42
Saboba	66.77	118.88	0.57	-166.8	300.35	0.56	11
Chereponi	359.26	59.15	0.00	243.04	475.47	6.07	19
Mamprusi West	338.82	104.16	0.00	134.17	543.48	3.25	11
Builsa	26.01	12.65	0.04	1.17	50.86	2.06	9
Kassena Nankana West	96.62	141.88	0.5	-182.15	375.39	0.68	11
Bawku West	221.05	52.78	0.00	117.36	324.75	4.19	30
Garu Tempane	198.97	61.84	0.00	77.47	320.48	3.22	41
Bawku Municipal	325.05	62.9	0.00	201.45	448.64	5.17	43
Wa West	69.99	29.04	0.02	12.93	127.05	2.41	9
Wa Municipal	8.16	32.52	0.8	-55.74	72.05	0.25	11
Wa East	48.53	80.65	0.55	-109.94	206.99	0.6	12
Jirapa	307.23	34.86	0.00	238.74	375.73	8.81	11

Maize Gross Margin (GHS) per Hectare per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	347.96	360.87	0.34	-361.16	1057.08	0.96	2
East Gonja	93.81	71.3	0.19	-46.3	233.91	1.32	21
Kpandi	308.74	92.29	0.00	127.39	490.09	3.35	11
Nanumba South	353.55	237.81	0.14	-113.75	820.85	1.49	7
Nanumba North	65.12	75.84	0.39	-83.9	214.13	0.86	10
Zabzugu/Tatale	601.68	75.92	0.00	452.49	750.86	7.92	30
Yendi	239.57	86.6	0.01	69.41	409.73	2.77	18
Tamale Metro	676.78	129.7	0.00	421.91	931.65	5.22	10
Tolon Kumbungu	324.6	99.65	0.00	128.78	520.42	3.26	61
Savelugu Nanton	85.01	194.67	0.66	-297.52	467.55	0.44	21
Karaga	581.16	179.2	0.00	229.02	933.29	3.24	30
Gusheigu	305.75	45.28	0.00	216.78	394.71	6.75	41
Saboba	8.11	104.87	0.94	-197.95	214.17	0.08	11
Chereponi	568.02	84.79	0.00	401.4	734.64	6.7	19
Mamprusi West	225.23	126.57	0.08	-23.48	473.94	1.78	11
Builsa	71.47	40.13	0.08	-7.38	150.31	1.78	9
Kassena Nankana West	284.07	276.03	0.3	-258.33	826.47	1.03	10
Bawku West	465.11	120.96	0.00	227.42	702.8	3.85	29
Garu Tempane	474.68	238.08	0.05	6.85	942.5	1.99	41
Bawku Municipal	415.33	77.48	0.00	263.07	567.58	5.36	41
Wa West	125.34	57.15	0.03	13.04	237.63	2.19	9
Wa Municipal	-77.67	157.75	0.62	-387.65	232.3	-0.49	11
Wa East	81.57	51.19	0.11	-19.02	182.15	1.59	11
Jirapa	444.41	43.75	0.00	358.44	530.39	10.16	10

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Rice Revenue (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	738.5	123.37	0.00	495.47	981.53	5.99	11
East Gonja	475.68	.	.	.	.	.	1
Kpandi	95.14	.	.	.	.	.	1
Nanumba South	316.51	47.97	0.00	222.02	411	6.6	8
Nanumba North	190.27	60.17	0.00	71.74	308.8	3.16	5
Zabzugu/Tatale	316.44	77.61	0.00	163.55	469.33	4.08	10
Yendi	.	.	.	.	.	.	.
Tamale Metro	376.74	72.76	0.00	233.41	520.07	5.18	8
Tolon Kumbungu	466.43	79.57	0.00	309.68	623.18	5.86	39
Savelugu Nanton	388.76	67.31	0.00	256.17	521.35	5.78	11
Karaga	1200.56	193.84	0.00	818.71	1582.41	6.19	7
Gusheigu	375.78	45.97	0.00	285.23	466.33	8.18	15
Saboba	491.53	230.32	0.03	37.83	945.24	2.13	3
Chereponi	514.89	40.44	0.00	435.23	594.55	12.73	6
Mamprusi West	478.29	206.43	0.02	71.65	884.94	2.32	4
Builsa	72.42	29.95	0.02	13.42	131.43	2.42	8
Kassena Nankana West	436.39	149.36	0.00	142.17	730.62	2.92	10
Bawku West	321.55	55.31	0.00	212.6	430.5	5.81	18
Garu Tempane	273.18	59.98	0.00	155.03	391.33	4.55	24
Bawku Municipal	254.14	52.31	0.00	151.1	357.18	4.86	30
Wa West	157.71	94.45	0.1	-28.35	343.76	1.67	7
Wa Municipal	323.46	97.95	0.00	130.51	516.41	3.3	5
Wa East	256.86	150.12	0.09	-38.86	552.59	1.71	5
Jirapa	167.91	61.07	0.01	47.61	288.22	2.75	5

Rice Variable Cost (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	214.64	40.92	0.00	134.16	295.12	5.25	11
East Gonja	60	.	.	.	.	.	1
Kpandi	5.89	4.14	0.16	-2.26	14.04	1.42	9
Nanumba South	124.38	37.2	0.00	51.22	197.53	3.34	8
Nanumba North	32.33	15.06	0.03	2.72	61.95	2.15	6
Zabzugu/Tatale	11.65	2.97	0.00	5.81	17.48	3.93	17
Yendi	35.5	35.5	0.32	-34.32	105.32	1	2
Tamale Metro	94.09	29.78	0.00	35.51	152.67	3.16	11
Tolon Kumbungu	125.18	52.48	0.02	21.98	228.39	2.39	52
Savelugu Nanton	142.34	27.6	0.00	88.07	196.62	5.16	16
Karaga	118.43	31.44	0.00	56.59	180.26	3.77	20
Gusheigu	83.94	18.21	0.00	48.14	119.75	4.61	17
Saboba	29	19	0.13	-8.37	66.37	1.53	4
Chereponi	101.71	29.86	0.00	42.98	160.44	3.41	17
Mamprusi West	76.17	42.61	0.07	-7.64	159.97	1.79	6
Builsa	35.6	9.38	0.00	17.16	54.04	3.8	10
Kassena Nankana West	161.91	56.55	0.00	50.7	273.12	2.86	11
Bawku West	34.66	6.33	0.00	22.21	47.1	5.48	29
Garu Tempane	74.77	18.7	0.00	38	111.54	4	33
Bawku Municipal	86.96	12.05	0.00	63.26	110.66	7.22	39
Wa West	70.5	49.7	0.16	-27.24	168.24	1.42	7
Wa Municipal	30	13.53	0.03	3.39	56.61	2.22	8
Wa East	52.56	20.57	0.01	12.11	93.01	2.56	8
Jirapa	75.45	13.37	0.00	49.15	101.76	5.64	11

Rice Gross Margin (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	523.86	147.9	0.00	232.52	815.21	3.54	11
East Gonja	415.68	.	.	.	.	.	1
Kpandi	77.14	.	.	.	.	.	1
Nanumba South	192.14	67.23	0.00	59.7	324.58	2.86	8
Nanumba North	160.87	43.61	0.00	74.96	246.78	3.69	5
Zabzugu/Tatale	300.24	77	0.00	148.57	451.91	3.9	10
Yendi	.	.	.	.	.	.	.
Tamale Metro	247.36	69.85	0.00	109.76	384.97	3.54	8
Tolon Kumbungu	303.44	109.03	0.01	88.65	518.23	2.78	39
Savelugu Nanton	241.44	69.55	0.00	104.44	378.44	3.47	11
Karaga	940.64	183.11	0.00	579.92	1301.35	5.14	10
Gusheigu	291.98	45.25	0.00	202.85	381.11	6.45	15
Saboba	479.53	235.93	0.04	14.77	944.3	2.03	3
Chereponi	317.22	51.55	0.00	215.67	418.78	6.15	6
Mamprusi West	364.04	210.12	0.08	-49.88	777.96	1.73	4
Builsa	31.92	31.98	0.32	-31.07	94.91	1	8
Kassena Nankana West	227.04	167.57	0.18	-103.06	557.14	1.35	10
Bawku West	277.25	56.47	0.00	166	388.49	4.91	18
Garu Tempane	176.37	63.66	0.01	50.97	301.77	2.77	24
Bawku Municipal	146.12	45.02	0.00	57.44	234.8	3.25	30
Wa West	87.21	103.65	0.4	-116.98	291.39	0.84	7
Wa Municipal	275.46	82.22	0.00	113.49	437.43	3.35	5
Wa East	201.96	138.53	0.15	-70.92	474.85	1.46	5
Jirapa	107.43	47.17	0.02	14.51	200.36	2.28	5

Rice Gross Margin (GHS) per Hectare per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	839.73	310.88	0.01	226.64	1452.82	2.7	11
East Gonja	743.74	.	.	.	.	.	1
Kpandi	186.72	.	.	.	.	.	1
Nanumba South	594.84	216.75	0.01	167.38	1022.3	2.74	8
Nanumba North	505.42	154.98	0.00	199.78	811.05	3.26	3
Zabzugu/Tatale	189.6	.	.	.	.	.	1
Yendi	.	.	.	.	.	.	.
Tamale Metro	354.92	147.41	0.02	64.21	645.63	2.41	6
Tolon Kumbungu	281.35	152.74	0.07	-19.88	582.59	1.84	18
Savelugu Nanton	417.2	127.02	0.00	166.71	667.7	3.28	11
Karaga	818.57	214.54	0.00	395.47	1241.68	3.82	7
Gusheigu	760.83	298.16	0.01	172.81	1348.86	2.55	13
Saboba	739.58	162.18	0.00	419.73	1059.42	4.56	6
Chereponi	1376.43	814.29	0.09	-229.47	2982.33	1.69	4
Mamprusi West	58.2	120.92	0.63	-180.26	296.66	0.48	8
Builsa	353.12	213.47	0.1	-67.88	774.12	1.65	10
Kassena Nankana West	1262.6	297.81	0.00	675.27	1849.93	4.24	16
Bawku West	891.47	314.41	0.01	271.42	1511.53	2.84	24
Garu Tempane	316.08	90.84	0.00	136.94	495.23	3.48	28
Bawku Municipal	365.97	209.59	0.08	-47.37	779.31	1.75	7
Wa West	719.72	176.57	0.00	371.5	1067.94	4.08	5
Wa Municipal	382.85	286.33	0.18	-181.83	947.53	1.34	4
Wa East	396.89	238.22	0.10	-72.9	866.69	1.67	5
Jirapa	.	.	.	.	.	.	.

Soybean Revenue (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	.	.	.	.	.	.	.
East Gonja	237.64	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	118.82	.	.	.	.	.	1
Nanumba North	315.77	40.21	0.00	236.23	395.31	7.85	6
Zabzugu/Tatale	198.04	.	.	.	.	.	1
Yendi	443.87	67.04	0.00	311.24	576.5	6.62	14
Tamale Metro	.	.	.	.	.	.	.
Tolon Kumbungu	317.65	154.01	0.04	12.98	622.33	2.06	5
Savelugu Nanton	473.46	82.73	0.00	309.8	637.12	5.72	14
Karaga	366.05	62.05	0.00	243.31	488.8	5.9	18
Gusheigu	184.03	35.28	0.00	114.23	253.83	5.22	13
Saboba	245.21	59	0.00	128.49	361.92	4.16	9
Chereponi	427.71	24.23	0.00	379.77	475.65	17.65	16
Mamprusi West	.	.	.	.	.	.	.
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	475.29	.	.	.	.	.	1
Bawku West	272	124.79	0.03	25.13	518.88	2.18	8
Garu Tempane	199.34	49.35	0.00	101.72	296.96	4.04	8
Bawku Municipal	136.62	27.75	0.00	81.72	191.52	4.92	16
Wa West	.	.	.	.	.	.	.
Wa Municipal	316.86	.	.	.	.	.	1
Wa East	.	.	.	.	.	.	.
Jirapa	.	.	.	.	.	.	.

Soybean Variable Cost (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	.	.	.	.	.	.	.
East Gonja	57	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	37	37	0.32	-35.87	109.87	1	2
Nanumba North	66.33	21.52	0.00	23.95	108.71	3.08	6
Zabzugu/Tatale	8	5.61	0.15	-3.04	19.04	1.43	7
Yendi	138.95	38.2	0.00	63.71	214.19	3.64	20
Tamale Metro	.	.	.	.	.	.	.
Tolon Kumbungu	9.5	5.37	0.08	-1.08	20.08	1.77	14
Savelugu Nanton	101.4	27.24	0.00	47.75	155.05	3.72	20
Karaga	99.81	19.27	0.00	61.86	137.76	5.18	24
Gusheigu	50.94	11.94	0.00	27.43	74.45	4.27	25
Saboba	12.27	3.26	0.00	5.84	18.7	3.76	11
Chereponi	90.62	9.93	0.00	71.07	110.17	9.13	21
Mamprusi West	0	.	.	.	.	.	1
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	31	31	0.32	-30.05	92.05	1	5
Bawku West	5.24	2.02	0.01	1.27	9.21	2.6	25
Garu Tempane	20.03	7.95	0.01	4.37	35.7	2.52	31
Bawku Municipal	36.09	7.17	0.00	21.96	50.22	5.03	34
Wa West	0	.	.	.	.	.	1
Wa Municipal	8.75	8.75	0.32	-8.48	25.98	1	4
Wa East	147	.	.	.	.	.	1
Jirapa	0	0	.	.	.	.	2

Soybean Gross Margin (GHS) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	.	.	.	.	.	.	.
East Gonja	180.64	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	44.82	.	.	.	.	.	1
Nanumba North	249.44	46.18	0.00	158.08	340.8	5.4	6
Zabzugu/Tatale	180.04	.	.	.	.	.	1
Yendi	245.37	63.3	0.00	120.15	370.59	3.88	14
Tamale Metro	.	.	.	.	.	.	.
Tolon Kumbungu	291.05	160.67	0.07	-26.79	608.9	1.81	5
Savelugu Nanton	328.6	68.67	0.00	192.75	464.45	4.79	14
Karaga	247.22	59.78	0.00	128.97	365.48	4.14	18
Gusheigu	94.14	23.73	0.00	47.21	141.08	3.97	13
Saboba	233.54	59.36	0.00	116.12	350.96	3.93	9
Chereponi	326.96	19.47	0.00	288.44	365.49	16.79	16
Mamprusi West	.	.	.	.	.	.	.
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	320.29	.	.	.	.	.	1
Bawku West	259	125.54	0.04	10.65	507.35	2.06	8
Garu Tempane	146.21	54.55	0.01	38.3	254.13	2.68	8
Bawku Municipal	85.37	31.48	0.01	23.09	147.64	2.71	16
Wa West	.	.	.	.	.	.	.
Wa Municipal	.	.	.	.	.	.	.
Wa East	169.86	.	.	.	.	.	1
Jirapa	.	.	.	.	.	.	.

Soybean Gross Margin (GHS) per Hectare per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	.	.	.	.	.	.	.
East Gonja	223.02	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	39.53	.	.	.	.	.	1
Nanumba North	501.91	188.45	0.01	128.51	875.3	2.66	5
Zabzugu/Tatale	.	.	.	.	.	.	.
Yendi	300.44	76.69	0.00	148.49	452.39	3.92	13
Tamale Metro	.	.	.	.	.	.	.
Tolon Kumbungu	163.71	287.26	0.57	-405.47	732.89	0.57	2
Savelugu Nanton	434.45	108.24	0.00	219.98	648.92	4.01	14
Karaga	315.84	79.72	0.00	157.89	473.79	3.96	17
Gusheigu	127.96	31.3	0.00	65.94	189.98	4.09	13
Saboba							
Chereponi	700.21	51.85	0.00	597.46	802.95	13.5	16
Mamprusi West	.	.	.	.	.	.	.
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	1581.68	.	.	.	.	.	1
Bawku West	871.98	761.06	0.25	-635.96	2379.92	1.15	5
Garu Tempane	1011	301.96	0.00	412.71	1609.29	3.35	8
Bawku Municipal	223.68	81.57	0.01	62.05	385.31	2.74	16
Wa West	.	.	.	.	.	.	.
Wa Municipal	.	.	.	.	.	.	.
Wa East	233	.	.	.	.	.	1
Jirapa	.	.	.	.	.	.	.

Proportion of Maize Output Sold (Percent) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	0.13	0.13	0.32	-0.12	0.37	1	2
East Gonja	0.02	0.02	0.32	-0.02	0.05	1	22
Kpandi	0.14	0.1	0.15	-0.05	0.34	1.43	11
Nanumba South	0.25	0.09	0	0.08	0.42	2.85	9
Nanumba North	0.21	0.1	0.04	0.01	0.4	2.07	11
Zabzugu/Tatale	0.01	0.01	0.32	-0.01	0.04	1	33
Yendi	0.4	0.08	0.00	0.25	0.55	5.31	18
Tamale Metro	0.25	0.06	0.00	0.13	0.37	4.03	10
Tolon Kumbungu	0.15	0.04	0.00	0.08	0.22	4.08	63
Savelugu Nanton	0.38	0.07	0.00	0.24	0.53	5.37	22
Karaga	0.29	0.05	0.00	0.19	0.4	5.4	31
Gusheigu	0.1	0.03	0.00	0.05	0.16	3.5	42
Saboba	0.05	0.05	0.32	-0.05	0.15	1	10
Chereponi	0.41	0.03	0.00	0.35	0.48	12.77	19
Mamprusi West	0.03	0.02	0.17	-0.01	0.07	1.37	11
Builsa	0.04	0.04	0.32	-0.04	0.11	1	9
Kassena Nankana West	0.07	0.03	0.04	0	0.13	2.07	11
Bawku West	0.24	0.05	0.00	0.13	0.34	4.45	30
Garu Tempane	0.56	0.04	0.00	0.47	0.65	12.64	41
Bawku Municipal	0.08	0.03	0.00	0.03	0.13	3.03	42
Wa West	0	0	.	.	.	.	9
Wa Municipal	0.04	0.02	0.03	0	0.07	2.12	11
Wa East	0.18	0.08	0.04	0.01	0.34	2.08	12
Jirapa	0.14	0.04	0.00	0.05	0.23	3.21	11

Proportion of Rice Output Sold (Percent) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	0.22	0.06	0.00	0.1	0.34	3.53	11
East Gonja	0	.	.	.	.	.	1
Kpandi	0	.	.	.	.	.	1
Nanumba South	0.49	0.11	0.00	0.27	0.71	4.44	8
Nanumba North	0.52	0.15	0.00	0.23	0.8	3.56	5
Zabzugu/Tatale	0.05	0.04	0.16	-0.02	0.12	1.39	10
Yendi							
Tamale Metro	0.65	0.05	0.00	0.55	0.74	13.41	8
Tolon Kumbungu	0.36	0.07	0.00	0.22	0.49	5.26	38
Savelugu Nanton	0.44	0.09	0.00	0.26	0.63	4.79	11
Karaga	0.38	0.06	0.00	0.26	0.5	6.32	10
Gusheigu	0.29	0.08	0.00	0.13	0.44	3.62	15
Saboba	0.07	0.07	0.32	-0.06	0.2	1	3
Chereponi	0.52	0.04	0.00	0.45	0.6	13.72	6
Mamprusi West	0	0	.	.	.	.	4
Builsa	0	0	.	.	.	.	7
Kassena Nankana West	0	0	0.32	0	0.01	1	7
Bawku West	0.17	0.06	0.01	0.04	0.29	2.66	17
Garu Tempane	0.38	0.05	0.00	0.28	0.49	7.19	24
Bawku Municipal	0.47	0.06	0.00	0.35	0.6	7.36	30
Wa West	0.21	0.15	0.16	-0.08	0.49	1.41	7
Wa Municipal	0.34	0.11	0.00	0.13	0.55	3.24	5
Wa East	0.07	0.07	0.32	-0.06	0.2	1	5
Jirapa	0	0	.	.	.	.	5

Proportion of Soybean Output Sold (Percent) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I. Lower Level	95% C.I. Upper Level	t-Value	Sample Size
Pru	.	.	.	.	.	.	.
East Gonja	0	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	.33	.	.	.	.	.	1
Nanumba North	.83	0.09	0.00	0.65	1.01	9.25	6
Zabzugu/Tatale	0	.	.	.	.	.	1
Yendi	0.77	0.05	0.00	0.66	0.87	14.88	13
Tamale Metro	.	.	.	.	.	.	.
Tolon Kumbungu	0.39	0.2	0.05	0	0.78	1.98	5
Savelugu Nanton	0.65	0.07	0.00	0.5	0.79	8.93	14
Karaga	0.79	0.07	0.00	0.64	0.93	10.83	18
Gusheigu	0.7	0.11	0.00	0.48	0.93	6.22	14
Saboba	0.66	0.15	0.00	0.37	0.95	4.48	9
Chereponi	0.39	0.05	0.00	0.29	0.49	7.84	16
Mamprusi West	.	.	.	.	.	.	.
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	0	.	.	.	.	.	1
Bawku West	0.11	0.09	0.21	-0.06	0.28	1.25	8
Garu Tempane	0.49	0.1	0.00	0.28	0.7	4.7	8
Bawku Municipal	0.61	0.07	0.00	0.48	0.74	9.18	16
Wa West	.	.	.	.	.	.	.
Wa Municipal	.	.	.	.	.	.	.
Wa East	1	.	.	.	.	.	1
Jirapa	.	.	.	.	.	.	.

Proportion of Maize Output Consumed (Percent) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	0.13	0.13	0.32	-0.12	0.37	1	2
East Gonja	0.32	0.07	0.00	0.17	0.46	4.31	22
Kpandi	0.61	0.09	0.00	0.44	0.78	6.96	11
Nanumba South	0.57	0.09	0.00	0.4	0.74	6.55	9
Nanumba North	0.54	0.1	0.00	0.35	0.73	5.66	11
Zabzugu/Tatale	0.02	0	0.00	0.01	0.03	4.71	33
Yendi	0.48	0.08	0.00	0.32	0.63	6.04	18
Tamale Metro	0.39	0.05	0.00	0.29	0.48	7.98	10
Tolon Kumbungu	0.4	0.05	0.00	0.3	0.49	8.11	63
Savelugu Nanton	0.42	0.05	0.00	0.33	0.51	9.12	22
Karaga	0.39	0.06	0.00	0.28	0.5	6.97	31
Gusheigu	0.58	0.04	0.00	0.5	0.65	15.34	42
Saboba	0.61	0.1	0.00	0.43	0.8	6.38	10
Chereponi	0.38	0.03	0.00	0.32	0.45	12.38	21
Mamprusi West	0.16	0.03	0.00	0.1	0.22	5.32	11
Builsa	0.27	0.08	0.00	0.11	0.44	3.22	9
Kassena Nankana West	0.44	0.09	0.00	0.26	0.62	4.87	11
Bawku West	0.42	0.07	0.00	0.28	0.56	5.82	28
Garu Tempane	0.34	0.04	0.00	0.25	0.42	7.75	41
Bawku Municipal	0.36	0.04	0.00	0.28	0.44	9.01	42
Wa West	0.46	0.07	0.00	0.33	0.59	7.03	11
Wa Municipal	0.55	0.09	0.00	0.38	0.73	6.17	11
Wa East	0.62	0.08	0.00	0.46	0.77	7.63	10
Jirapa	0.63	0.04	0.00	0.55	0.72	14.51	11

Proportion of Rice Output Consumed (Percent) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	0.06	0.01	0.00	0.03	0.09	4.17	11
East Gonja	0.2	.	.	.	.	.	1
Kpandi	0.5	.	.	.	.	.	1
Nanumba South	0.24	0.05	0.00	0.14	0.34	4.57	8
Nanumba North	0.05	0.02	0.06	0	0.09	1.91	5
Zabzugu/Tatale	0.12	0.1	0.22	-0.07	0.31	1.24	10
Yendi							
Tamale Metro	0.09	0.05	0.07	-0.01	0.18	1.85	8
Tolon Kumbungu	0.13	0.04	0.00	0.05	0.22	3.11	38
Savelugu Nanton	0.1	0.04	0.02	0.02	0.19	2.31	11
Karaga	0.14	0.06	0.02	0.02	0.27	2.36	10
Gusheigu	0.27	0.07	0.00	0.14	0.4	4.15	15
Saboba	0.06	0.06	0.32	-0.05	0.17	1	3
Chereponi	0.32	0.09	0.00	0.13	0.5	3.42	9
Mamprusi West	0.08	0.08	0.31	-0.08	0.25	1.02	4
Builsa	0.49	0.19	0.01	0.12	0.85	2.6	7
Kassena Nankana West	0.63	0.12	0.00	0.39	0.87	5.18	7
Bawku West	0.34	0.1	0.00	0.14	0.54	3.36	14
Garu Tempane	0.4	0.06	0.00	0.28	0.53	6.53	24
Bawku Municipal	0.15	0.03	0.00	0.1	0.2	5.48	30
Wa West	0.68	0.12	0.00	0.45	0.92	5.75	5
Wa Municipal	0.24	0.04	0.00	0.15	0.32	5.37	5
Wa East	0.63	0.14	0.00	0.35	0.91	4.46	7
Jirapa	0.69	0.1	0.00	0.51	0.88	7.29	5

Proportion of Soybean Output Consumed (Percent) per Farm Household in 2013

District Name	Mean	S.E.	P Value	95% C.I.		t-Value	Sample Size
				Lower Level	Upper Level		
Pru	.	.	.	.	.	.	.
East Gonja	0	.	.	.	.	.	1
Kpandi	.	.	.	.	.	.	.
Nanumba South	0.13	.	.	.	.	.	1
Nanumba North	0.11	0.11	0.32	-0.11	0.34	1	6
Zabzugu/Tatale	0	.	.	.	.	.	1
Yendi	0.01	0.01	0.16	-0.01	0.04	1.41	13
Tamale Metro	.	.	.	.	.	.	.
Tolon Kumbungu	0.31	0.19	0.1	-0.06	0.67	1.65	5
Savelugu Nanton	0	0	.	.	.	.	14
Karaga	0.01	0.01	0.1	0	0.03	1.68	18
Gusheigu	0	0	.	.	.	.	14
Saboba	0.01	0.01	0.32	-0.01	0.02	1	9
Chereponi	0.4	0.05	0.00	0.3	0.5	7.62	17
Mamprusi West	.	.	.	.	.	.	.
Builsa	.	.	.	.	.	.	.
Kassena Nankana West	0.01	.	.	.	.	.	1
Bawku West	0.46	0.19	0.02	0.09	0.84	2.43	7
Garu Tempane	0.06	0.01	0.00	0.03	0.08	4.27	8
Bawku Municipal	0.2	0.05	0.00	0.1	0.3	4.03	16
Wa West	.	.	.	.	.	.	.
Wa Municipal	.	.	.	.	.	.	.
Wa East	0	.	.	.	.	.	1
Jirapa	.	.	.	.	.	.	.

Appendix 2: The Survey Instrument

MONITORING, EVALUATION AND TECHNICAL SUPPORT SERVICES (METSS) AGRICULTURE PRODUCTION SURVEY IN THE FTF ZOI

SURVEY QUESTIONNAIRE

INFORMED CONSENT

INFORMED CONSENT: IT IS NECESSARY TO INTRODUCE THE HOUSEHOLD TO THE SURVEY AND OBTAIN THE CONSENT OF THE PROSPECTIVE RESPONDENT TO PARTICIPATE. IF A PROSPECTIVE RESPONDENT IS NOT PRESENT AT THE BEGINNING OF THE INTERVIEW, MOVE TO THE NEXT HOUSEHOLD AND BE SURE TO RETURN TO THIS PAGE AND OBTAIN CONSENT BEFORE INTERVIEWING HIM OR HER ON YOUR NEXT VISIT. ASK TO SPEAK WITH A RESPONSIBLE ADULT IN THE HOUSEHOLD.

Hello. My name is _____. I am a Ministry of Food and Agriculture (MoFA) staff working with the METSS Project. We are conducting a survey to learn about agriculture production and household hunger status in the three Northern Regions of Ghana and part of Brong Ahafo Region. The information we collect will help USAID/ EG Office and the Government of Ghana to plan agriculture related development interventions in the target areas, known as a USAID FTF Zone of Influence. Your household was selected for the survey. I would like to ask you some questions about your household. The questions usually take about an hour for the first session and will involve fourteen other visits. All of the answers you give will be confidential and will not be shared with anyone other than members of our survey team. You don't have to participate in the survey, but we hope you will agree to answer the questions since your views are important. If I ask you 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. In case you need more information about the survey, you may contact the person listed on the back of the ID card of the enumerator.

GIVE CARD WITH CONTACT INFORMATION

Would you [NAME] like to participate in this agricultural production study?

          Yes _____

          No _____

I _____, the enumerator responsible for the interview taking place on _____, 2013 certify that I have read the above statement to the participant(s) and she/he has consented to the interview. I pledge to conduct this interview as indicated in the instructions and inform my supervisor of any problems encountered during the interview process.

Interviewer's Signature

Date (dd/mm/yyyy): _____/_____/_____

_____

MONITORING, EVALUATION AND TECHNICAL SUPPORT SERVICES (METSS) AGRICULTURE PRODUCTION SURVEY IN THE FTF ZOI

VISIT I

NOTE TO ENUMERATOR: Within each Enumeration Area, you will interview 11 farm holders. Locate and obtain consent of the farm holder before interviewing respondents on the list assigned to you by your supervisor. If after two attempts you are unsuccessful in obtaining an audience, report the case to your supervisor who will advise you accordingly. Do not complete question **1.18** until after completing Visit I. Fill out the consent form if the farm holder agrees to continue with the survey. Fill out the questions as completely as possible until the farm holder refuses to continue, then stop or move to another farm holder.

Household Identification	Code		Interview Details				
1.1 Region:			**1.14 Number of household members:**				
1.2 District:			Adult males	Adult females	Male children	Female children	Total HH size
1.3 Enumeration Area:							
1.4 Farm holder Number:			**1.15 Type of household?** **Male & Female adult** (HH contain at least one male and female adult) **Female adult only** (HH contain at least one female adult and no male adult) **Male adult only** (HH contain at least one male adult and no female adult) **Child only** (HH contain no adult male and adult female)				
1.5 Farm holder ID: [This will be provided by METSS]							
1.6. Name of Farmholder **Surname, First Name: _____**							
1.7 What is sex of farm holder**?** 1= Male 2 = Female			**1.16** Name of enumerator				
1.8 What is the marital/civil status of farm holder?			**1.17** Date of Interview				
1.9 Can farm holder read and write in English? 1=Yes, 2=No			**1.18** Outcome of first visit:				
1.10 Can farm holder read and write in any local language or Arabic? 1=Yes, 2=No If No skip → 1.12			1. Complete 2. No HH member at time of visit 3. Respondent not appropriate 4. Entire HH absent for an extended period of time		5. Postponed 6. Refused 7. Other (specify) _____		
1.11 What is the highest grade of education completed by farm holder?							
1.12 Main religion of household (See code below):							
1.13 Main ethnic group of the household (See code below):			1.19 GPS Coordinates of farm holder's location				
			Latitude (W)/(E)		**Longitude (N)**		

Codes for questions in table above

1.1 Region Codes	1.2 Districts Name and Codes		
	Northern Region Districts	**Upper East Region Districts**	**Upper West Region Districts**

07 – Brong Ahafo 08 - Northern Region 09 - Upper East Region 10 - Upper West Region	East Gonja - 805 Kpandai - 806 Nanumba South - 807 Nanumba North - 808 Zabzugu/Tatale - 809 Yendi - 810 Tamale Metro - 811 Tolon Kumbungu - 812 Savelugu Nanton - 813 Karaga - 814 Gusheigu - 815 Saboba - 816 Chereponi - 817 Bunkpurugu Yunyoo - 818 Mamprusi West - 820	Builsa - 901 Kassena Nankana West - 902 Talensi Nabdam - 905 Bawku West - 907 Garu Tempane - 908 Bawku Municipal - 909	Wa West - 1001 Wa Municipal - 1002 Wa East - 1003 Jirapa - 1006 Lambussie Karni - 1008
1.12 Main Religion	**1.8 Marital/Civil Status**	**1.11 Education level**	**1.18 Outcome of first interview**
1 - No Religion 2 - Catholic 3 - Protestant (Anglican, Lutheran, Presbyterian, Methodist etc.) 4 - Pentecostal/Charismatic 5 - Other Christian 6 - Islam 7 - Ahmadi 8 - Traditionalist 9 - Other (specify)	1 - Never married/Single 2 - Informal/consensual union/living together 3 - Married 4 - Separated 5 - Divorced 6 - Widowed	1- None 2- Primary 3- MLSC 4- BECE 5- Voc/Comm 6- Teacher Tra. A 7- Teacher Post Sec 8- GCE O Level 9- SSCE 10- GCE A Level 11- Tech/Prof Cert	1. Complete 2. No HH member at time of visit 3. Respondent not appropriate 4. Entire HH absent for an extended period of time 5. Postponed 6. Refused 7. Other (specify) _____
1.13 Main ethnic Group	**1.10 Literacy Level**	12- Tech/Prof Dip	
1 - Akan 2 - Ga-Dangme 3 - Ewe 4 - Guan 5 - Mole-Dagbani 6 - Grusi 7 - Mande 8 - Gurma 9 - Other	1- None 2- Can read and write Arabic 3- Can read and write in a local language	13- HND 14- Bachelors 15- Masters 16- Doctorate 17- Other (specify) _____	

2.0 Basic information on household agricultural production activities for 2012 cropping season

2.1 Did you cultivate any farm land last year (i.e. during the 2012 cropping season)?

    1 = Yes

    2 = No

If yes to question **2.1** above, please complete the table below [previous Year's (2012) Cropping Information]. Ask about all the crops that the farmer cultivated in 2012, including fruit trees, nuts and cocoa or other fruit tree cash crops where applicable.

Crop ID	Type [crop name] grown in 2012 cropping season	What is the variety of [main crop name] planted in 2012?	Area of land planted to crop Acres	Quantity of harvest		Quantity Sold		Total Amount [GHS]	Where did you sell the majority of your 2012 produce?	Quantity Consumed		Quantity given as Gifts		Quantity still in storage		Other Uses of Harvest	
				Qty	Unit	Qty	Unit of sale			Qty	Unit	Qty	Unit	Qty	Unit	Qty	Unit
	2.2	**2.3**	**2.4**	**2.5**	**2.6**	**2.7**	**2.8**	**2.9**	**2.10**	**2.11**	**2.12**	**2.13**	**2.14**	**2.15**	**2.16**	**2.17**	**2.18**
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	
10																	

Codes for questions

CROP VARIESTIES						UNITS OF QUANTITIES		WHERE DID YOU SELL?
MAIZE			ICE		SOYBEANS			
1 = Pan 12 2 = Pan 53 3 = Panar	4 = Mamaba 5 = Etubia 6 = Pioneer seed	7 = Obtampa 8 = Abroahoma 9 = Okomasa	1 = Nerica 2 = Aguaba 3 = Molga	4 = Jasmine 5 = Senkyea 6 = GR 18 7 = Other	1 = Anidaso 2 Jenguma	1 = 1 kg bag 2 = 2.5 kg bowl 3 = 5 kg bag 4 = 10 kg bag	5 = 25 kg bag 6 = 50 kg bag 7 = 100 gk bag	1 = Farm gate 2 = village market 3 = Another community market 4 = Another district market

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3.0 Household Hunger Situation Questions

Enumerator Note: Ask the questions in the table below of the person responsible for household food preparation.

No.	Question	Response Code	Number of people experiencing condition?
3.A	In the last 4 weeks was there ever no food to eat of any kind in your house because of lack of resources to get food?	1 = Yes 2 = No >>3.**C**	
3.B	How often did this happen in the last 4 weeks?	**1** = Rarely (1-2 times) **2** = Sometimes (3-10 times) **3** = Often (more than 10 times)	███████
3.C	In the last 4 weeks did you or any household member go to sleep at night hungry because there was not enough food?	**1** = Yes **2** = No>>3.**E**	
3.D	How often did this happen in the last 4 weeks?	**1** = Rarely (1-2 times) **2** = Sometimes (3-10 times) **3** = Often (more than10 times)	███████
3.E	In the last 4 weeks did you or any household member go a whole day and night without eating anything at all because there was not enough food?	**1** = Yes **2** = No >>end this section of the questionnaire	
3.F	How often did this happen in the last 4 weeks?	**1** = Rarely (1-2 times) **2** = Sometimes (3-10 times) 3 = Often (more than 10 times)	███████

VISIT II

NOTE TO ENUMERATOR: Ask the questions below of only the farm holder who has been selected for this survey. Do not ask questions related to the household members' production information. Restrict all questions to the three value chain crops under consideration (**Maize, Rice and Soybean**) and any other one crop (cereal or legume) of importance to the farm holder. As much as possible, pull data from the farm diary provided to the sampled farmer to complete this table. Ensure that you cover all plots related to the three value chain crops under consideration.

4.A   Please complete the table below with information related to crops grown by the farmer in the 2013 growing season.

Crop ID	Type [crop name] grown in 2013 cropping season	Area of land planted to [crop name] **(Acres)**	What type of seed did you use? 1 = Hybrid seeds 2 = Retained OPV seeds 3 = Improved OPV seeds 4= Traditional seeds	What is the variety of [main crop name]? (Refer to codes sheet for a list of varieties)	Is [crop name] intercropped? 1 = Yes 2 = No	Name of intercrop	What type of land preparation method used? 1 = Tractor service 2 = Animal traction 3 = Manual land prep	Is [crop name] for commercial purposes 1 = Yes 2 = No
	4.a.1	**4.a.2**	**4.a.3**	**4.a.4**	**4.a.5**	**4.a.6**	**4.a.7**	**4.a.8**
01								

93

02							
03							
04							
05							
06							
07							
08							
09							
10							

Codes for questions

CROP VARIESTIES					
MAIZE			RICE		SOYBEANS
1 = Pan 12 2 = Pan 53 3 = Panar	4 = Mamaba 5 = Etubia 6 = Pioneer seed	7 = Obtampa 8 = Abroahoma 9 = Okomasa	1 = Nerica 2 = Aguaba 3 = Molga	4 = Jasmine 5 = Senkyea 6 = GR 18 7 = Other	1 = Anidaso 2 Jenguma

5. Please fill out the table below with information relating to only maize, rice and soybean crops cultivated by farm holder, and the fourth crop of importance to the farmer.

Crop ID	Type [crop name] grown in 2013 cropping season Crop Name (Location of Crop)	Land Use Management and Cost				Cost of Land Preparation			Sources of seeds and Cost				
		Size of Land [Acres]	Ownership status *If owned skip to →5.6*	Land Rent [GHS]	Mode of Payment	Ploughing Services [GHS]	Harrowing Services [GHS]	Other Contracted Services [GHS]	Source of Seed	Qty	Unit	How much did you pay for the seed? [GHS]	Transport Cost [GHS]
	5.1	5.2	5.3	5.4	5.5	5.6	5.7	5.8	5.9	5.10	5.11	5.12	5.13
01													
02													
03													
04													

Codes

Land Ownership Status	Mode of land Payment	Sources of Seed		Unit of Seed Qty	
1. Outright ownership 2. Family owned 3. Communal ownership 4. Other	1. Cash payment 2. Abuna 3. Abusa 4. Exchange of produce 5. Other (Specify)	1. Farmer retained seeds 2. Bought from local market 3. Bought from other farmer 4. Gift from other farmer	5. NGO distributed seeds 6. Research organization 7. Extension agent 8. Certified seeds dealer 9. Other (Specify)	1. 2. 1 kg container 3. 2.5 kg bowl 5 kg bag 4. 10 kg bag	5. 25 kg bag 6. 50 kg bag 7. 75 kg bag 8. 100 kg bag

6. Please fill out the table below with information relating to chemical applications. The information should be related to only maize, rice and soybean crops cultivated by a household member selected for this survey. Also complete the section for the other crop cultivated by the farmer

Crop ID	Type [crop name] grown in 2013 cropping season	FERTILIZER					AGRO-CHEMICAL INPUT 1					AGRO-CHEMICAL INPUT 2					MANURE			
		Type	Qty	Unit	Total Cost	Transport Cost	Input Type	Qty	Unit	Total Cost	Transport Cost	Input Type	Qty	Unit	Total Cost	Transport Cost	Own Qty (kg)	Bought Qty (kg)	Total Cost	Transport Cost
	6.1	6.2	6.3	6.4	6.5	6.6	6.7	6.8	6.9	6.10	6.11	6.12	6.13	6.14	6.15	6.16	6.17	6.18	6.19	6.20
01																				
	Specify other																			
02																				
	Specify other																			
	Specify other																			
04																				
	Specify other																			

Code

Types of Fertilizer	Type of Agro-Chemicals	Unit of of Agro-Chemicals		
1. 2. Compound Fertilizer (NPK) Sulphate of Ammonia 3. Urea 4. Other (specify)	1. Herbicides 2. Insecticides 3. Fungicides 4. Other (specify)	1. 2. 1kg container 3. 2.5 kg bowl 5 kg bag 4. 10 kg bag	5. 25 kg bag 6. 50 kg bag 7. 75 kg bag	8. 100 kg bag 9. Litres 10. Grams of Sachet

VISIT III

7. Please ask the target farmer about all the agriculture-related assets listed below and complete the table.

Asset Code	Asset	How many of these assets do you own? [If partial ownership, indicate fraction owned]Number	What is the value of your total portion of the assets if sold today Total Value in GHS	If a value cannot be determined, state the year asset was bought and for how much?		Used for the cultivation of [Crop Code]
				Year Purchased	Price when Purchased [GHS]	
		7.1	7.2	7.3	7.4	7.5	7.6
01	Machete/Cutlass					
02	Hoe					
03	Sickle					
04	Axe					
05	Backpack Sprayer					
06	Wellington Boots					
07	Bullock Traction Equipment					
08	Tractor					
09	Donkey Cart					
12	Other (Specify)					

7.6 Crop Cultivation Code		
Maize only = 1	Maize and Soya only = 4	All crops = 6
Rice only = 2	Maize and Rice only = 5	None of the crops = 0
Soya only = 3	Soya and Rice only = 6	

8. Agricultural Extension Information

Member ID Code	Have you, or any member of your farm household had any technical assistance? 1. Yes → Complete the table 2. No → skip table									
	Technical Assistance Organization	HH Member Name	How many years has member been active with Org.?	Is member still receiving technical assistance from Org.? 1= Yes, 2= No	If "No", why?	If member quit, how many years ago?	Is HH member participating in any Ag production technical assistance training sessions this year?	How often has member attended these trainings?	Characterize participation of this member	Do you obtain information on Ag production technical assistance through the electronic media? 1= Yes, 2= No
8.1	8.2	8.3	8.4	8.5	8.6	8.7	8.8	8.9	8.10	8.11

Codes

8.6 Reason for not Receiving Technical Assistance	8.7 How often attend trainings	8.8 Participant Characteristics
1. Member quit 2. Organisation no more operating 3. Member migrated to new location 4. Other (Specify)	1. 2. Weekly 3. 4. Every 2 weeks 5. Monthly 6. Quarterly Semi-annually Annually	1. The member is an officer of the training group Member always attends trainings 2. 3. Member sometimes attends trainings Member rarely attends trainings 4. Member never attends trainings 5.

VISIT IV COST OF PRODUCTION - LABOR RELATED

9. Please fill out the table below with information relating to only maize, rice and soybean crops cultivated by farm holder

Crop ID	Type [crop name] grown in 2013 cropping season	Activity Type	Hired Labor			Communal or Exchange Labor			Family Labor					
			# of People	# of Days	Cost per Person / Day	# of People	# of Days	Total Cost of Food + Others	Adult Male		Adult Female		Children < 15	
									# of eople	# of Days	# of People	# of Days	# of People	# of Days
	9A.1	9A.2	9A.3	9A.4	9A.5	9A.6	9A.7	9A.8	9A.9	9A.10	9A.11	9A.12	9A.13	9A.14
01		Site clearing												
		Land Preparation												
		Planting												
		Fertilizer Application												
		Other Chemical Application												
		1st Weeding												
		2nd Weeding												
		Scaring Birds & Rodents												

		Watering/Irrigation														
		Other (Specify_____)														
02		Site Clearing														
		Land Preparation														
		Planting														
		Fertilizer Application														
		Other Chemical Application														
		1st Weeding														
		2nd Weeding														
		Scaring Birds & Rodents														
		Watering/Irrigation														
		Other (Specify_____)														
03		Site clearing														
		Land Preparation														
		Planting														
		Fertilizer Application														
		Other Chemical Application														
		1st Weeding														
		2nd Weeding														
		Scaring Birds & Rodents														
		Watering/Irrigation														
		Other (Specify_____)														
04		Site Clearing														
		Land Preparation														
		Planting														
		Fertilizer Application														
		Other Chemical Application														
		1st Weeding														
		2nd Weeding														
		Scaring Birds & Rodents														
		Watering/Irrigation														
		Other (Specify_____)														

10A. Farm Measurement - GIS Data of the entire farm where yield plot is established. Use a different sheet for each target crop

Name of Farm Holder			Farm Holder ID	
Type of crop			Crop ID	
Field Number	**Field Point**	**(W/E) X Coordinates (Latitude)**	**(N) Y Coordinates (Longitudes)**	

10B. Yield Plot Establishment

Crop ID	Type of [crop name] grown in the 2013 cropping season	Date of Planting	Date Plot Established	Yield Plot Area [dimension of plot in meters]	Type of Crop (Rice only) 1 = Upland rice 2 = Valley bottom	Probable Date of Harvesting
	10B.1	**10B.2**	**10B.3**	**10B.4**	**10B.5**	**10B.6**
01						
02						
03						

04						
05						
06						
07						
08						

VISIT VI

11. **COST OF HARVEST AND POST HARVEST - LABOR RELATED:** Please fill out the table below with information relating to only maize, rice and soybean crops cultivated by farm holder.

Crop ID	Type [crop name] grown in 2013 cropping season	Activity Type	Cost if by mechanical means [GHS]	Hired Labor			Communal or Exchange Labor			Family Labor					
										Adult Male		Adult Female		Children < 18	
				# of People	# of Days	Unit Cost	# of People	# of Days	Total Cost of Food + Others	# of People	# of Days	# of People	# of Days	# of People	# of Days
	11.1	**11.2**	**11.3**	**11.4**	**11.5**	**11.6**	**11.7**	**11.8**	**11.9**	**11.10**	**11.11**	**11.12**	**11.13**	**11.14**	**11.15**
01		Harvesting													
		Shelling													
		Threshing													
		Winnowing													
		Bagging													
		Transportation from field to storage													
		Other (Specify_____)													
02		Harvesting													
		Shelling													
		Threshing													
		Winnowing													
		Bagging													
		Transportation from field to storage													
		Other (Specify_____)													
03		Harvesting													
		Shelling													
		Threshing													
		Winnowing													
		Bagging													

100

	Transportation from field to storage													
	Other (Specify_____)													

12. Information on Harvest and Immediate Sales Data. Enumerator, please collect complete data on the farm on which yield plot was established.

Crop ID Code	Type of Crop	Date of Harvesting [Yield plot]	Yield Plot Output [In kg]				Farm Output		Sales at Harvest			Produce given out as gifts		Qty Consumed by Household?	
			Wet Weight	% Moisture Content 1	Dry Weight	% Moisture Content 2	Qty	Unit of Measure	Qty	Unit	Price	Qty	Unit	Qty	Unit
	12.1	**12.2**	**12.3**	**12.4**	**12.5**	**12.6**	**12.7**	**12.8**	**12.9**	**12.10**	**12.11**	**12.12**	**12.13**	**12.14**	**12.15**
01															
02															
03															
04															
05															
06															
07															
08															

VISIT VII

13. Crop Storage Information

Crop ID	Type of Crop	Type of Storage facility?	Qty Stored	Unit of Qty Stored	Where is this storage facility located?	Did you treat your produce before storage?	Cost of preservatives				What other cost other than what is not stated in the questionnaire did you incur during the production season?
							What preservative did you use to prevent PHL?	Qty	Unit	Unit Cost	
	13.1	**13.2**	**13.3**	**13.4**	**13.5**	**13.6**	**13.7**	**13.8**	**13.9**	**13.10**	**13.11**
01											
02											

101

03							
04							

Codes for questions

UNITS OF QUANTITIES STORED		UNIT OF PRESERVATIVE
1 = 1 kg bag 2 = 2.5 kg bowl 3 = 5 kg bag 4 = 10 kg bag	5 = 25 kg bag 6 = 50 kg bag 7 = 100 gk bag	1 = 1 litre container 2 = 1.5 litre container 3 = 1 kg bag of powder (suspension) 4 = Grams of sachet

VISIT VIII

14. Make a last visit to the selected farm holder to collect the relevant information on marketing of the crop produced.

Crop ID	Type of Crop	Additional Qty Sold [In kg]			Month most crops sold?	Please indicate a yes or no if you sold your produce to any of the underlisted buyers 1 = Yes 2 = No				Distan ce to Market If no travel = 0	Type of Transpo rt used to Market	Transport Cost to Market [GHS]		Additional Qty Consumed		Qty Left in Storage	
		Qty	Unit of Sale?	Total Amou nt		Consu mers	Aggreg ator	Proces sor	NBSC			Trans port	Loading & OffLoading	Qty	Unit	Qty	Unit
	14.1	14.2	14.3	14.4	14.5	14.7	14.8	14.9	14.9	14.10	14.11	14.12	14.3	14.14	14.15	14.16	14.17
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	

Codes for questions

UNITS OF QUANTITIES SOLDS/CONSUMED/STORED		TYPE OF TRANSPORT	
1 = 1 kg bag 2 = 2.5 kg bowl 3 = 5 kg bag 4 = 10 kg bag	5 = 25 kg bag 6 = 50 kg bag 7 = 100 gk bag	1 = Bicycle 2 = Motor bike 3 = Motor king	4 = Tractor 5 = Market truck 6 = Public bus 7 = Animal Drawn Vehicle 8 = Head Portage

VISIT IX

14. Make a last visit to the selected farm holder to collect the relevant information on marketing of the crop produced.

Crop ID	Type of Crop	Additional Qty Sold [In kg]			Month most crops sold?	Please indicate a yes or no if you sold your produce to any of the underlisted buyers 1 = Yes 2 = No				Distance to Market If no travel = 0	Type of Transport used to Market	Transport Cost to Market [GHS]		Additional Qty Consumed		Qty Left in Storage	
		Qty	Unit of Sale?	Total Amount		Consumers	Aggregator	Processor	NBSC			Transport	Loading & OffLoading	Qty	Unit	Qty	Unit
	14.1	**14.2**	**14.3**	**14.4**	**14.5**	**14.7**	**14.8**	**14.9**	**14.9**	**14.10**	**14.11**	**14.12**	**14.3**	**14.14**	**14.15**	**14.16**	**14.17**
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	

Codes for questions

UNITS OF QUANTITIES SOLDS/CONSUMED/STORED		TYPE OF TRANSPORT	
1 = 1 kg bag 2 = 2.5 kg bowl 3 = 5 kg bag 4 = 10 kg bag	5 = 25 kg bag 6 = 50 kg bag 7 = 100 gk bag	1 = Bicycle 2 = Motor bike 3 = Motor king	4 = Tractor 5 = Market truck 6 = Public bus 7 = Animal Drawn Vehicle 8 = Head Portage

VISIT X

14. Make a last visit to the selected farm holder to collect the relevant information on marketing of the crop produced.

Crop ID	Type of Crop	Additional Qty Sold [In kg]			Month most crops sold?	Please indicate a yes or no if you sold your produce to any of the underlisted buyers 1 = Yes 2 = No				Distance to Market If no travel = 0	Type of Transport used to Market	Transport Cost to Market [GHS]		Additional Qty Consumed		Qty Left in Storage	
		Qty	Unit of Sale?	Total Amount		Consumers	Aggregator	Processor	NBSC			Transport	Loading & OffLoading	Qty	Unit	Qty	Unit
	14.1	14.2	14.3	14.4	14.5	14.7	14.8	14.9	14.9	14.10	14.11	14.12	14.3	14.14	14.15	14.16	14.17
01																	
02																	
03																	
04																	
05																	
06																	
07																	
08																	
09																	

Codes for questions

UNITS OF QUANTITIES SOLDS/CONSUMED/STORED		TYPE OF TRANSPORT	
1 = 1 kg bag 2 = 2.5 kg bowl 3 = 5 kg bag 4 = 10 kg bag	5 = 25 kg bag 6 = 50 kg bag 7 = 100 gk bag	1 = Bicycle 2 = Motor bike 3 = Motor king	4 = Tractor 5 = Market truck 6 = Public bus 7 = Animal Drawn Vehicle 8 = Head Portage

VISIT XI

14. Make a last visit to the selected farm holder to collect the relevant information on marketing of the crop produced.

Crop ID	Type of Crop	Additional Qty Sold [In kg]			Month most crops sold?	Please indicate a yes or no if you sold your produce to any of the underlisted buyers 1 = Yes 2 = No				Distance to Market If no travel = 0	Type of Transport used to Market	Transport Cost to Market [GHS]		Additional Qty Consumed		Qty Left in Storage	
		Qty	Unit of Sale?	Total Amount		Consumers	Aggregator	Processor	NBSC			Transport	Loading & OffLoading	Qty	Unit	Qty	Unit
	14.1	14.2	14.3	14.4	14.5	14.7	14.8	14.9	14.9	14.10	14.11	14.12	14.3	14.14	14.15	14.16	14.17
01																	
02																	
03																	
04																	
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Codes for questions

UNITS OF QUANTITIES SOLDS/CONSUMED/STORED		TYPE OF TRANSPORT	
1 = 1 kg bag 2 = 2.5 kg bowl 3 = 5 kg bag 4 = 10 kg bag	5 = 25 kg bag 6 = 50 kg bag 7 = 100 gk bag	1 = Bicycle 2 = Motor bike 3 = Motor king	4 = Tractor 5 = Market truck 6 = Public bus 7 = Animal Drawn Vehicle 8 = Head Portage