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CIMMYT
International Maize and Wheat Improvement Center

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Drought Tolerant Maize for Africa (DTMA) Project
Country Report–Household Survey

# Characterization of Maize Producing Households in the Northern Region of Ghana

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DTMA Country Report - Ghana

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**CSIR/SARI**
The Savannah Agricultural Research Institute (SARI) is a research institute mandated to conduct agricultural research, on food and fiber crops in northern Ghana. For the purpose of introducing improved technologies to enhance agricultural productivity, the institute, in close collaboration with typical farm households, in the various agro-eclogical zones, develops options of production techniques which are compatible with farm households and which enhance the capacity of farm families to increase crop production per unit area without injury to the environment. Given its farming systems orientation, the institute has programs for all the major crops cultivated in northern Ghana, including sorghum, millet, maize, rice, groundnut, cowpea, bambara beans, pigeon pea, soybean, yam, cassava, cotton, and vegetables.

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**DTMA**
The Drought Tolerant Maize for Africa (DTMA) Project is jointly implemented by CIMMYT and the IITA, and is funded by the Bill & Melinda Gates Foundation and the Howard G. Buffett Foundation. The project is part of a broad partnership, involving national agricultural research and extension systems, seed companies, non-governmental organizations (NGOs), community-based organizations (CBOs), and advanced research institutes, known as the Drought Tolerant Maize for Africa (DTMA) Initiative. Its activities build on longer-term support by other donors, including the Swiss Agency for Development and Cooperation (SDC), the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Fund for Agricultural Development (IFAD), the United States Agency for International Development (USAID), and the Eiselen Foundation. The project aims to develop and disseminate drought tolerant, high yielding, locally adapted maize varieties and aims to reach 30–40 million people in sub-Saharan Africa with better technologies in 10 years.


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# Acknowledgments

The Drought Tolerant Maize for Africa (DTMA) initiative aims to address the challenge of combating the impact of drought on people's livelihoods, food security, and economic development. It links the efforts of several organizations and projects supporting the development and dissemination of DT maize in 13 countries in sub-Saharan Africa (SSA). The initiative is supported by the Bill & Melinda Gates Foundation (B&MGF), Howard G. Buffett Foundation, and the United States Agency for International Development (USAID). DTMA also benefits from the long-term, generous support of core donors to the International Maize and Wheat Improvement Center (CIMMYT). For further information about the initiative, refer to the project website (http://dtma.cimmyt.org).

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# Acronyms and abbreviations

| | |
|---|---|
| B&MGF | Bill & Melinda Gates Foundation |
| CIMMYT | International Maize and Wheat Improvement Center |
| CRI | Crop Research Institute |
| CSIR | Council for Scientific and Industrial Research |
| DDA | District Directorate of Agriculture |
| DT | drought tolerant |
| DTMA | Drought Tolerant Maize for Africa |
| FBO | farmer-based organization |
| FGD | focus group discussion |
| GAP | good agricultural practices |
| GoG | Government of Ghana |
| GPS | global positioning systems |
| GSS | Ghana Statistical Service |
| HPI | Human Poverty Index |
| IITA | International Institute of Tropical Agriculture |
| KI | key informant |
| masl | meters above sea level |
| MoFA | Ministry of Food and Agriculture |
| NGO | non-governmental organization |
| OPV | open-pollinated variety |
| PCA | Principal Component Analysis |
| PHC | Population and Housing Census |
| SARI | Savannah Agricultural Research Institute |
| SRID | Statistics Research Information Division |
| SSA | sub-Saharan Africa |
| UNDP | United Nations Development Program |

# Executive summary

The characterization of households for the Drought Tolerant Maize for Africa (DTMA) project in the Northern Region of Ghana was implemented to provide a profile of maize producing households in the project area, and assess the rate of adoption of existing maize varieties and their impact on the welfare of maize producing farm households. Maize is indeed an important food and cash crop, therefore, improving the production and productivity of the crop will enhance food self-sufficiency among the households. About two thirds of the  of the sampled households are less endowed, as indicated by the wealth indices computed using principal component analysis (PCA) which gives an indication of the incidence of poverty. The few well endowed farm households have access to large areas of land resources. Despite the numerous constraints associated with maize production in the study area, the estimated rate of adoption of existing improved maize varieties is about 95%. However, low level of farmer participation in field demonstrations is a source of concern for the newly improved DT maize varieties that are yet to be released. High rates of adoption of the DT maize varieties are assured if proper targeting is undertaken. For this project to be successful there is a need to foster strong linkages between the DTMA working group in the country and the associated development agencies to identify synergies to ensure the effective dissemination of the DT maize varieties through intensive field demonstrations. Farmers from Tolon-Kumbungu, by virtue of their proximity to research and development agencies, are more likely to adopt newly improved maize varieties. From the Probit adoption regression model, the area allocated to improved maize, the cost of fertilizer, and household income all have significant effects on the adoption of improved maize varieties. The results also suggest that farmers with high incomes tend to invest in off-farm activities. Moreover, the high cost of fertilizer is a disincentive for the adoption of improved maize varieties. The technology development process must therefore consider the cost implications in terms of the fertilizer and labor requirements to enable the farmers with a lower income to adopt the technologies. Finally, since the technology development process and dissemination occur simultaneously, it is also necessary to progressively track the rate of diffusion and the potential impact.

# 1. Introduction

As climate change progresses with recurrent droughts and floods, lives and livelihoods are threatened and sometimes destroyed. In fact, huge production losses have already been a formidable component of the livelihoods of resource-poor rural farm households in sub-Saharan Africa (SSA) (Hodson et al. 2002). To contribute to the global and continental efforts to adapt vulnerable livelihoods to the consequences of climate change, the Drought Tolerant Maize for Africa (DTMA) initiative aims at developing and disseminating DT maize varieties to farm households in SSA. The development, distribution, and cultivation of DT maize varieties will make a significant contribution towards reducing hunger and vulnerability in SSA.

Among the sets of activities to be implemented under the DTMA project is assessment and targeting research, which seeks to create knowledge on the delivery pathways and identify the necessary modifications to DT maize technologies required to increase livelihood impacts. In this regard, household and community surveys have been implemented to assess baseline conditions and the potential for the adoption of improved DT varieties. Characterizing the status quo of the target households will help in the later assessment of changes that can be attributed to the adoption and use of DTMA technologies at the household level.

This report presents the results from the household survey for the DTMA project in the northern region of Ghana. The principal objective of the household assessment is to describe and explain current conditions in the project area.

*Farmers' demo plot.*

This will allow the estimation of the adoption of existing maize varieties and assess impacts on the welfare of producers. The baseline survey can be repeated to provide a panel data set for impact assessment during the follow-up phase of the project and to analyze the dynamics of adoption and impact.

Section 2 of this report presents a description of the sample location and the sampling and data collection procedure. In Section 3, the agroclimatic characteristics of the survey locations are briefly described. The demographic characteristics of the households involved in the study are described in Section 4; the agricultural production systems and livelihood strategies of the households are discussed in Section 5. In Section 6, the resource endowments and the wealth status of the households are discussed. Section 7 presents the discussion on the adoption incidence and the determinants of adoption of improved maize varieties among the households. The impact of shocks on household livelihood outcomes is discussed in Section 8. Further discussions on agricultural production and price risk are given in Section 9, with a summary of impact indicators among wealth categories in Section 10. Section 11 provides a synthesis of the outcomes of the study and draws conclusions on them.

# 2. Sampling and data collection

The study began with familiarization visits to the Northern Regional Directorate of the Ministry of Food and Agriculture (MoFA) to enlighten the officers about the project and its objectives. The visits provided a platform for generating information on key maize-producing zones, and also for identifying sources of relevant secondary data. In consultation with the regional directors of the MoFA and other collaborators in the DTMA project, Karaga and Tolon-Kumbungu districts were selected for the survey (Fig. 1). The districts fall in areas with drought probability risks between 20 and 40%[1] and are among the districts in northern Ghana selected for the testing of DT maize genotypes.

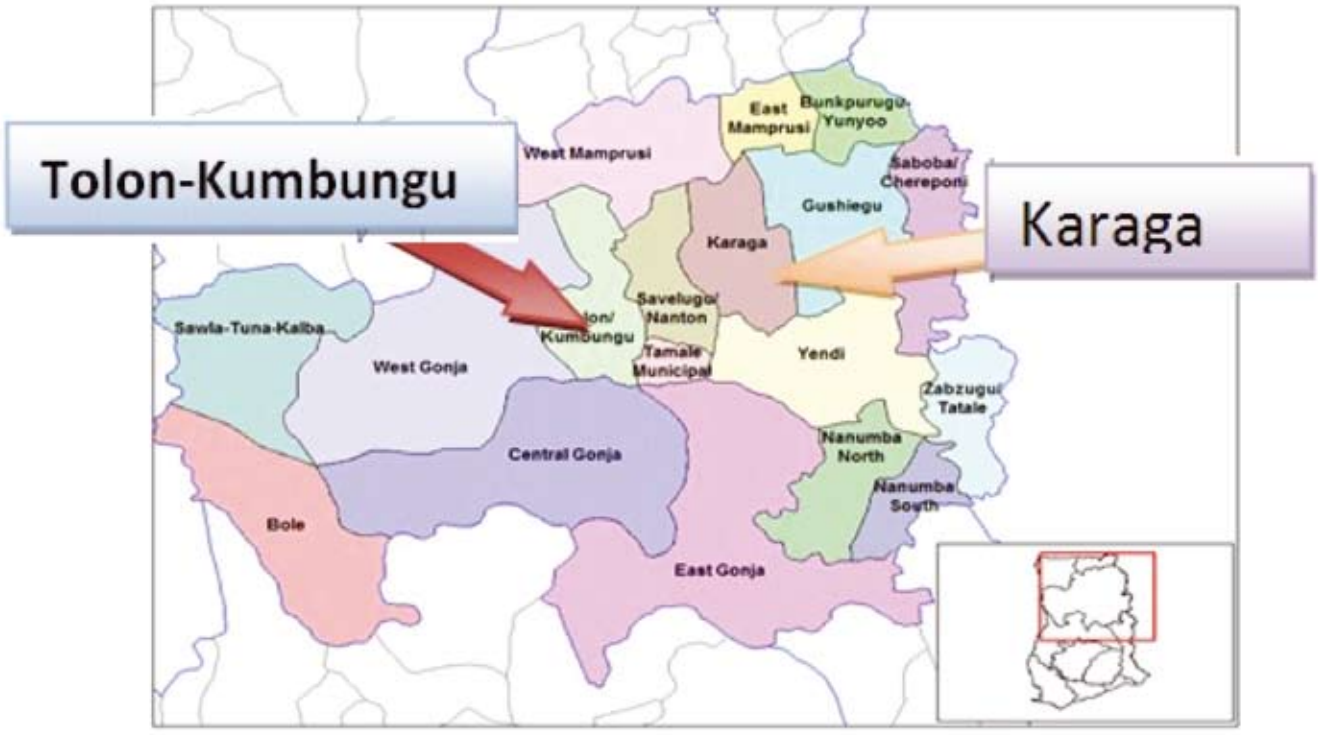


*Figure 1. District map of the Northern Region of Ghana.*

[1] See maps of failed seasons in Ghana (n.p). DTMA Community Survey Site Selection by Dave Hodson, CIMMYT.

Karaga district is one of the newly created districts in the Northern Region. It was carved out of the then Gushegu-Karaga district in 2004. Geographically, the district is located in the north-eastern part of the region and lies approximately between 09°30´N and 10°30´N latitude and between 0°W and 45°W longitude. The average elevation of the district is about 228.57 m above sea level (masl) and it covers an area of about 2898 km$^2$ (about 289,800 ha) (MoFA: Karaga District Profile 2007. Karaga shares boundaries with four districts—East and West Mamprusi districts to the north, Savelugu/Nanton to the west, and Gushegu (the mother district) to the south. The current population of the district is estimated at 75,575 from a population and housing census (PHC) figure of 62,719 at a growth rate of 2.7% (GLSS 2000). At the current growth rate, the population will double in 20 years. The dominant ethnic group in the district is the Dagomba. Others are Mamprusi, Konkombas, Frafra, Akans, Ewes, and Gas (MoFA: Karaga District Profile 2007).

Tolon-Kumbungu district is a relatively older district, created in 1988 with Tolon as its capital. The district is located closer to the center of the region and is bordered in the north by the West Mamprusi district, and in the west by the West Gonja district. In the south, it is bordered by the Savelugu-Nanton district and in the east by the Tamale Municipal Assembly. The district lies between 10°N and 20°N latitude and between 10°W and 50°W longitude. The average elevation of the district is 163.43 masl and it covers an area of about 2741 km$^2$ which is equivalent to 274,100 ha (MoFA: Tolon-Kumbungu District Profile 2007). The PHC in 2000 placed the population for the district at 132,338, but 2006 estimates put it at 145,876 (GLSS 2006), at a growth rate of about 3%. The population density is approximately 50 inhabitants/km$^2$. The dominant ethnic group in the area is the Dagomba. Also present are the Frafras, Akans, Ewes, and Gas who live harmoniously among the Dagomba (MoFA: Tolon-Kumbungu District Profile 2007).

For the purpose of this assessment study, 150 farm households (75/district) were interviewed from randomly selected maize producing communities and households in the two districts. The interviews were guided by pre-tested structured questionnaires and the global position coordinates of households were also recorded for easy identification.

# 3. Agroclimatic characteristics of survey locations

Karaga and Tolon-Kumbungu are located in the Guinea savanna agroecological zone. The zone experiences a mono-modal rainfall pattern, beginning in May and ending in October, with annual rainfall ranging between 900 and 1000 mm. Temperatures are high throughout most of the year with the highest of 36 °C in March and April. Lower temperatures are experienced between November and February, the harmattan period (Table 1). The savanna agroecology is characterized by drought tolerant plant species. Shea tree (*Butyrospermum parkii*), parkia (*Parkia biglobosa*) and mango (*Mangifera indica*) are common tree crops that form an integral part of the people's livelihood. The major arable crops cultivated in the zone include maize, rice, millet, sorghum, cassava, yam, groundnut, cowpea, and soybean.

**Table 1. Annual climatic data for the savanna agroecological zone.**

| Climatic factor | Minimum | Maximum | Average |
|---|---|---|---|
| Rainfall (mm) | 900 | 1000 | 948.23 |
| Temperature (°C) | 25 | 36 | 28 |

*Source*: Meteorological Service Department, Ghana, 2008.

**Table 2. Descriptive statistics of heads of sampled households.**

| Characteristics | Tolon-Kumbungu | Karaga | Overall |
|---|---|---|---|
| **Av. age (years)** | 49.57 | 54.24 | 52.13 |
| **Gender (%)** | | | |
| Male | 100 | 100 | 100 |
| **Decision-maker (%)** | | | |
| Head | 70.49 | 86.49 | 79.26 |
| Family | 29.51 | 13.51 | 20.74 |
| **Marital status (%)** | | | |
| Married | 96.72 | 100 | 98.52 |
| Widowed | 3.28 | 0 | 1.48 |
| **Literacy level (%)** | | | |
| Literate | 16.39 | 0 | 6.41 |
| Illiterate | 83.61 | 100 | 92.59 |
| Association | | | |
| **Members of FBO (%)** | 40.98 | 60.81 | 51.85 |
| Av. years of membership | 3.31 | 2.7 | 2.9 |
| **Sample size** | 61 | 74 | 135 |

*Source:* Household survey data, Ghana, 2008.

# 4. Demographic characterization of households

Traditionally, the rural households in northern Ghana are male-headed. The role of females can be observed within the household, where they are mostly involved in household chores. Almost all the household heads are married. This highlights the importance of the marriage institution, a highly cherished institution that also serves as a source of family labor.

Apart from ensuring the general well-being of the members of the household, the head also serves as the official spokesman of the family. In fact, most of the sampled households rely on their heads for decisions on farming activities. However, a significant proportion, about 30% of the households in Tolon-Kumbungu, makes collective decisions, taking into account the contributions and interests of all members (Table 2).

The head of a farm household in the study area is, on average, 52 years old. This provides an indication of the level of experience in agriculture and maize cultivation among the sampled households. However, there is a low level of literacy with only 6.41% of the farm households having a background of formal education. Despite this gap, more than half of the respondents have been members of farmer-based organizations (FBOs) for about three years. Membership of FBOs varies greatly between the districts. While about 41% of the households in Tolon-Kumbungu belong to FBOs, in Karaga, about 61% of the households are members of FBOs. The FBOs are critical sources of education on the types and availability of inputs and markets. In addition, the farm households benefit as members of the association from a wide variety of training programs in group formation, farm planning and budgeting, good agricultural practices (GAP), postharvest management, and marketing strategies (Table 2).

# 5. Production system/livelihood strategies

Agriculture, arable crop production, and livestock rearing are the main sources of livelihood for rural farm households in the Northern Region and in Ghana as a whole. Some members of the rural communities also engage in off-farm income-generating activities. These include food processing, petty trading, and craftsmanship.

### Crop production

Northern Ghana accounts for a greater proportion of the grain produced in the country and can be described as the grain basket of the national economy. Maize, sorghum, millet, and rice are the common cereal crops produced in the north (Fig. 2a). Leguminous grains, including groundnut, cowpea, and soybean, are also produced. The three Northern Regions are also known for the production of significant quantities of root and tuber crops, such as yam, potato, and cassava (Fig. 2b). Additionally, horticultural produce, such as pepper, egg plant, tomato, and onion, are common in the north (SRID, MoFA 2007).

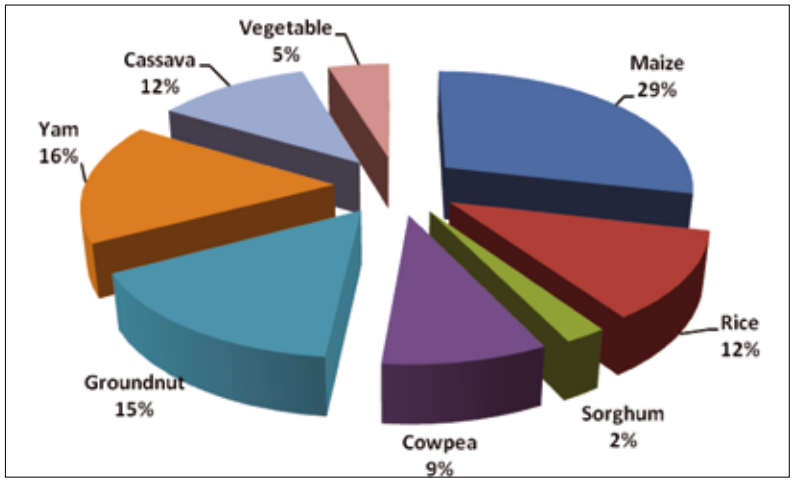


*Figure 2a. Distribution of land area among crops in Tolon-Kumbungu district.*

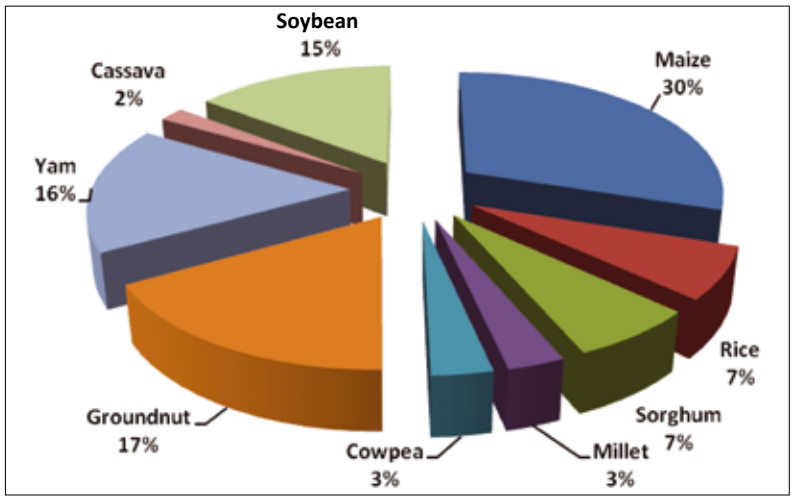


*Figure 2b. Distribution of land area among crops in Karaga district.*

### Distribution of farm lands among crops

The distribution of farm lands among food crops depends greatly on the food needs of the household, the availability of cash, and the suitability of the crop to the soil conditions. Certainly, slight variations exist in the distribution of land among crops in the two surveyed districts.

### Input use by farm households

Apart from seeds, the farm households in the surveyed districts use other inputs, mainly fertilizers. Low fertility, a typical characteristic of soils in Northern Ghana, explains the heavy use of inorganic fertilizers in the study area. A typical household applies about 87 kg of NPK and 50 kg of urea on one hectare of soil. Farmers in Tolon-Kumbungu apply organic manure, herbicides, and pesticides on their farm lands (Table 3).

**Table 3. Non-seed input use by households in selected districts.**

| Input | Tolon | Karaga | Overall |
|---|---|---|---|
| NPK (kg/ha) | 130 | 51.35 | 86.89 |
| Urea (kg/ha) | 61.92 | 40.54 | 50.20 |
| Manure (cart/ha) | 0.69 | 0.15 | 0.39 |
| Herbicide (L/ha) | 1.59 | 0.95 | 1.24 |
| Insecticide (L/ha) | 0.51 | 0 | 0.23 |

*Source:* Household survey data, Ghana, 2008.

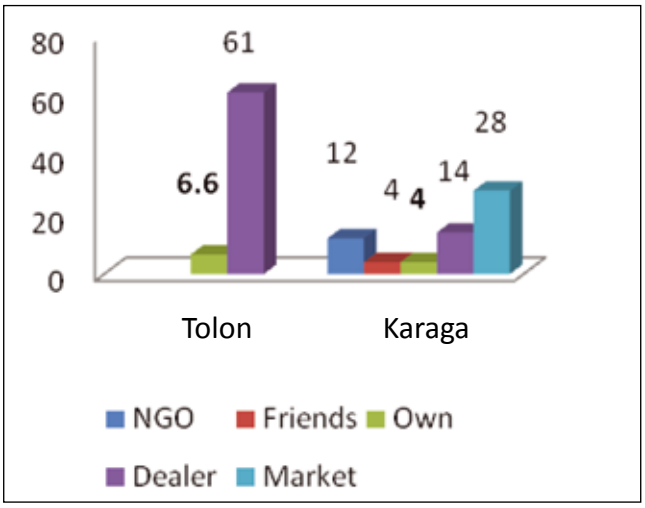


*Figure 3. Sources of crop inputs.*

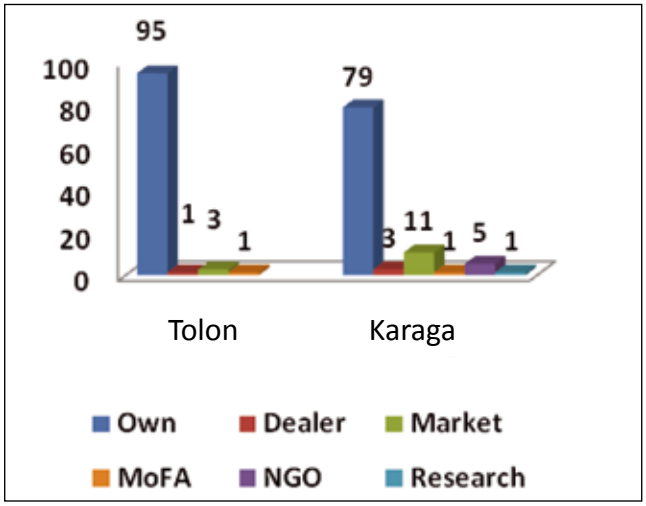


*Figure 4. Sources of crop seeds.*

**Table 4. Identified maize varieties in the surveyed districts.**

| Variety | Tolon-Kumbungu | Karaga | Total |
|---|---|---|---|
| **Local** | 100 | 100 | 100 |
| **Improved** | 98.36 | 91.89 | 94.81 |
| Okomasa | 75.41 | 44.59 | 58.52 |
| Obaatanpa | 39.34 | 40.54 | 40.00 |
| Popcorn | 1.64 | 0 | 0.74 |
| Dorke | 8.2 | 12.6 | 10.37 |
| Dobidi | 6.56 | 2.70 | 4.44 |
| Laposta | 0 | 2.70 | 1.48 |
| Dodzi | 0 | 2.70 | 1.48 |

*Source:* Household survey data, Ghana, 2008.

For most of the farm households in Tolon-Kumbungu, input dealers are the major source of non-seed inputs. However, some farmers in the district obtain inputs from their own sources. In addition, farmers in Karaga obtain non-seed inputs from the markets, input dealers, and NGOs (Fig. 3).

In both districts, most farm households recycle their seeds from previous harvests. Input dealers, traders in the market, MoFA, NGOs, and research institutions are all important sources of seeds (Fig. 4).

**Maize production**

All the sampled farm households cultivate a local variety of yellow maize. Discussions with farmers revealed that local varieties provide security against huge yield losses as they are relatively tolerant to unfavorable climate and poor soil conditions. The local varieties are also palatable and suitable for the preparation of local dishes.

Apart from the local yellow maize variety, almost all the farm households cultivate at least one improved variety. The improved varieties identified by the households include Okomasa, Obaatanpa, Popcorn, Dorke, Dobidi, Laposta, and Dodzi. Laposta and Dodzi are absent from the list of varieties identified with the farm households in Tolon-Kumbungu district. Popcorn is also absent from the list of varieties cultivated in Karaga district. According to collaborating breeders on the project, all the improved varieties identified are open pollinated varieties (OPVs). They indicated that the absence of hybrids easily allows farmers to recycle seeds from the existing varieties. Dodzi is identified by the breeders as early maturing and possibly a drought-escaping variety (Table 4).

Further analysis of the maize production systems in the two districts underscores the importance of improved varieties. Overall, the farm households cultivate an average of 0.61 ha of improved maize varieties and use

**Table 5. Maize production parameters.**

| | Tolon-Kumbungu | Karaga | Overall |
|---|---|---|---|
| Land size (ha) | | | |
| Local | 0.42 | 0.11 | 0.23 |
| Improved | 1.23 | 1.92 | 1.61 |
| Seeds (kg/ha) | | | |
| Local | 33.27 | 12.26 | 19.34 |
| Improved | 114.69 | 88.82 | 91.71 |
| Yield (t/ha) | | | |
| Local | 0.04 | 0.02 | 0.02 |
| Improved | 1.16 | 0.76 | 0.92 |

*Source:* Household survey data, Ghana, 2008.

**Table 6. Disposal of crop harvested.**

| | Proportion of harvest | | | | |
|---|---|---|---|---|---|
| Crop | Consumed | Sold | Gift | Reserved | Lost |
| Local maize | 86.19 | 2.41 | 3.11 | 3.52 | 4.77 |
| Improved maize | 79.06 | 14.5 | 3.66 | 2.27 | 0.51 |
| Millet | 61.98 | 34.27 | 1.37 | 2.22 | 0.16 |
| Sorghum | 74.84 | 15.33 | 4.21 | 5.53 | 0.09 |
| Rice | 10.71 | 75.22 | 2.94 | 8.03 | 3.10 |
| Groundnut | 11.10 | 72.03 | 4.38 | 12.23 | 0.26 |
| Cowpea | 39.62 | 54.10 | 2.26 | 0.56 | 3.46 |
| Soybean | 5.51 | 82.48 | 7.88 | 3.81 | 0.32 |
| Yam | 49.83 | 17.34 | 2.56 | 30.16 | 0.11 |
| Average | 46.54 | 40.85 | 3.6 | 7.59 | 1.42 |

*Source*: Household survey data, Ghana, 2008.

about 91 kg/ha of improved maize seeds. This represents about three times the amount of local varieties. Yields from improved[1] maize varieties are obviously higher than from the local varieties. On average, the yield from improved maize varieties for both districts is estimated at 0.92 t/ha while that of the local varieties is 0.02 t/ha (Table 5).

**Crop marketing decisions**

Household consumption and cash requirements influence household crop production and marketing decisions. On average, nearly half of the harvested agricultural produce (about 47%) is for home consumption. The remainder is sold, given out as gifts, stored for future use, or destroyed by disease and pest infestation while in store (Table 6).

Crops that are produced mainly for home consumption include maize, millet, and sorghum. Rice, groundnut, cowpea, soybean, and yam are produced for sale. The revenue from the sales of harvested agricultural produce is spent on education, health care, clothing, shelter, and other domestic needs (Table 6).

**Livestock production and marketing**

Livestock rearing is an important source of livelihood for the rural farm households in the study area. The ease of keeping a particular animal determines the number kept. There is minimal variation in the size of the livestock enterprises operated by households in the two districts. In general, the sampled farm households keep

[1] Further comparison of yield parameters of DT would have been interesting. However, Dodzi, the only DT maize variety, is cultivated by only three farmers so it was impossible to make such a comparison.

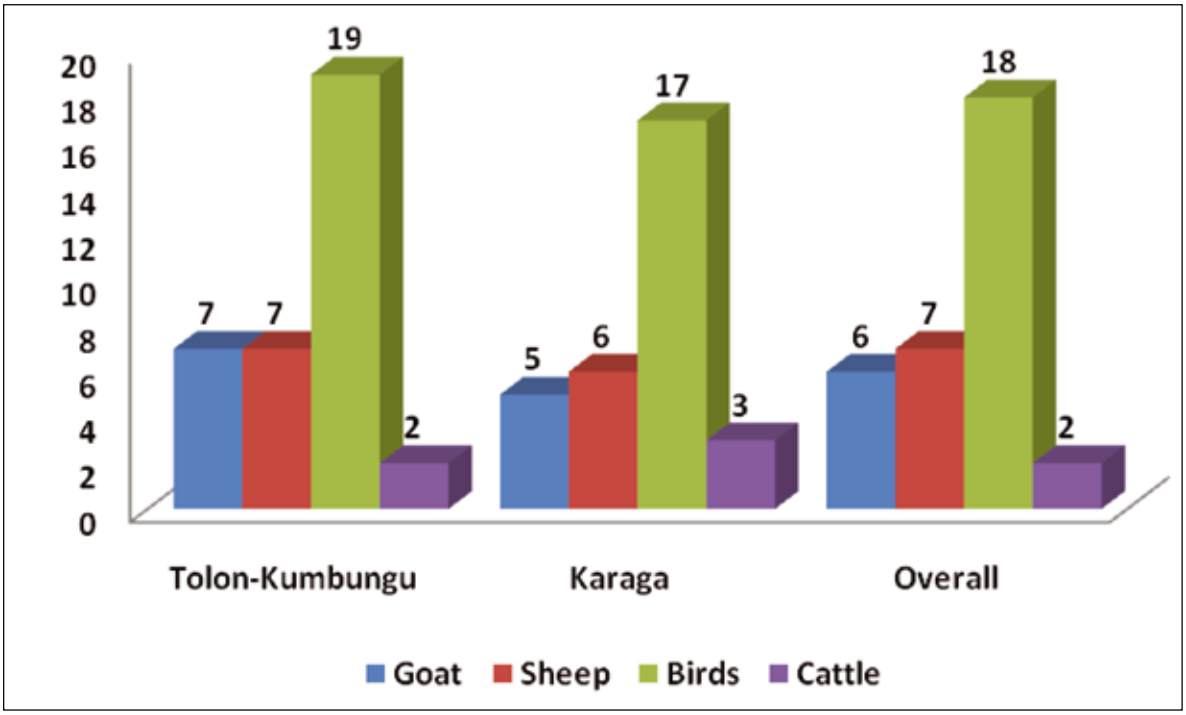


*Figure 5. Distribution of mean livestock ownership by district.*

**Table 7. Sources of household income.**

| Income sources | Tolon | Karaga | Overall |
|---|---|---|---|
| Average income (GH ¢) | 502.89 | 1,438.92 | 1,015.98 |
| Crop sales (%) | 50.45 | 69.31 | 61.36 |
| Fruit/vegetable sales (%) | 5.58 | 3.93 | 4.62 |
| Livestock/fish sales (%) | 19.83 | 12.45 | 15.56 |
| Petty trading (%) | 12.12 | 10.03 | 10.91 |
| Paid employment (%) | 4.9 | 1.26 | 2.79 |
| Self-employment (%) | 4.28 | 2.87 | 3.46 |
| Remittances (%) | 0.47 | 0.13 | 0.28 |
| Casual labor (%) | 2.37 | 0 | 1.00 |

*Source:* Household survey data, Ghana, 2008.

large numbers of free-range chickens, which are far easier to rear and require little or no capital investment. The numbers of small ruminants reared also outnumber the large ruminants, as the former are relatively easier to handle.

On average, households in the two districts rear 18 birds, 6 goats, 7 sheep, and 2 cows. All these are kept under a free-range system with minimal investment. The results further suggest that the farm households in Tolon-Kumbungu have slightly larger numbers of livestock, except for those with bulls (Fig. 5).

## Income and expenditure profiles of households

### Income from agriculture and off-farm activities

The sale of crops is a major source of income for farm households in the study area. Cattle are seen as a kind of medium to long-term investment, hence these are sold only in dire circumstances. Poultry are, however, readily sold as a source of income. Sales of fruits and vegetables and petty trading are also common sources of income (Table 7).

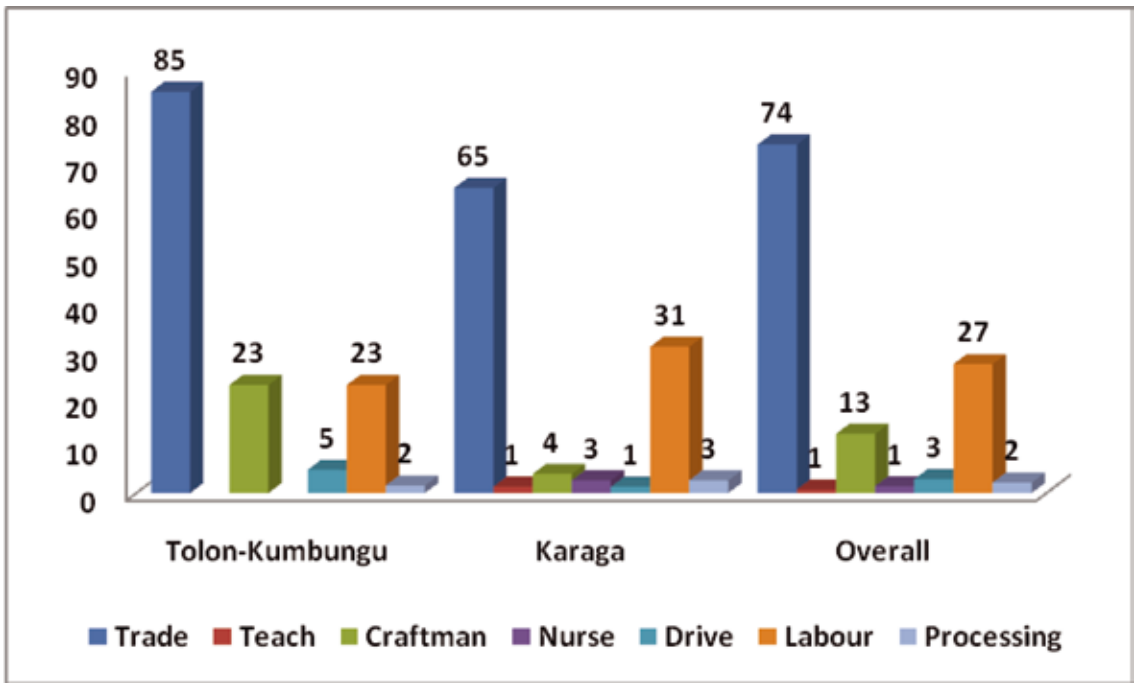


*Figure 6. Proportion of households engaged in off-farm activities.*

**Table 8. Expenditure patterns of households.**

| | Tolon | Karaga | Overall |
|---|---|---|---|
| Staples | 20.99 | 42.18 | 32.61 |
| Snacks | 0.69 | 0 | 0.31 |
| Tobacco/alcohol | 2.74 | 0.98 | 1.78 |
| Education | 18.27 | 7.91 | 12.59 |
| Medical | 8.84 | 10.73 | 9.88 |
| Clothing | 11.78 | 12.83 | 12.36 |
| Fuel | 5.53 | 6.34 | 5.97 |
| Remittances | 2.54 | 2.52 | 2.53 |
| Contributions | 7.91 | 4.97 | 6.30 |
| Transport | 4.35 | 3.73 | 4.01 |
| Accommodation | 10.89 | 5.09 | 7.71 |
| Miscellaneous | 5.46 | 2.71 | 3.95 |

*Source:* Household survey data, Ghana, 2008.

In addition to the sale of farm produce, all the farm households interviewed in Karaga district are involved in other off-farm activities as additional sources of income and food security. Some respondents are self-employed or employed in the formal sector, while others are engaged in casual work in addition to receiving remittances from family and friends abroad (Fig. 6).

**Expenditure profiles**

Given the wide range of needs and the limited availability of resources, farm households must make rational decisions on the components and volumes of expenditure. The expenditure baskets of farm households in the study area can be broadly classified as necessities and lifestyle commodities. A large proportion of farmers' income is spent on household necessities, including the purchase of staple food items and snacks. The farm households also spend a considerable amount on education, medical bills, clothing, fuel, transportation, and accommodation. It is worth noting that the farmers also contribute some of their income to the society in the form of remittances and social contributions. Some lifestyle expenditure items of the farm households include tobacco and alcohol (Table 8).

**Table 9. Household labor force.**

| | Tolon | Karaga | Overall |
|---|---|---|---|
| Av. man-days | 1343.43 | 1481.51 | 1418.67 |
| Av. months | 55.93 | 61.73 | 59.11 |

*Source:* Household survey data, Ghana, 2008.

**Table 10. Land use by households (ha).**

| Land type | Tolon-Kumbungu | Karaga | Overall |
|---|---|---|---|
| Arable | 6.40 | 17.24 | 12.34 |
| Forest | 0.83 | 2.11 | 1.53 |
| Pasture | 0.32 | 0.24 | 0.28 |
| Fallow | 0.61 | 2.27 | 1.52 |
| Abandoned | 0.30 | 0.34 | 0.32 |
| Total | 8.46 | 22.20 | 15.99 |

*Source:* Household survey data, Ghana, 2008.

# 6. Household resource endowments and wealth status

Various forms of resources were identified with the farm households involved in the study. Access to these resources varies across households and across districts. The level of resource endowment is a useful measure of the wealth status of a given household.

## Access to capital assets

### Access to human capital assets

Agricultural activities in the surveyed districts are largely carried out using manual labor. The farm family is actually the key source of labor in farm operations. The results suggest a relatively better access to labor resources among households in Karaga district than for those in Tolon-Kumbungu (Table 9). Focus group discussions in some selected communities further showed that females constitute a significant part of the household labor resource endowment. They are mainly responsible for sowing seeds, applying fertilizer, harvesting, and transporting harvested produce. The tasks of their male counterparts are more labor-intensive and include land preparation, weed control, as well as harvesting.

### Access to natural/land capital assets

Despite the increasing pressure on land resources due to the increasing population, farmers continue to allow their lands to lie fallow to regain lost nutrients, while inaccessible lands are abandoned. Forest lands with shea trees and Parkia  are an important source of livelihood for women in the study area.

In addition to crop production, the sampled households also raise farm animals. Pasture lands therefore constitute an important natural resource, serving primarily as grazing lands for livestock. Among the various forms of land use, crop cultivation claims the largest portion (Table 10).

The results further suggest changes in land allocation to maize. These changes, however, vary by district. The majority of the farmers in Karaga have increased the land area allocated to maize while in Tolon-Kumbungu, the majority have maintained the same area. Nevertheless, it is worth noting that the percentage of households that have increased their land area for maize cultivation in Karaga district is about twice that of Tolon-Kumbungu (Fig. 7).

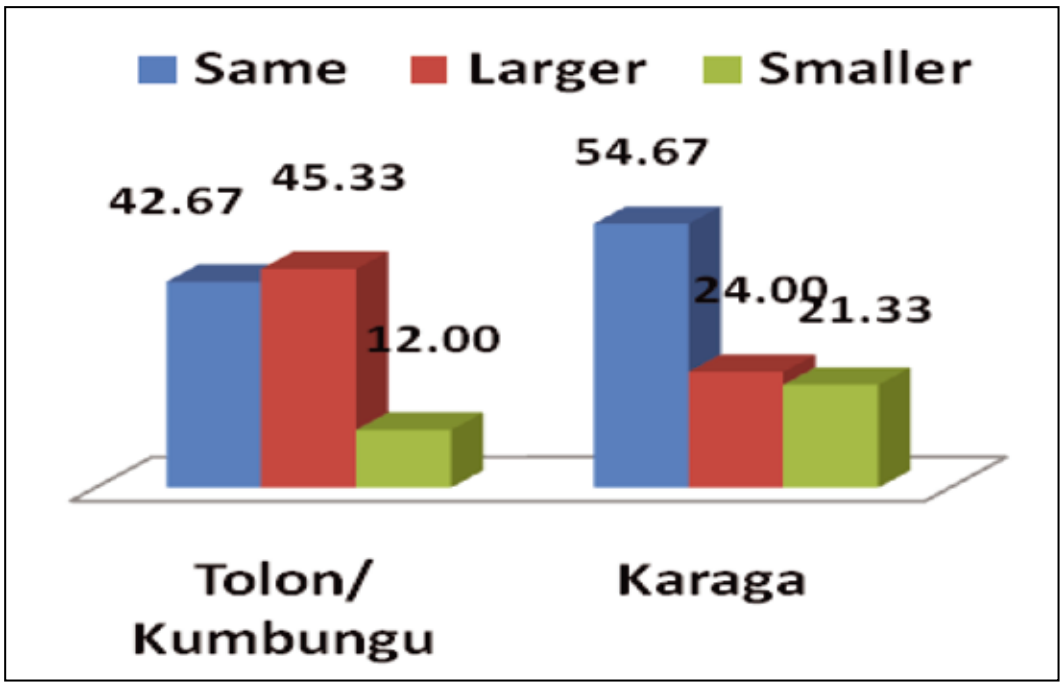


*Figure 7. Dynamics of farm size over time.*

**Table 11. Factors influencing land use.**

| Factors | Tolon | Karaga | Overall |
|---|---|---|---|
| Cash availability | 2 | 2 | 2 |
| Food needs | 1 | 1 | 1 |
| Current grain price | 3 | 4 | 3 |
| Expected family labor | 3 | 3 | 3 |

*Source:* Household survey data, Ghana, 2008.

**Table 12. Proportional distribution of assets by households.**

| Assets | Tolon-Kumbungu | | Karaga | | Overall | |
|---|---|---|---|---|---|---|
| | **Percentage** | **Mean** | **Percentage** | **Mean** | **Percentage** | **Mean** |
| Asbestos roof | 73.77 | 1 | 81.08 | 1 | 77.78 | 1 |
| Bicycle | 93.44 | 3 | 97.30 | 3 | 95.56 | 3 |
| Radio | 90.16 | 2 | 79.73 | 2 | 84.44 | 2 |
| Mobile phone | | | 47.3 | 1 | 40.74 | 1 |

*Source:* Household survey data, Ghana, 2008.

The decisions on land use within the districts are influenced by the food needs of households, cash availability, expected amount of family labor, and the prevailing market price of grain, in that order. The results are quite obvious for rural farm households whose primary objective in any agricultural enterprise is to satisfy their food needs (Table 11).

### Access to physical capital assets

Mud huts, roofed with thatch or asbestos sheets, are the common forms of dwelling in the study area. Mud huts roofed with thatch are employing a very old traditional housing technology and are widely used by households in the study area. Although these are relatively cheaper to construct they are easily destroyed during the dry season (Table 12). In any case, households who can afford mud huts roofed with asbestos sheets are regarded as well endowed.

**Table 13. Access to credit by households.**

| District | Percentage | Amount (GH ¢) |
|---|---|---|
| Tolon | 14.75 | 101.48 |
| Karaga | 18.92 | 20.54 |
| Overall | 17.04 | 57.11 |

*Source:* Household survey data, Ghana, 2008.

**Table 14. Sources of institutional support to households.**

| Institutions | Tolon-Kumbungu | Karaga | Overall |
|---|---|---|---|
| World Vision | 7.24 | 12.98 | 12.22 |
| Agric Dev Proj. | | 2.43 | 1.44 |
| ADRA | 22.96 | | 13.37 |
| Government | 8.02 | 7.88 | 7.98 |
| Demonstrations | 21.31 | 43.24 | 33.33 |

*Source:* Household survey data, Ghana, 2008. ADRA = Adventist Development and Relief Agency.

Bicycles are predominantly used for transport in the Northern Region. About 96% of the households in the study area own at least one bicycle. Radio is an important source of information and entertainment for a majority of the sampled households. Another important information and communication tool is the cellular phone, which is becoming very popular among rural households. Although not common in the sampled households in Tolon-Kumbungu, about 47% of households in Karaga own at least one cellular phone. Their use facilitates communication among farmers and also serves as a means of sharing up-to-date market information (Table 12).

**Access to financial capital assets**

As mentioned above, the status of financial resources is a key determinant of the size of arable crop lands in the study area. Access to credit or the availability of financial resources facilitates timely access to adequate inputs for the implementation of all field operations. Access to credit can motivate farmers to invest adequately in newly improved technologies. Results from the study, however, show minimal access to credit and credit facilities in the two districts. Although a relative higher proportion of the farm households in Karaga have access to credit, the average amount of credit received by farm households in the district is far lower than for those in Tolon-Kumbungu district (Table 13).

Further interactions with key informants (KI) revealed that some of the households that do not have access to credit are not aware of the availability of credit facilities. Others intentionally make no effort to search for such facilities. The latter may sometimes be due to the perceived bureaucratic processes associated with credit delivery, the high interest rates charged on credit, and the need for collateral.

**Access to institutional and social capital assets**

A wide range of development agencies exists and provides institutional, technical, and social support to households in Karaga and Tolon-Kumbungu districts. They include parastatals, such as the extension division of MoFA, research institutions, and non-governmental organizations (NGOs).

These institutions implement programs that seek to distribute quality inputs (such as seeds), demonstrate time-tested technologies, and train farmers in appropriate and improved agricultural practices. The results of the study, however, suggest low levels of participation in such programs. On the whole, less than 20% of the sampled farm households have received support from the above-mentioned institutions. Only 33% of the households have participated in field demonstrations (Table 14).

## Household wealth indices

The physical, human, and social capital endowments of households that have been described in earlier sections are key indicators of wealth. Based on these asset endowments, wealth indices were generated for the households in the study area. Following the basic steps outlined by Langyintuo (2008), the wealth indices were computed with the principal component analytic (PCA) procedure. The procedure involved the identification of the relevant weight for each asset indicator by extracting from a set of variables those few with orthogonal linear combinations that capture the common information (Langyintuo 2008).

Given that the levels of endowment vary across the households and to ease comparison, there was the need first to normalize the assets by weighting to avoid distortions. Assets such as farm size and household size which are measured in absolute values were also scaled from 0 to 1. Scaling was done as follows:

$$i = \frac{x_l - x_{\min}}{x_{\max} - x_{\min}} \qquad (1)$$

where *i* represents the index, x*l* represents the level, while $x_{min}$ and $x_{max}$ represent the minimum and maximum values of x, , taken from the actual data collected. Once these were scaled (or normalized), it was easier to aggregate the indicators without distortion.

Secondly, descriptive statistics (i.e., mean and standard deviation) and the component score coefficient matrix for the normalized variables were generated using the Statistical Package for Social Sciences (SPSS). With these, the wealth indices were computed as follows:

$$W_j = \sum_{i=1}^{k} [b_i (a_j - x_i] \ / s_i \qquad (2)$$

where *Wj* represents a standardized wealth index for each household 'j'; b*i* represents the weights (scores) assigned to the (*k*) variables on the first principal component; a*ji* represents the value of each household 'j' on each of the *k* variables; x*i* represents the mean of each of the *k* variables; and 's'*i* the standard deviations.

### Household wealth ranking

A graphical exposition of the distribution of the wealth ranking of the households and the probability distribution of households within wealth groups provides both qualitative and quantitative evidence of the incidence of poverty in the study area. The results suggest a high incidence of poverty and confirm the human poverty indices (HPI) estimates of the Ghana Statistical Services (GSS 2005).

Specifically, the computed wealth indices range between –1.14 and 4.26. From these estimates, two main wealth groups have been identified within the area. Well endowed households have indices above zero and are shown by the upward section of the distribution of wealth ranking. The well endowed group is heterogeneous, as shown by the relatively steeper side of their end of the curve.

About 64% of the households are less endowed and are shown by the relatively longer section of the curve below the zero mark. On average, a farmer in the survey districts is less endowed with an estimated wealth index of –0.001 (Survey data 2008; Figs 8 and 9). There is minimal variation in the distribution of wealth groups within the districts. In both cases, more than 60% of the sampled households are less endowed.

*Farm families show off maize produce.*

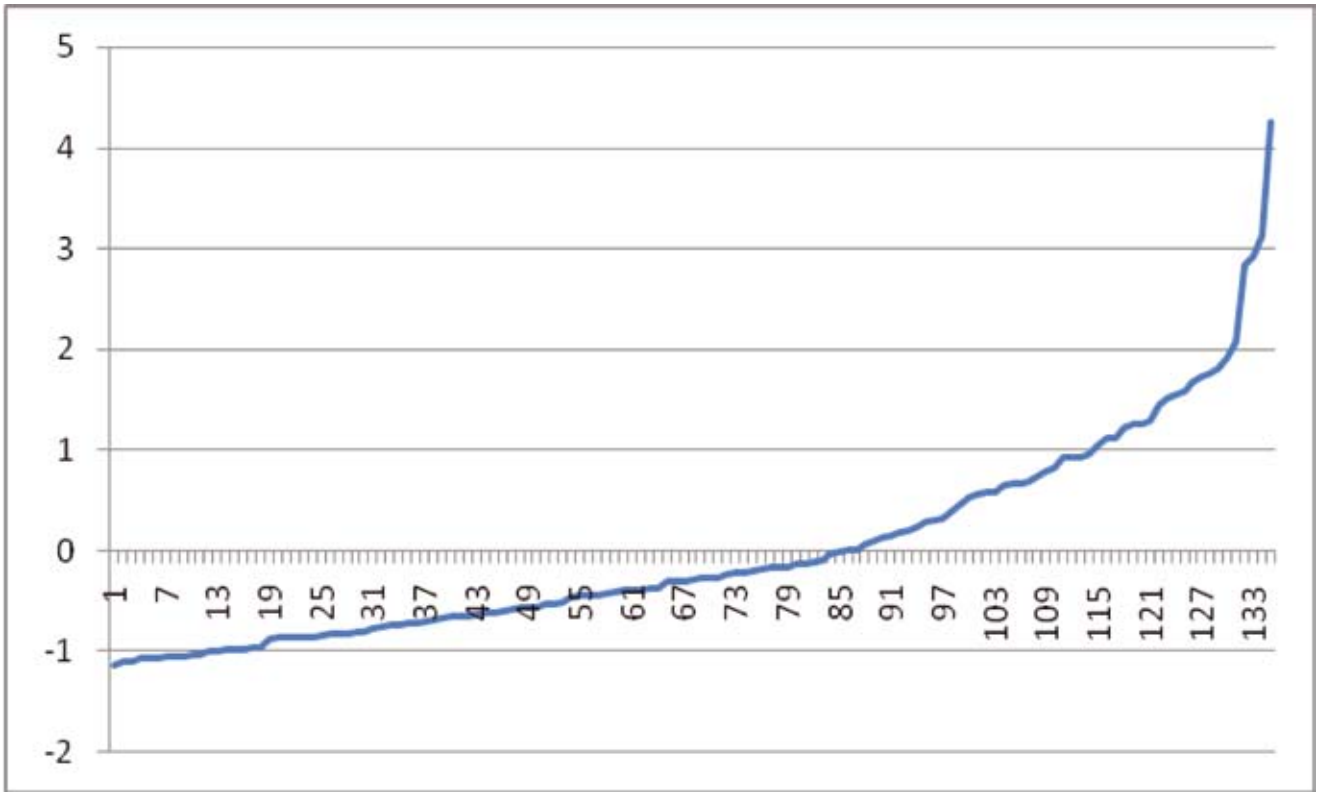


*Figure 8. Distribution of wealth index ranking of households.*

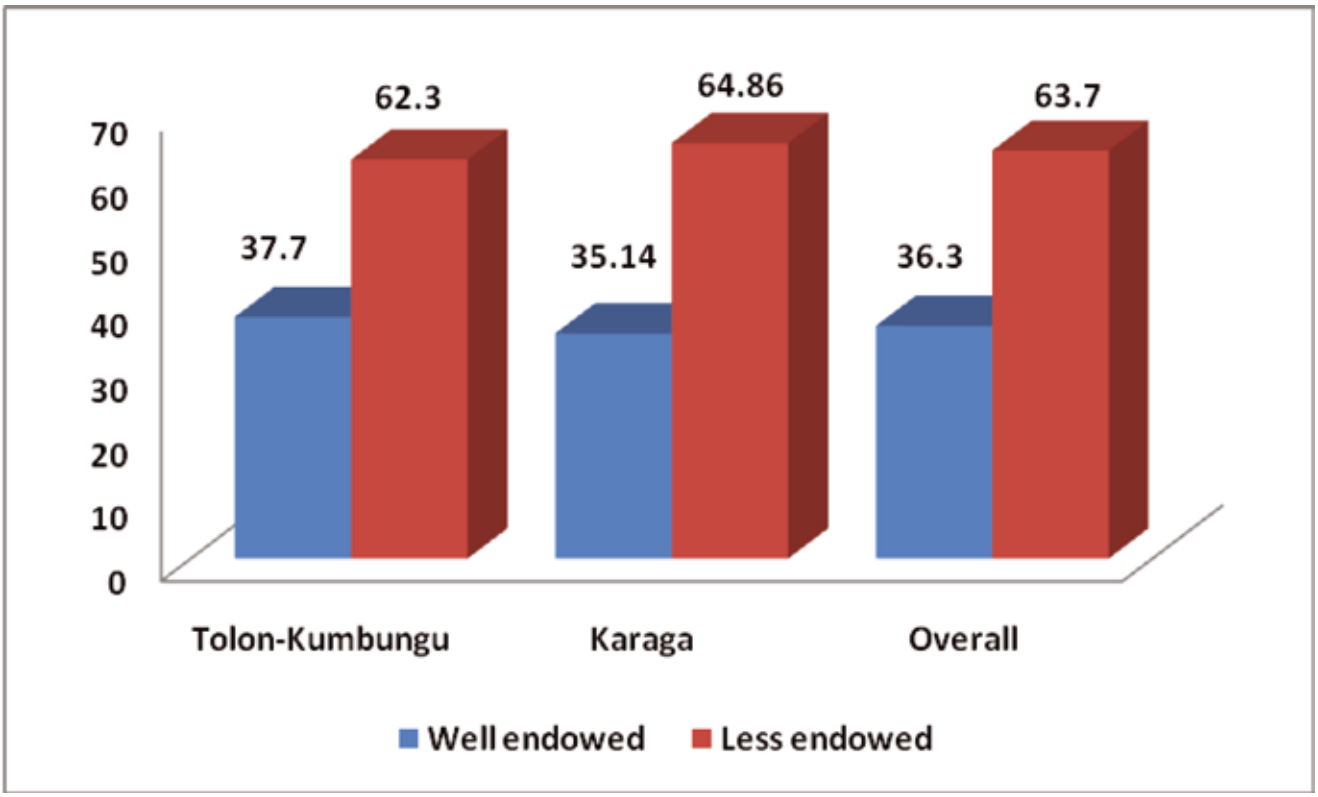


*Figure 9. Probability distribution of households within wealth categories.*

**Table 15. Descriptive statistics of heads of wealth groups.**

| Characteristics | Wealth group | |
|---|---|---|
| | Well endowed | Less endowed |
| **Av. age (years)** | 53.71 | 51.23 |
| **Decision-maker (%)** | | |
| Head | 69.39 | 84.88 |
| Family | 30.61 | 15.12 |
| **Marital status (%)** | | |
| Married | 97.96 | 98.84 |
| Widowed | 2.04 | 1.16 |
| **Literacy (%)** | | |
| Literate | 89.80 | 94.19 |
| Illiterate | 10.20 | 5.81 |
| **Association** | | |
| Members (%) | 46.94 | 54.65 |
| Av. years of membership | 3.10 | 2.75 |
| **Sample size** | 86 | 49 |

*Source:* Household survey data, Ghana, 2008.

**Table 16. Identified maize varieties in the survey districts.**

| Variety | Well endowed | Less endowed |
|---|---|---|
| Local | 100 | 100 |
| Improved | 91.84 | 96.51 |
| Okomasa | 65.31 | 54.65 |
| Obaatanpa | 38.78 | 40.70 |
| Popcorn | 0 | 1.16 |
| Dorke | 14.29 | 8.14 |
| Dobidi | 5.81 | 2.04 |
| Laposta | 0 | 2 |
| Dodzi | 0 | 2.33 |

*Source:* Household survey data, Ghana, 2008.

Obviously, the well endowed households have access to human, physical, and institutional resources. However, very little variations exist in the characteristics of the household heads of the wealth groups. The well endowed household heads slightly dominate in terms of age, joint decision-making processes, literacy, and years of membership of FBOs. Most of the less endowed household heads make their own decisions about farm operations, are illiterate, and are members of FBOs (Table 15).

# 7. Determinants of adoption of improved maize seeds

As indicated earlier, almost all the farm households involved in the study use at least one improved variety, in addition to the local yellow maize variety. Minimal variations exist in the rates of adoption of existing maize varieties among the wealth groups. Overall, the less endowed farmers have adopted at least one of the improved varieties, while the well endowed have not adopted varieties such as Popcorn, Laposta, and Dodzi. In fact, the less endowed farm households have a relatively higher adoption rate than the well endowed farmers. They are also dominant in the adoption of Obaatanpa. The well endowed are dominant in the adoption of Okomasa, the most popular improved variety in the study area, as well as Dorke and Dobidi (Table 16).
The high rate of adoption of existing improved maize varieties suggests a high adoption potential for promising DT varieties. Effective and efficient dissemination of new DT maize varieties, therefore, requires a

better appreciation of the adoption behavior of the targeted farm households. The adoption behavior of farm households in the study area is analyzed using the Probit regression model. The Probit model was used to capture the factors that affect the probability that a farmer adopts an improved variety. Since almost all the farmers have adopted at least one of the existing improved varieties, the analysis was limited to the adoption of Okomasa, the most popular variety in the study area (Tables 4 and 16).

In order to describe the probability of adoption of Okomasa, variables that describe the farmers' characteristics, farm-level characteristics, and institutional characteristics were used as explanatory variables. Older farmers, who have vast experience in agricultural operations and are aware of the benefits of improved technologies, were expected to be more likely to adopt Okomasa, also households with large families since they have much better access to free labor. The well endowed farmers and farmers with high incomes were expected to have the ability to finance the extra expenses associated with the use of improved varieties and were therefore expected to be more likely to adopt Okomasa.

Considering the farm-level characteristics, farmers with access to large plots of land were expected to be more likely to adopt Okomasa. However, the high cost of fertilizers was expected to deter farmers from adoption. Institutionally, proximity to research and development institutions suggests access to information on improved technologies. The farm households in Tolon-Kumbungu, who are more closely located to CSIR-SARI and the University for Development Studies (UDS) in the Northern Region of Ghana, were expected to be more likely to adopt Okomasa.

With the exception of income, all the variables in the model bear the expected sign. Although not significant, the size of household, age of the household head, and wealth status were all positively related to the adoption of Okomasa. The probability of adoption was significantly affected by the location of the household, area allocated to improved maize varieties, and cost of fertilizer at 5% alpha level. The income of the farm household also had a significant effect on adoption at 10% alpha level.

The outcome of the model confirms the fact that farmers in Tolon-Kumbungu are relatively exposed to improved technologies by virtue of their proximity to research and development organizations, such as SARI and UDS) Given access to information about the benefits of improved maize varieties, rational farmers will adopt these to ensure the food security of their households. It is therefore certain from the model that the level of adoption of Okomasa will increase by over 100% if farmers in Karaga are also exposed to the variety.

The adoption model also shows the larger the area of improved maize varieties, the higher the likelihood of adoption of Okomasa. Farmers with access to large areas of land are more likely to commit some of their land resources to improved varieties without altering the allocation to other crops. As indicated in the model, a unit increase in land area allocated to improved maize varieties will increase adoption of Okomasa by about 25% (Table 17).

**Table 17. Factors affecting the adoption of Okomasa.**

| Ext_adopt | Marginal effects | Standard Error |
|---|---|---|
| Household size | .0015018 | 0.0399242 |
| Age | .0075525 | 0.0086085 |
| Tolon-Kumbungu | 1.080613* | 0.2771453 |
| Area of improved maize | .2483763* | 0.1222708 |
| Cost of fertilizer | –.0042871* | 0.0021323 |
| Total income | –.0001735** | 0.0000968 |
| Well endowed | .4077203 | 0.2791469 |

*Note:* * and ** denote 5% and 10% levels of significance,.

Agricultural interventions are usually introduced as a package. Thus, the dissemination of improved maize varieties comes with a number of practices (complementary technologies) such as the use of fertilizer, row planting, and other GAP. The use of fertilizers is a key component of the maize technology package. This also has cost implications that may deter adoption. As revealed by the Probit model, the cost of fertilizers actually has a negative effect on the adoption of Okomasa. Maize is a heavy feeder, and cultivation requires the use of appreciable quantities of fertilizer. Besides, the soils in the study area are poor in nutrients, thus to cultivate a large area implies accepting a heavy burden of fertilizer costs. Therefore, farmers are not motivated to adopt improved maize varieties which need fertilizer to survive.

Although not significant, the adoption of Okomasa is shown to be negatively affected by income. This suggests that farmers are less willing to plow back gains from agriculture (which is their largest contributor to income). It also affirms the idea that, as incomes increase, households tend to shift their investments to non-agricultural activities.

The insignificant effect of wealth on adoption may be due to the minimal variation of the characteristics of the farm households between the wealth categories. Moreover, the computation of the wealth indices of the households may not be very accurate, and may have omitted necessary variables or included those that are unnecessary. Perhaps further refinement of the estimation procedure may result in significant effects.

*Farmer who has adopted the improved maize varieties.*

**Table 18. Perceived shocks to household livelihoods.**

| Shock | Well endowed | | Less endowed | | Overall | |
|---|---|---|---|---|---|---|
| | Rank | Occurrence | Rank | Occurrence | Rank | Occurrence |
| Drought | 1 | Yearly | 1 | Yearly | 1 | Yearly |
| Flood | 2 | Two yrs | 2 | Yearly/two yrs | 2 | Yearly/two yrs |
| Input prices | 3 | Yearly | 4 | Yearly | 3 | Yearly |
| Livestock disease | 4 | Two/three yrs | 3 | Two yrs | 3 | Two and three yrs |
| Weeds | – | Yearly | 5 | Yearly | 6 | Yearly |
| Loss of livestock | 5 | Yearly/three yrs | – | Yearly/three yrs | 5 | Yearly/three yrs |

*Source:* Household survey data, Ghana, 2008.

# 8. Impact of shocks on household livelihood outcomes

Increasing food production and food security, enhancing access to quality health care and education, and reducing asset and market risks constitute the major livelihood concerns of the farm households in the study areas. The farm households have developed strategies for achieving these livelihood objectives. To increase food production, the farm households seek to adopt GAP, such as early planting and the use of improved technologies *inter alia*. In addition to the adoption of GAP, farmers are also considering safe postharvest handling practices to ensure that the food harvested is properly secure in storage to sustain household food needs during and after the main season. They have also decided to adopt a positive attitude towards savings so as to reserve some of their income for satisfying future food needs (Table 18).

To ensure healthy living, the farm households are considering the intake of hygienic and nutritious food. According to a KI, regular visits by community health nurses have enlightened them on the need to consume a balanced diet and also to keep the environment clean and healthy. Acknowledging the need for education, they intend to invest significant amounts of their incomes to fund the education of children. Farmers also intend to participate actively in all extension training activities to be educated in the application of new technologies. The farmers are also considering the reduction of asset and marketing risks as an important source of livelihood. To safeguard asset risk, the farmers seek to develop a positive attitude towards savings. They also intend to undertake effective price targeting to minimize market risk (Table 18).

Among the list of shocks that pose threats to the livelihood of farmers, droughts, floods, and input prices have been identified as the most important. Drought and input price shocks are annual phenomena. Floods may occur annually or every other year. Other threats to the livelihood of farm households include livestock diseases, weeds, and loss of livestock. These may occur annually, or at two- or three-year intervals (Table 18).

# 9. Production and price risk analysis

## Households' perception about production risk and their coping mechanisms

As mentioned, farmers perceive droughts and floods as the most important livelihood risks. These risk factors also have severe impacts on the crop and livestock production activities of most of the farm households. Coupled with livestock diseases and weeds, they have dire consequences on the livelihoods of farmers (Table 19).

Unlike the less endowed farm households, the well endowed households have a wide range of coping mechanisms against crop and livestock production risks. In addition to reducing their levels of consumption, using GAP, and crop diversification, well endowed farm households also undertake timely operations as well as the cultivation of improved crop varieties on their fields. Timely operations enable the farm households to escape harsh environmental conditions, such as terminal droughts and subsequent floods. Again, the adoption of improved technologies which are much more tolerant of harsh climatic conditions also saves the well endowed farm households from huge production losses (Fig. 10).

**Table 19. Major crop and livestock production risks farmers face.**

| | Well endowed | Less endowed | Overall |
|---|---|---|---|
| Drought | 59.5 | 71.4 | 63.07 |
| Flood | 87.1 | 80.7 | 85.18 |
| Input prices | 27.5 | 53.8 | 35.39 |
| Livestock disease | 27.5 | 29.6 | 28.13 |
| Weeds | 15 | 50.9 | 25.77 |
| Loss of livestock | 10.5 | 56.6 | 24.33 |

*Source:* Household survey data, Ghana, 2008.

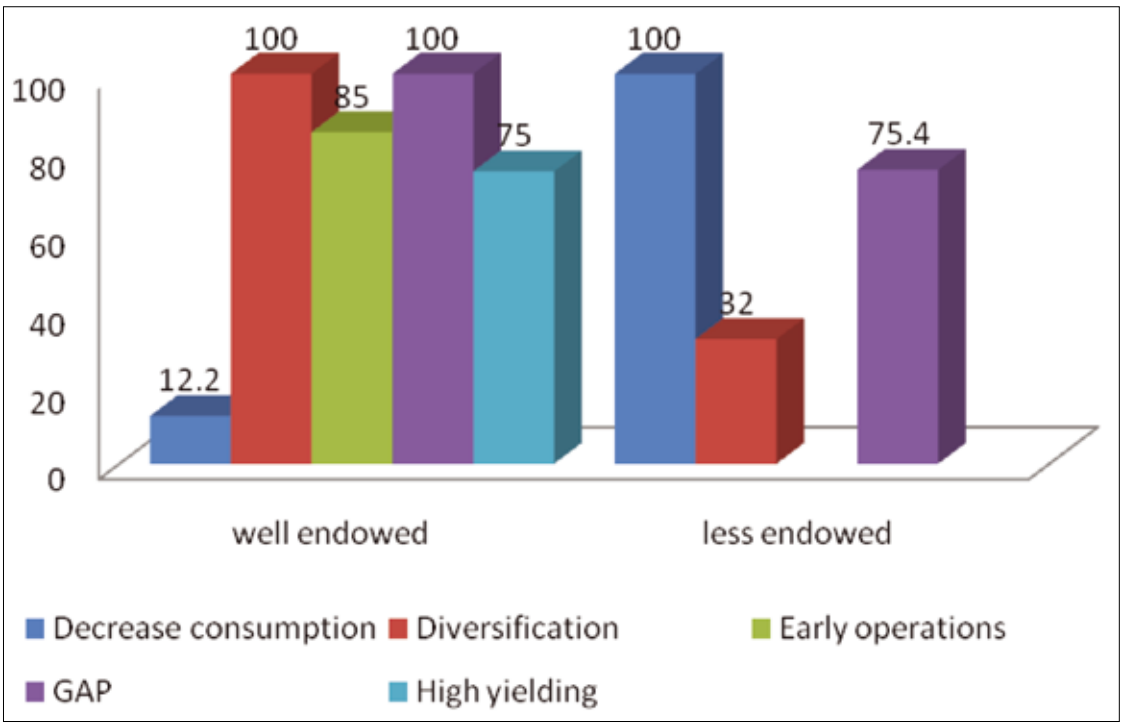


*Figure 10. Production risk coping strategies by wealth groups.*

**Table 20. Major crop and livestock price risks farmers face.**

| Risk | Well endowed | Less endowed | Overall |
|---|---|---|---|
| Low produce price | 100 | 100 | 100 |
| High fertilizer price | 76 | 90 | 80.2 |

*Source:* Household survey data, Ghana, 2008.

**Table 21. Adjustment in crop portfolio to mitigate selected production risks.**

| Risk situation | Strategy | Less endowed | Well endowed | Overall |
|---|---|---|---|---|
| Low price | Decrease | 9.12 | 17.65 | 15.09 |
| | Same | 73.22 | 67.94 | 69.52 |
| | Increase | 18.59 | 17.95 | 18.14 |
| High price | Decrease | 4.89 | 7.65 | 6.82 |
| | Same | 47.79 | 46.8 | 47.10 |
| | Increase | 47.3 | 45.59 | 46.10 |
| Low yield | Decrease | 13.78 | 14.09 | 14.00 |
| | Same | 78.09 | 75.05 | 75.96 |
| | Increase | 8.15 | 10.86 | 10.05 |
| High yield | Decrease | 5.55 | 33.3 | 24.98 |
| | Same | 46.41 | 44.73 | 45.23 |
| | Increase | 54.63 | 53.61 | 53.92 |
| Access to fertilizer | Decrease | 9.73 | 6.02 | 7.13 |
| | Same | 48.5 | 49.01 | 48.86 |
| | Increase | 55.64 | 52.99 | 53.79 |
| Scarce fertilizer | Decrease | 19.57 | 12.82 | 14.85 |
| | Same | 70.59 | 67.65 | 68.53 |
| | Increase | 4.49 | 14.3 | 11.36 |
| Ready credit | Decrease | 12.98 | 14.55 | 14.08 |
| | Same | 37.23 | 35.85 | 36.26 |
| | Increase | 54.42 | 64.8 | 61.69 |

*Source:* Household survey data,,Ghana, 2008.

It is generally agreed that low produce prices and high fertilizer prices are serious challenges to farm households (Table 20). During the peak of harvest, the prices of farm produce are so low that farmers are sometimes unable to recoup their investment capital. Yet during the production periods, the prices of inputs, especially fertilizers, inflate the cost of operations. These occurrences serve as a disincentive for farmers to invest completely in the entire package of improved technologies.

The risk coping strategies of farm households vary by wealth groups. In all cases, the majority of the farm households will either maintain or increase their crop production portfolio. When prices are low, the majority of farm households maintain the same crop area. When prices are high, some will increase the farming area while those who are risk-averse maintain the same area. The same is true for all other conditions except in situations where there is ready credit for investment. Here, the majority of the farmers from both wealth classes will increase their land area (Table 21). Certainly, the availability of ready credit is expected to stimulate investment on improved technologies. Unfortunately, access to credit facilities is limited in the study area.

**Table 22. Adjustment in crop portfolio to mitigate selected price risks.**

| Risk situation | Wealth groups | | | |
|---|---|---|---|---|
| | Strategy | Well endowed | Less endowed | Overall |
| Low produce price | Decrease | 28.93 | 72.45 | 41.99 |
| | Same | 15.27 | 27.55 | 18.95 |
| | Increase | 55.80 | | 39.06 |
| High fertilizer price | Decrease | 13.27 | 97.70 | 38.60 |
| | Same | 86.73 | 2.30 | 61.40 |
| | Increase | | | |

*Source:* Household survey data, Ghana, 2008.

**Table 23. Price risk coping strategies adopted by well endowed farmers.**

| | Risk situation | |
|---|---|---|
| Wealth group | Low produce price | High input price |
| Well endowed | Collective marketing<br>Diversification | Collective marketing |
| Less endowed | Sale of assets<br>Bulk purchase | Sale of assets |

*Source*: Household survey data, Ghana, 2008.

## Households' perception on price risk and their coping mechanisms

One of the coping strategies used by farmers against price risk is to vary the allocation of land to maize in general and improved maize varieties in particular. The change might be increasing, decreasing, or maintaining the same proportion of land under improved maize varieties. The study has identified variations in the behavior of farmers by wealth groups. To make up for low product prices, more than half (55%) of the well endowed farmers intend to increase the area cultivated. This increases their volume of production and revenue without necessarily increasing their profit. On the contrary, the majority of the less endowed farmers (72%), intend to decrease the land area allocated to maize when the price of the harvested produce is low.

In terms of input prices, the majority (87%) of well endowed farm households have no option other than to maintain the same size of their lands. The rest tend to decrease the area they allocate to maize production. Almost all the less endowed households intend to decrease their crop area to minimize the cost of operations (Table 22).

The wealthy farmers usually diversify their crops and produce those that are more marketable and have attractive prices. A few well endowed farmers also engage in collective marketing as a strategy for strengthening their bargaining power (Tables 22 and 23).

Apart from these adjustment processes, the farmers also adopt other forms of coping mechanisms. These include crop diversification, collective marketing, bulk purchase, and the sale of some assets. In this instance, the well endowed are more versatile in coping with risk situations. They adopt all the outlined strategies. Apart from engaging themselves in collective marketing to mitigate the effect of low produce prices, they also diversify their crops base to produce high value crops, such as groundnut, soybean, and pepper. To mitigate the effect of high fertilizer prices, they buy inputs in bulk and also sell some of their assets. On the other hand, the less endowed farmers participate in collective marketing to cope with low produce prices and sell some of their assets to cope with high input prices (Table 23).

*Scientists visiting demo plot.*

# 10. Distribution of summary impact indicators by household wealth category

The study was implemented to characterize households in the DTMA project zone in the Northern Region of Ghana. The study area, Karaga and Tolon-Kumbungu districts, is the zone where DT maize varieties are being tested and has a drought probability risk lying between 20 and 40%.

A wide range of development agencies exists and provides institutional, technical, and social support to households in Karaga and Tolon-Kumbungu districts. These institutions implement programs that seek to distribute quality inputs (such as seeds), demonstrate time-tested technologies, and train farmers in appropriate and improved agricultural practices. However, there is a low level of participation in such programs.

Traditionally, the rural households in the study are headed by males who serve as the official spokesmen of their families and also make decisions on agricultural activities. The farm family is a key source of labor for farm operations, and females are a significant part of the household labor resource. Agriculture, arable crop production, and livestock rearing, are the main livelihood sources for rural farm households in the study area. Some members of the rural communities also engage in off-farm income generating activities. These include food processing, petty trading, and craftsmanship.

Almost all the households in the study area own at least one bicycle, which is an important means of transport. Radios and cellular phones are important sources of information and entertainment for a majority of the sampled households. The analysis of wealth status revealed that the majority of the households are poorly endowed. However, there is little variation in the household characteristics of the wealth groups.

There is also minimal access to credit among the farm households. The farm families are either ignorant of the availability of credit facilities or make no effort to search for such facilities. There is also the perception of excessive bureaucratic measures in the credit delivery process, high interest rates, and the need for collateral.

*Maize harvesting in northern Ghana.*

The dynamics and distribution of land allocation among the crops under production are informed by cash availability, the food needs of households, grain price, and the expected amount of family labor. Among the various forms of land resources, arable lands form the largest resource. Apart from seed inputs, the farm households in the survey districts use other non-seed inputs, mainly fertilizers. Input dealers located in the farm communities

are the major source of non-seed inputs. Some farmers obtain inputs from their own sources. Seeds are mostly obtained from their own sources, usually from previous harvests. Some obtain their seed inputs from input dealers, traders in the market, MoFA, NGOs, and research institutions.

Although recorded yields are low, the farm households continue to cultivate the local yellow maize. Improved maize varieties, such as Okomasa, Obaatanpa, Popcorn, Dorke, Aburotia, Dobidi, Laposta, and Dodzi, are also cultivated by the farm households. A Probit model was estimated to assess the determinants of adoption of the most common improved maize variety (Okomasa). The results showed that the location of farmers, the area allocated to improved maize varieties, the cost and amount of fertilizers, and the income of farm households are important factors that determine the adoption of Okomasa.

Household consumption requirements and cash requirements influence household crop marketing and consumption decisions. On average, the largest proportion of harvested agricultural produce is for home consumption. The remainder is sold, given out as gifts, stored for future use, or destroyed while in storage. Maize, millet, sorghum, and rice are largely produced for home consumption. The sampled farm households produce grain legumes such as groundnut, cowpea, and soybean, as well as yam for sale. Notably, 13.81% of the harvested improved maize is lost through pest and disease attacks.

Given the wide range of wants and their limited resource availability, farm households must make rational decisions on the component and volumes of expenditure. The revenue from the sales of harvested agricultural produce is spent on education, health care, clothing, shelter, and other domestic needs.

Increasing food production and food security, enhancing access to quality health care and education, and reducing asset and market risks constitute the major livelihood concerns of the farm households in the study areas. These are to be achieved through the adoption of GAP, the use of improved technologies, and safe postharvest handling practices.

Droughts, floods, and input prices have been identified as the most important shocks that pose a threat to the livelihood of farmers. Drought and input price shocks are annual phenomena. Floods may occur yearly or every other year. Other threats to the livelihood of farm households include livestock diseases, weeds, and the loss of livestock. These may occur yearly, or at three- year intervals. These factors also have a severe impact on the crop and livestock production activities of most farm households and have dire consequences on the livelihoods of farmers.

Unlike the poorly endowed farm households, the well endowed households have a wide range of coping mechanisms against crop and livestock production risks. In addition to adopting GAP and crop diversification, well endowed farm households also reduce their levels of consumption to cope with these threats. Again, the adoption of improved technologies which are more tolerant of harsh climatic conditions spares the well endowed farm households from huge production losses.

It is generally agreed that low produce prices and high fertilizer prices pose a serious challenge to farm households. These are disincentives for farmers to invest completely in the entire package of improved technologies. In all cases, the majority of the farm households will either maintain the same level or increase their crop production portfolio.

# 11. Conclusions

Traditionally, the rural households in Northern Ghana are male-headed. Almost all household heads are married, and the family also serves as a source of labor. Decisions on crop production activities are mostly left to the household heads who also serve as the official spokesmen for their families. A typical household head is about 52 years old and highly experienced in agriculture and maize cultivation. However, most of these heads are not educated. More than half of the households are affiliated to FBOs which are critical sources of education on the types and availability of input and markets.

The current adoption rate of existing improved maize varieties, 95 percent, is very impressive. However, the low level of farmers' participation in field demonstrations is a source of concern for the newly improved DT maize varieties that are yet to be released. For this project to be successful, there is a need to foster strong linkages between the DTMA working group in the country and the identified development agencies who already have programs that seek to distribute quality inputs (such as seeds), demonstrate time-tested technologies, and train farmers in appropriate and improved agricultural practices. This is necessary for the identification of synergies to ensure the effective dissemination of the DT maize varieties through intensive field demonstrations, among other methods.

Moreover, high adoption rates of the DT maize varieties can be achieved if proper targeting is undertaken. Essentially, farmers in Tolon-Kumbungu district are more likely to adopt newly improved maize varieties. The results also suggest that the farmers in the lower income category are more likely to adopt the DT varieties. Therefore, to achieve a massive impact, the poorly endowed farmers should also be targeted. The technology development process must also take into account the cost implications in terms of the fertilizer and labor requirements to allow the poorly endowed to have the opportunity to adopt and use the technologies.

Since the technology development process and dissemination occur simultaneously, it is also necessary to progressively track the rate of diffusion and the potential impact. Progressive impact assessment can provide an opportunity to capture information that has not been well considered in this baseline study.

Droughts, floods, low produce prices, and high input prices continue to pose a threat to the rural farm households who are generally poor and less endowed. In many instances, the less endowed households will have to reduce their crop land area and engage in collective marketing to mitigate the effect of low produce prices. They also sell some of their assets to purchase farm inputs in situations where prices of inputs are high. In addition to these coping strategies, the well endowed farm households also diversify their crops when produce prices are high and engage in bulk purchases when they expect high input prices.

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