



FOOD SECURITY IN THE UPPER EAST REGION OF GHANA: A SITUATIONAL ANALYSIS

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Abstract

Despite significant progress made by the government of Ghana in recent times in reducing poverty incidence in rural areas of the country there still remain some challenges in food access, use and availability. The experience of less developed countries shows that food security has often been negatively affected by climate variability, natural disasters and socio-political instability. The main research question is whether or not poverty reduction always brings about increased food security. This paper examines the food situation in the Upper East Region of Ghana with respect to both irrigated and non-irrigated smallholder farmers with focus on food sources and causes of food insecurity and food insecurity coping strategies. Results of in-depth interviews and desk studies reveal that poverty reduction is not always accompanied by increased food security. However, increased access to agricultural water through small-scale irrigation schemes has a positive impact on the food security status of rural households. Irrigation farmers' inability to expand their farming ventures is due to a number of constraints, prominent among them are difficulty in securing credit to buy inputs such as seeds, fertilizer and agro-chemicals; high disease infestation of irrigated crops (eg nematodes) and poor maintenance of the schemes. The policy implication is that increased access to food security requires the joint support of government, civil society organisations (NGOs) and the private sector.

Key words: Food Security, Irrigation and Poverty.

Background

The outcome of the World Food Summit held in 1996 showed that food security (FS) is achieved when “all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life” (World Bank, 1996). Achieving food security therefore has three dimensions. First, it is necessary to ensure a safe and nutritionally adequate food supply both at the national level and at the

household level. Second, it is necessary to have a reasonable degree of stability in the supply of food both from one year to the other and during the year. Third, and most critical, is the need to ensure that each household has physical, social and economic access to enough food to meet its needs. Achieving food security requires different developmental interventions involving both policy and technology. According to Obayelu (2013) in order to transit from food insecurity to food security there is the need to

ensure birth control, participation in agriculture and to promote gender-sensitive food insecurity alleviation policies that enhance endowments of female-headed households.

Previous governments of Ghana have, since the 1950s and 1960s, embarked on various agricultural programmes including the construction and rehabilitation of small reservoirs (dams) and dugouts in order to provide reliable water supplies to communities in the Upper East Region for domestic use, livestock watering, fishing and crop irrigation (Coche, 1998) as ways of improving food availability. The long term objective has been to reduce the adverse impacts of the single unreliable rainy season on agricultural productivity (Coche, 1998; Blench, 2006). MoFA (2011) has argued that the government's current policy on small scale irrigation is aimed at increasing smallholders' crop production by providing improved technology, infrastructure and institutional support. This is in line with the thinking that extensive irrigation projects have positive impacts on agricultural production and poverty reduction for farmers (Dillon, 2008; Kissawike, 2008; Lipton 2007; Bhattarai & Narayanamoorthy, 2004; Hussain & Hanjra 2004; Bhattarai, Sakthivadivel & Hussain. 2002; von Braun, Puetz & Webb, 1989).

However, the experience of Ghana shows that both small and large scale public irrigation schemes have performed poorly over the years compared with private schemes, in which farmers feel they have more to benefit (Namara et al., 2011). Farmers usually have very high expectations in government built and controlled irrigation schemes, but are

¹ Although the level of extreme poverty is relatively low, it is concentrated in Rural Savannah, with more than a quarter of the people being extremely poor. According to GSS 1998/99 and 2005/06 above 80 percent of the total population living below the poverty line in Ghana were living in the rural areas. In 2012/13, the rural population comprised 50 percent of the

quickly disillusioned when things begin to get bad as schemes deteriorate (Nanedo, 2014). Bhattarai, Sakthivadivel & Hussain (2002) have observed that the nature and scale of feedback effects associated with irrigation access and their impacts on food security are often not clearly understood or reported in irrigation literature. Dry season farming plays a significant role in agricultural production activities in the Bolgatanga Municipality. Veia Irrigation Project and a number of small scale irrigation schemes located in the Municipality facilitate dry season farming. For example, the irrigation dams provide a total of about 815.5 ha for irrigated farming during the dry periods. The Veia project alone contributes about 637.5 ha of land for irrigated farming, while the small-scale dams provide a total irrigable area of about 78 ha. In addition, there exists potential of about 500 ha for water pump irrigation along the banks of the White Volta from which many farmers mostly grow cash crops.

The latest analysis of the living conditions of Ghanaian households and the poverty profile based on the sixth round of the Ghana Living Standards Survey (GLSS6) conducted in 2012/2013 indicate that the country has made great strides in reducing poverty. According to the Ghana Statistical Service given that the rate of poverty for 1991/92 is not any different from the rate in 1990, the country is on its way to attaining the MDG 1 target, which seeks to halve poverty by 2015 from the rate in 1991/92 (51.7%).

Despite the interesting performance of the Ghanaian economy in reducing poverty, about a quarter of Ghanaians are still poor whilst about a tenth of the population is in extreme poverty (GSS, 2013)¹.

population of Ghana, yet it accounts for 78 percent of those in poverty. Overall, the dynamics of poverty in Ghana over the 7-year period indicate that poverty is still very much a rural phenomenon implying that reducing rural poverty should become critical to Ghana's poverty reduction initiatives if

Poverty incidence varies significantly across the ten regions of Ghana. Whilst half of the ten regions (Greater Accra, Western, Central, Eastern, and Ashanti) had their rates of poverty incidence lower than the national average of 24.2 percent, the remaining half had rates higher than the national average; Greater Accra is the least poor region and the Upper West the poorest overall. Though most regions show a reduction in poverty incidence since 2005/06, the pattern of poverty by region has not changed. Recent publications by the Ghana Statistical Service indicate that more than four in every ten persons are poor in Upper East region (44.4%), increasing to one in every two in the Northern region (50.4%) and seven out of every ten in Upper West region (70.7%). Extreme poverty defined as those whose standard of living is insufficient to meet their basic nutritional requirements even if they devoted their entire consumption budget to food is high in the Upper East Region (21%) as compared to national average (8%). The puzzle here is that, even among the three northern regions of Ghana, there are very wide differences between their rates of poverty incidence, irrespective of the closeness of the regions and whether the regions concerned share boundaries (GSS, 2013).

Thus, despite significant progress made by the government of Ghana in reducing poverty incidence in rural areas of the country there still remain some challenges in food access, use and availability. More so, climate variability, natural disasters as well as socio-political instability have cumulatively affected all four dimensions of food security at any particular time (FAO, 2008). The main research questions are: *What are the food sources and causes of food insecurity among irrigators and non-irrigators in the Upper East region? How do smallholders cope with*

food insecurity in the Upper East region of Ghana? What are the effects of improved agricultural water access and use of small-scale irrigation schemes on food security in the Upper East Region of Ghana? What are the challenges faced by smallholders in irrigated agriculture? The main objective of this paper is to examine food sources and causes of food insecurity in the region. Another objective is to investigate food security challenges in the region and food insecurity coping strategies designed and adopted by small scale irrigated and non-irrigated farmers.

Methodology

The study was conducted in the Bolgatanga Municipality, which is the administrative capital of Upper East Region of Ghana. The study used a semi-structured questionnaire to collect both quantitative and qualitative data that elicited smallholder farmers' perceptions of the effects of the community irrigation schemes in improving their food situation at the time of data collection. The study population included all farmers who were registered under the Water Users Association (WUA) and non-irrigation farmers in three case study communities (Dorongo, Sumburungu and Winkogo). Irrigation farmers were considered as those who regularly engage in dry season farming using water from the community irrigation scheme, and non-irrigators as those who predominantly depend solely on rain-fed subsistence agriculture.

The Dorongo, Sumburungu and Winkogo schemes were purposively selected because of accessibility, scale, functionality, management type and similarity in terms of crops cultivated and market access. The schemes are all located in close proximity to Bolgatanga. This has significance for the people in these communities in terms of the

poverty reduction is to achieve the desired levels for Ghana as a middle income country.

disposal of surplus products as well as opportunities for other livelihood pathways. All the schemes use the gravity system of irrigation. As part of the methodology, the study measured household food security by asking respondents whether in the previous month following the survey, 1) family members ate fewer meals per day than usual, 2) reduced food quantity per meal, 3) ate less preferred foods, and 4) whether some family members worked outside to earn money for food.

The sample frame for irrigation farmers consisted of 289 farmers who had registered to undertake dry season farming during the 2012/2013 cropping season in the three communities (See Table 2). The

list of registered irrigators was obtained from the Secretaries of the community Water User Associations (WUAs). The total of 289 WUA members under the three schemes is made up of 150 farmers in Dorongo, 41 farmers in Sumbrungu and 98 farmers in Winkogo. Convenience sampling procedure was used to sample 240 farmers (120 irrigators and 120 non-irrigators) for data collection due to resource constraints. The irrigators sample for each community was chosen with a probability proportionate to its sample frame size, and then an equal number of farmers who have never participated in irrigation farming selected from each community (see Table 2).

Table 2: Sample Size of Respondents

Irrigation Scheme	Registered irrigation farmers (2012/2013 season)	Sample		
		Irrigation farmers	Rain-fed farmers	Total
Dorongo	150	62	62	124
Sumbrungu	41	17	17	34
Winkogo	98	41	41	82
Total	289	120	120	240

Data Collection Instruments

The study made use of both primary and secondary data. Primary data were gathered from the respondents of the study through interviews and observations. Secondary data sources on the other hand included books, peer-review journal articles, project documents, internet sites and periodicals. Such materials were extensively reviewed. The secondary data helped to put the study into perspective as well as providing the necessary theoretical underpinning within which the discussions in the study have been framed.

A semi-structured interviewer questionnaire was the main data collection instrument used. The questionnaire included topics on the demographic

characteristics of respondents, their household characteristics, income/consumption patterns, household food security, employment and the effects of small scale irrigation. Individual farmers were visited and interviewed to obtain information on how the irrigation project has influenced their poverty situation. Data collected from the household survey was entered in SPSS (Version 16) after which it was cleaned. The data was also analysed using SPSS. Data analysis was guided by the research questions. Qualitative data was manually organized into meaningful themes based on the topical issues addressed in the research. Quantitative results are presented in simple and relevant descriptive and inferential statistical methods such as means,

percentages and frequency distributions and chi-square.

The conceptual framework for the study is presented in Figure 3. It shows a schematic representation of the transmission pathways between irrigation and food production. Five key inter-related dimensions of the relationship between access to reliable agricultural water and food production have been identified. The dimensions are production, income/consumption, employment, vulnerability/food security, and overall welfare (Figure 3). Thus, increased availability of water facilities attract smallholders to engage in dry season farming thereby improving the employment situation. Increased employment raises income level of smallholders. Increased access to irrigation land and water facilities also brings about increased food production leading to improved food situation, hence reduction in food vulnerability. Improved access to irrigation facilities also lead to reduced out-migration by young people, increased access to health services and a reduction in indebtedness.

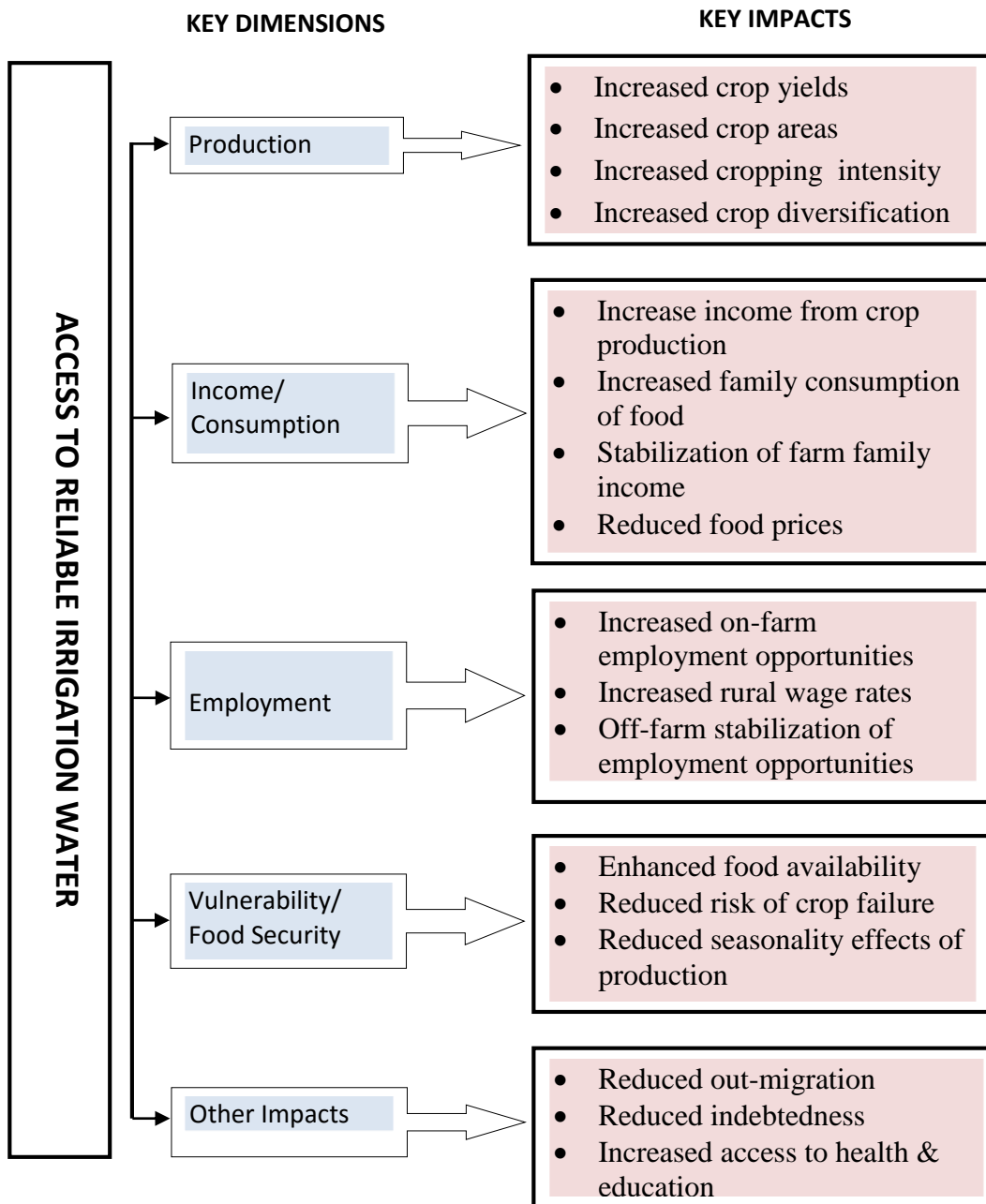


Figure 1: Conceptual Framework (Adapted from Hussain & Hanjra, 2004)

Results and Discussions

Food Security Situation in the Upper East Region

Figures on Table 1 indicate that majority of the severely food insecure people are from the Upper East region (6.4%) followed by Northern region (2%) and Upper West region (1.4%).

Table 1: Food Security Groups by Region

Region	Severely food insecure (%)	Moderately food insecure (%)	Mildly food insecure (%)	Food secure (%)
Northern	2.3	7.4	10.6	79.7
Upper East	6.4	21.9	10.1	61.7
Upper West	1.4	14.8	7.5	76.3

Source: WFP, 2012.

The World Food Programme (2012) has observed that with the exception of maize, other major cereals (millet, sorghum and rice) consumed largely by majority of the households in the Upper East region are all trading at higher prices as compared to 2011 price. The year-to-date increase in the price of maize is 5%, but when compared to the start of the major harvest in November, the price of maize went up by 7%. From the nominal wholesale price of GHC 150 per 100kg bag, the price of millet decreased by (-12%) in November 2012 when the major harvest occurred. Although these price trends tend to indicate a certain degree of market stability, the increases over the previous year and the five-year average is significant and could have the effect of reducing food access for a large number of food deficit households in the region (WFP, 2012).

In overall terms, the country still faces lots of nutritional deficiencies. Available statistics by the Ghana Health Service (GHS) indicate that 12,000 children in Ghana die every year of under-weight related ailments due to malnutrition (GHS, 2012). The statistics also indicate that under nutrition contributes to about half of all child deaths beyond early infancy whilst one out of every thirteen children in Ghana die before their fifth birthday mostly as a result of under-nutrition. The level of

stunting is higher in the rural areas (32 percent) than in the urban areas (21 percent) in Ghana². Stunting varies by region; it is highest in the Eastern and Upper East regions (38 and 36 percent, respectively) and lowest in the Greater Accra region (14 percent). Stunting decreases as mother's level of education and wealth quintile increase.

The prevalence of overweight children is one (1) percent in the Upper East region. Overall, 14 percent of Ghanaian children are underweight, with 3 percent classified as severely underweight. The percentage of children who are underweight decreases as mother's nutritional status increase. Children living in rural areas are more likely to be underweight than urban children (16 and 11 percent, respectively). The proportion of underweight children ranges from 7 percent in the Greater Accra region to 27 percent in the Upper East region. The proportion of children under five who are stunted decreased from 34 percent in 1988 to 31 percent in 1998, and then peaked at 35 percent in 2003 before decreasing to 28 percent in 2008. Iron is essential for cognitive development. Low iron intake contributes to anemia. Although consumption of vitamin A foods is highest among children in the Upper East region (86 percent) the consumption of fruits on a daily basis is substantially

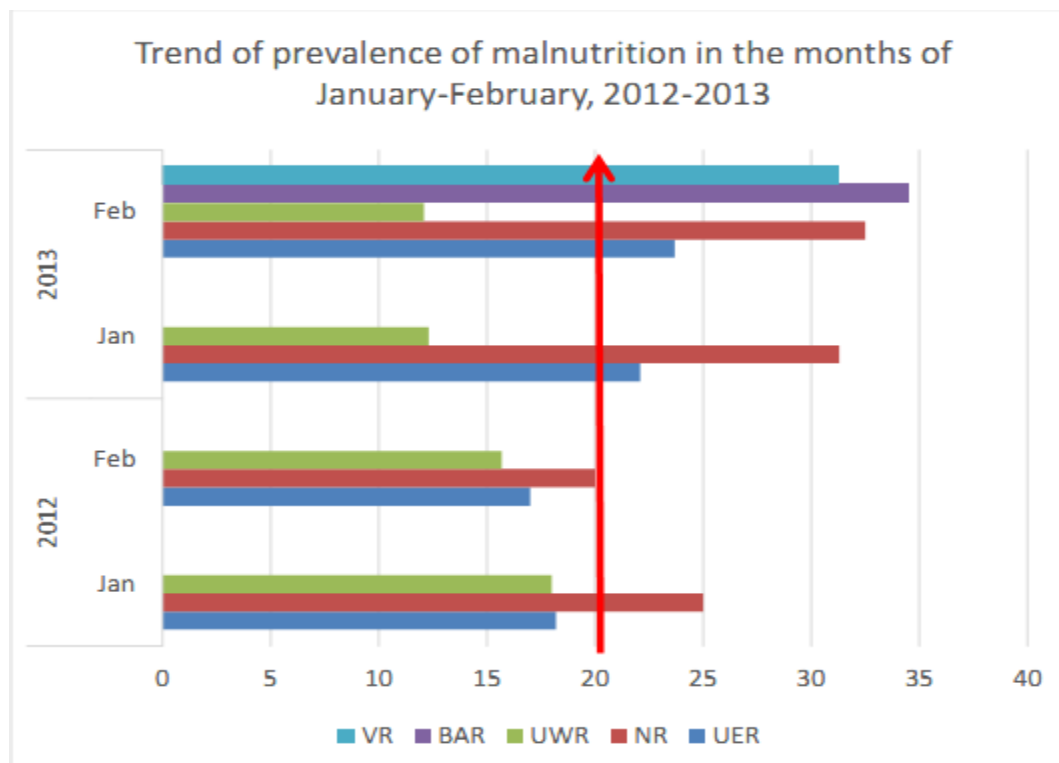
² Stunting reflects malnutrition; wasting reflects acute malnutrition; underweight reflects chronic or acute malnutrition or a combination of the two.

lower among women in the region (15%) and among men in the same region (7%).

Figure 2 compares the nutritional status of children in five regions – Volta, Brong Ahafo, Upper East, Upper West and Northern - in the month of January and February of 2012 and 2013 in comparison with WHO cut off point for underweight³. The levels of underweight in the Upper East region (23.5) increased slightly in February 2013 as compared to the previous month and were progressively higher when compared to 2012. The level of underweight in the Upper East Region increased by 1.6 as compared to the previous month and the

situation can be termed as serious (WFP, 2012). It is estimated that more than 680,000 people representing 16% are considered either severely or moderately food insecure with 140,000 of them being severely food insecure (WFP, 2012). Twenty eight percent (28%) of those who are severely food insecure live in the Upper East region (16%) as compared to Upper West region (16%) and Northern region (10%) (WFP, 2012). Further, about 2 million people are vulnerable to becoming food insecure across the entire country with about 507,000 people representing 40% living in the rural areas of northern Ghana.

Figure 2



Source: WFP, 2012

³ The red arrow shows the WHO threshold of 20%. Prevalence greater than 20% is termed serious and calls for further investigation.

The food sources for most parts of northern Ghana, especially in the Upper East region are cash purchase, own production, fishing/ hunting/gathering, credit purchase and gifts (Table 2). Figures on Table 2 show that over 70% of the people in the Upper East Region rely on food purchases. Out of these, cash purchase and own production remain the two major sources of food in northern Ghana. Only a small proportion (1%) of the people in the region relies on gifts for their food source. Details of the livelihood groups and their dietary diversity are presented in Table 2.

Table 2: Food sources in the three Northern Regions of Ghana

Region	Cash Purchase (%)	Own Production (%)	Fishing, Hunting Gathering (%)	Credit Purchase (%)	Gift (%)	Other (%)
Northern	62	31	3	3	1	0
Upper East	72	22	0	2	1	0
Upper West	56	34	5	3	1	1

Source: Constructed from WFP report, 2012.

In terms of farm categories, the findings revealed that households in the Upper East Region derive their food from two sources: own staple food production under rain-fed agriculture and food purchases from the market. As presented in Table 3, fewer irrigators in all the three communities were likely to depend on their own food production compared to non-irrigators. Eleven percent of irrigation beneficiaries compared with 36% of non-beneficiaries depended on their own food production in Dorongo, and in Winkogo, 22% of irrigators compared with 37% of non-irrigation farmers reported own production as source of household food. The study revealed that majority of both irrigators and rain-fed farmers rely on the market as a secondary source of food. This indicates that household grain stocks are usually exhausted during the lean season in April-May. This finding further suggests that staple cereal crop production under rain-fed cultivation was inadequate for both irrigators and non-irrigators to ensure food availability throughout the year. Irrigators were more likely to use cash earned from irrigation farming to purchase food to supplement shortfalls in rain-fed food production.

Table 3: Sources of Household Food

Characteristic	Household Source of Food			
	Own farm	Own farm & purchase	Total	
Dorongo	Irrigators	7 (11%)	52 (84%)	62
	Non-irrigators	22 (36%)	40 (65%)	62
Sumbrungu	Irrigators	8 (47%)	8 (47%)	17
	Non-irrigators	6 (50%)	6 (50%)	12
Winkogo	Irrigators	9 (22%)	32 (78%)	41

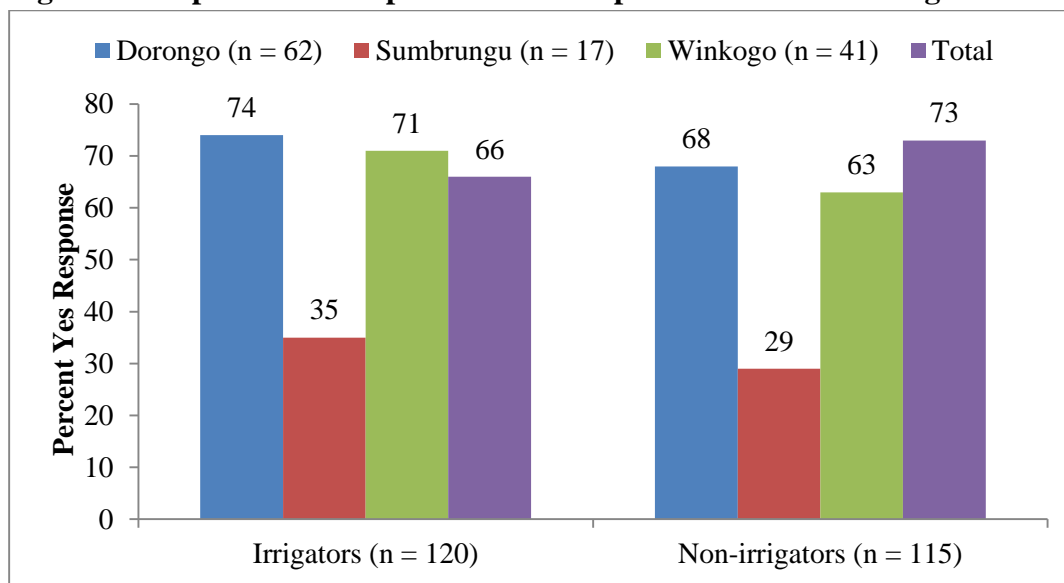
Non-irrigators	15 (37%)	26 (63%)	41
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Source: Fieldwork (2013)

Months of inadequate household food provisioning has been defined as the time between stock depletion and the next harvest (Bilinsky & Swindale, 2007). It is usually used as a measure of food insecurity in a highly subsistence-oriented area where production is primarily for home consumption and households do not make significant sales or purchases in the market. Hence, respondents were first asked whether they had experience shortage of staple foods during the preceding harvest season. As presented in Figure 3, two-thirds (66%) of irrigators in all the three communities compared to 73% of rain-fed farmers reported having experienced food shortages from harvest of the preceding rainy season cultivation. This shows that non-irrigators have longer periods of food insecurity than irrigators.

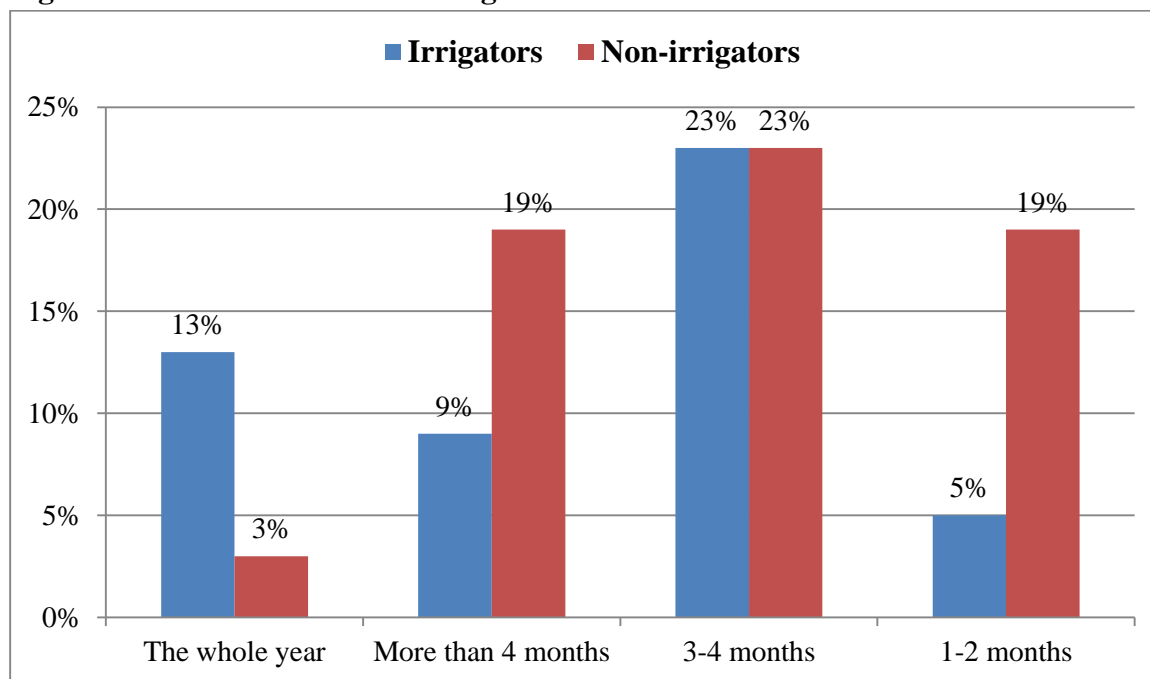
The finding is consistent with the conclusions of WFP (2012) that food security situation in the Upper East Region is more pronounced. MOFA (2012) further reported that 56% of respondents of sentinel sites in the region have 10% or less of their harvest remaining from the previous season, and 89% are relying on the market as a primary or secondary source of food.

Figure 3: Proportion of Respondents who experienced Food Shortages



Source: Fieldwork (2013)

Figure 4: Duration of Food Shortages



Source: Fieldwork (2013).

Survey respondents who reported experiencing food shortages were further asked to indicate the number of months they had experienced food shortage during the year. As illustrated in Figure 4, fewer irrigator households (5%) experienced shorter periods of food shortage of between 1 to 2 months compared to 19% of rain-fed households. Interestingly, more irrigators (13%) as against 3% of rain-fed farmers reported having experienced food shortage throughout the year. However, out of the 13% of irrigators who did not meet their food consumption needs throughout the year, 80% of them were from Winkogo. This was not surprising because the Winkogo scheme appears to have been underutilized with most of the canals broken. The irrigable land area under cultivation is also very small and it appears only leafy vegetables are cultivated, mainly for home consumption.

Causes of Household Food Insecurity

As presented in Table 6, almost all respondents (93%) of rain-fed farmers indicated that poor crop harvest was a major cause of food insecurity. On the other hand, only 26.4% of the irrigators share the same view. Again, majority of rain-fed farmers (83%) identified weather vagaries as a cause of poor crop yields and food unavailability throughout the year. This finding is similar to the conclusion reached by Akudugu, Dittoh and Mahama (2012) that communities in northern Ghana that hitherto never experienced floods and droughts are now faced with the realities of these natural phenomena and these are adversely affecting food security and household livelihoods. Similarly, the IPCC in 2007 documented that agricultural production, food availability and food security in many African

countries and regions are likely to be severely compromised by climate change.

The results indicate that household size is an important factor affecting food security situation among smallholder farmers in the study area. Ten percent (10%) of irrigators and 37% of rain-fed farmers agreed that large household size contributes to food insecurity. The explanation is that increasing family size leads to more land fragmentation, hence low output per landholding. A possible explanation is that subsistence food crop production does not usually involve the application of improved farm technologies and inputs. The traditional hoe and

bullock ploughs are still the main implements for land tillage and farmers usually do not depend much on organic fertilizer and other agro chemicals. Over reliance on traditional methods of farming lead to poor crop yield thereby posing a greater challenge for households ability to attain food security. This finding confirms the conclusion reached by Aidoo, Mensah and Tuffour (2013) that household size has a negative and significant relationship with food security, suggesting the probability of food security decreasing with increasing rural farm household size. Similarly, Obayelu (2012) reported that household size significantly determines households' food security status in Nigeria.

Table 4: Causes of Food Insecurity in the Upper East Region

Cause	Response			
	Irrigators		Non-irrigators	
	N	% (Cases)	N	% (cases)
Weather vagaries	78	26.7%	92	82.9%
Low income of farmers	56	19.2%	53	47.7%
High household size	30	10.3%	41	36.9%
Poor crop harvest	80	27.4%	103	92.8%
High cost of production inputs	48	16.4%	40	36.0%

Source: Fieldwork 2013.

Coping strategies for food shortages

Although farmer households interviewed produce mainly for domestic consumption, they suffered food insecurity. Due to small landholding and continuous mono-cropping, farmers are not able to produce enough to last throughout the year. Both irrigators and rain-fed farmers adopted a number of coping strategies in order to meet their household food requirement during periods of food insecurity. For irrigators and non-irrigators, the most important way of obtaining food when stocks ran out was to sell some of their livestock to purchase food. It is not surprising that the sale of livestock plays a crucial role in bridging the hunger gap. In mixed-

farming systems, livestock reduces the risks associated with crop production and therefore represents liquid assets that can be realized at any time, adding further stability to the production system.

Table 5 presents responses on households coping mechanisms during food shocks periods. About two-thirds (67%) of irrigators and almost half (47%) of rain-fed farmers reported that sale of livestock was crucial in building household resilience to food insecurity. Also, about (60%) and 40% of irrigators and rain fed farmers respectively reported using

income from various sources to buy food during the lean season. Fewer households were likely to borrow foodstuff or money to buy food during food crisis. However, other alternative strategies was to reduce the number of meals served each day, reduction in the portions/ sizes of meals and

consumption of less preferred foods to cope with the situation ration. This confirmed the reason why most of the respondents indicated that income from irrigation was partly used to invest in livestock keeping, which serve as safety nets during shocks.

Table 5: Proportion of Responses on Food Deficit Coping Strategies

Characteristic	Irrigators		Non-irrigators	
	N	%	N	%
Borrowed food stuff to cope with food shortage	6	5.8%	3	2.5%
Borrowed money to buy food to cope	29	28.2%	4	3.3%
Received relief assistance	16	15.5%	8	6.6%
Engaged in off farm activities to cope food shortage	61	59.2%	49	40.5%
Sold livestock to cope food shortage	69	67.0%	57	47.1%

Source: Field data (2013).

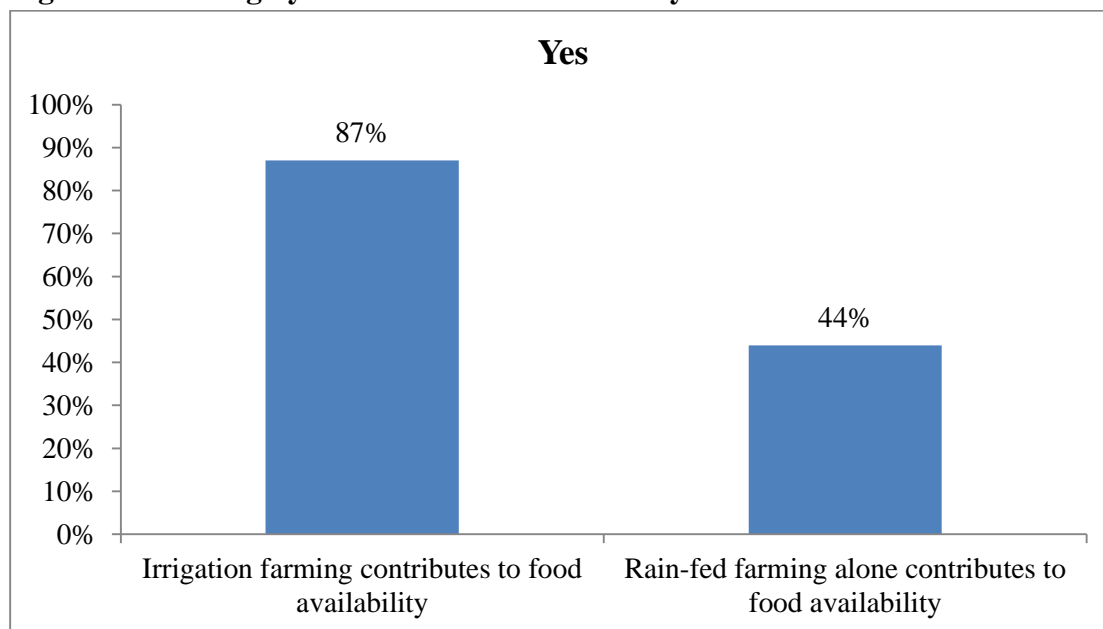
The July 2012 Northern Ghana FSNMS sentinel survey also reported that households in the Upper East were more likely to rely heavily on coping strategies during the lean season, with 83% eating fewer meals - only two meals per day (SRID/MoFA, 2012). The high proportion of households already consuming fewer meals per day in March 2012 suggests high levels of vulnerability to food insecurity and the need for promoting irrigated agriculture in the study area instead of the over-dependence on unpredictable rain-fed agriculture.

Contribution of Irrigation to Reduction in Food Insecurity

Irrigators were asked to indicate whether irrigation farming contributes to reducing food insecurity in their communities. Similarly, the rain-fed farmers were also asked whether they think lack of access to dry season irrigation aggravates food unavailability in their households. As shown in Figure 5, majority (87%) of irrigators were of the view that access to irrigation for year round farming contributes significantly to reducing food insecurity. On the other hand, only 44% of rain-fed farmers were of the view that rainy season alone contributes to household

food availability. The results are similar to the findings of Oxfam (2011) that access to community irrigation in Malawi created new sources of food and income to peasant farmers by making water available all year round for crop diversification. More so, Saleth et al (2003) have pointed out that access to irrigation has been regarded as a powerful factor that provides a greater opportunity for multiple cropping, cropping intensity and crop diversification.

Figure 5: Farming Systems and Food Availability



Source: Fieldwork (2013)

Small scale irrigation, does not only improve food security but a better nutritional diet of irrigation farmers and the entire community. Smallholder irrigation systems are mostly used to grow vegetables in the dry season and therefore vegetable consumption among irrigation users and their communities usually increases (Burney et al. 2010; Aseyehgn, Yirga, and Rajan 2012). These vegetables are rich in micronutrients and provide important benefits, especially on birth weight, child anthropometric status, and improved hemoglobin concentrations (Hoddinott and Yohannes 2002; Namara et al. 2011). Irrigation systems are also likely to improve the intake of animal-source foods as a result of higher incomes and improved livestock productivity.

Namara et al. (2011) compared the Household Dietary Diversity Score of farmers using rainfed agriculture with that of farmers using groundwater

irrigation in Ghana and indicated that as a result of enhanced access to fresh vegetables and animal sources of food, irrigation systems can improve nutrition and health, particularly of children. Consumption of iron-rich foods, such as dark green leafy vegetables, can reduce incidences of anemia. Iron deficiency is a risk factor for maternal mortality and is responsible for 115,000 deaths (Black et al. 2008). Furthermore, access to greater quantities of nutritious food can reduce incidences of underweight and wasting.

Conclusions and Policy Implications

The major conclusion is that increased access to agricultural water through small-scale irrigation schemes has a positive impact on the food security status of rural households. However, poverty reduction is not always accompanied by increased food security. The findings show that food shortage occurrence among non-irrigating households

appears to be higher than that of irrigating households. This suggests that small-scale irrigation has an important influence on rural household food security. It can be concluded that access to irrigated agriculture increases household incomes, hence food security. Irrigation farmers' inability to expand their farming ventures is due to a number of constraints, prominent among which are difficulty in securing credit to buy inputs such as seeds, fertilizer and agro-chemicals; high disease infestation of irrigated crops (eg nematodes) and poor maintenance of the schemes. Irrigators also reported the lack of good and readily available markets for farm produce as well as lack of credit as challenges that need to be addressed.

Increased access to food security requires the joint support of government, NGOs and the private sector to invest smallholder irrigation schemes. The government should concentrate on providing the physical infrastructure involving the construction of dams. The Government should also play a direct role in extension service training and provision of other technical support services, like training on small-dam construction, scheme design and the production of manuals for design and management of micro-dams and water diversion structures. The Government through MOFA/GIDA and the District Assemblies should foster public-private partnerships (PPP) to develop and implement comprehensive guidelines for smallholder irrigation development in order to operationalise the National Irrigation policy. Further, the Government and District Assemblies should develop appropriate policies and mechanisms to facilitate access to credit by smallholder farmers. There is the need to rehabilitate the deteriorating infrastructure (dams) and to ensure that members of the Water User Associations (WUAs) have their capacities

developed particularly in the area of technical operation and maintenance of dams.

Civil society and private investors should deal with capacity development for irrigators and facilitate the provision of relevant agricultural services involving transportation, storage and marketing. This will ensure food security, increased incomes, improved standards of living and employment creation for the rural farmers.

Marketing was reported as one of the major problems faced by irrigators. It is therefore, recommended that to enhance production and incomes, there is the need for the Bolgatanga Municipal Assembly and MoFA to assist farmers in marketing their produce, including making information about market prices of irrigated produce and the provision of storage facilities.

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