

*Full Length Research Paper*

# **Irrigated agricultural production and poverty reduction in Northern Ghana: A case study of the Tono Irrigation Scheme in the Kassena Nankana District**

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**Irrigated agriculture offers opportunities for greater livelihoods security and poverty reduction in northern Ghana where climatic conditions do not allow for an all-year-around agricultural production. It is the knowledge gap as regards the contribution of existing irrigation facilities in the area that occasioned the case study of the Tono irrigation scheme in the Kassena-Nankana District. The investigation adopted a treatment and control experimental approach. The treatment group comprised a sample of 93 out of a total of 1328 Tono irrigation tomato farmers and a control group sample of 86 out of 614 irrigation tomato farmers operating outside the Tono irrigation scheme. The samples were selected at a confidence level of 90% allowing for 0.1% margin of error. The Tono irrigated scheme created a platform for employment and high agricultural output but made only modest gains towards poverty reduction in the district. The challenges to that that served as a check included high cost of hiring farm machinery, inadequate access to credit, poor water supply for irrigation, ineffective technical assistance, lack of entrepreneurial skills, lack of storage facilities and inadequate ready market to translate the outputs into incomes for the farmers. A more responsive institutional arrangement inclusive of all pertinent stakeholders is recommended to ensure the effective management and utilisation of the irrigation infrastructure; the efficient delivery of farm inputs to farmers; farmer-centred capacity building training for improved performance, and provision of storage facilities, the establishment of agro-industry processing linkages, market search and promotion.**

**Keywords:** Agriculture, Irrigation, Poverty, Tono Irrigation Scheme.

## **INTRODUCTION**

Ghana envisions attaining a middle income status with a per capita income of US\$1,000 by the year 2015. To effect this transformation, the government of Ghana has resolved to promote shared economic growth to create wealth and reduce poverty so that the citizenry, irrespective of wherever they are, can have access to the opportunities that will enable them to realize their potential for the betterment of their lives. In Ghana, agriculture accounts for about 35% of the Gross

Domestic Product and employs 55% of the country's economically active population (GSS 2007). In addition, the sector contributes an average of 12 and 8% to tax revenue and total revenue, respectively (IWMI, 2006). Ghana can, therefore, not achieve its desired economic growth for wealth creation and poverty reduction without a significant improvement in the agricultural sector (Kyei-Baffour and Ofori, 2006).

Development through agriculture as a strategy is perceived as a process encompassing the attainment of number of objectives simultaneously: a growth objective, an employment objective, a food security objective, a risk reducing objective and industrialization objective with the overarching goal being poverty reduction. These

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objectives are only achievable based on agricultural performance in which irrigation is inevitable component in semi-arid regions like northern Ghana (Abebe, 2000). In most parts of sub-Saharan Africa, increased agricultural production constitutes one of the most strategic ways towards poverty reduction, and investment in irrigation development can be a springboard for economic development (Faurès et al., 2007). Research conducted by IFAD (2001) indicated that for many developing countries, increased agricultural production is a key to poverty reduction. For instance, China's rural poverty fell from 31.6% in 1978 to 2.3% in 2006 through agriculture (NBSC, 2006). Up to 40% of China's cropland is irrigated (Hays, 2008). Investment in irrigation infrastructure constitutes an important poverty reduction strategy since it would boost agricultural productivity by reducing the risks associated with the rainfall unreliability in arid regions.

In Ghana, an accelerated agricultural growth in the range of 5 to 6% per annum is targeted to ensure food security and adequate nutrition, to supply raw materials to industry, to generate surplus for export and provide producers with increasing incomes towards wealth creation and poverty reduction. Agricultural modernization through performance improvement in the existing irrigation sector, utilization of the nation's irrigation potential, mechanization, improvement in farmers' access to appropriate technologies including high-yielding input varieties, improvement in agronomic practices and crop protection techniques are vital to the sustainable growth of the sector.

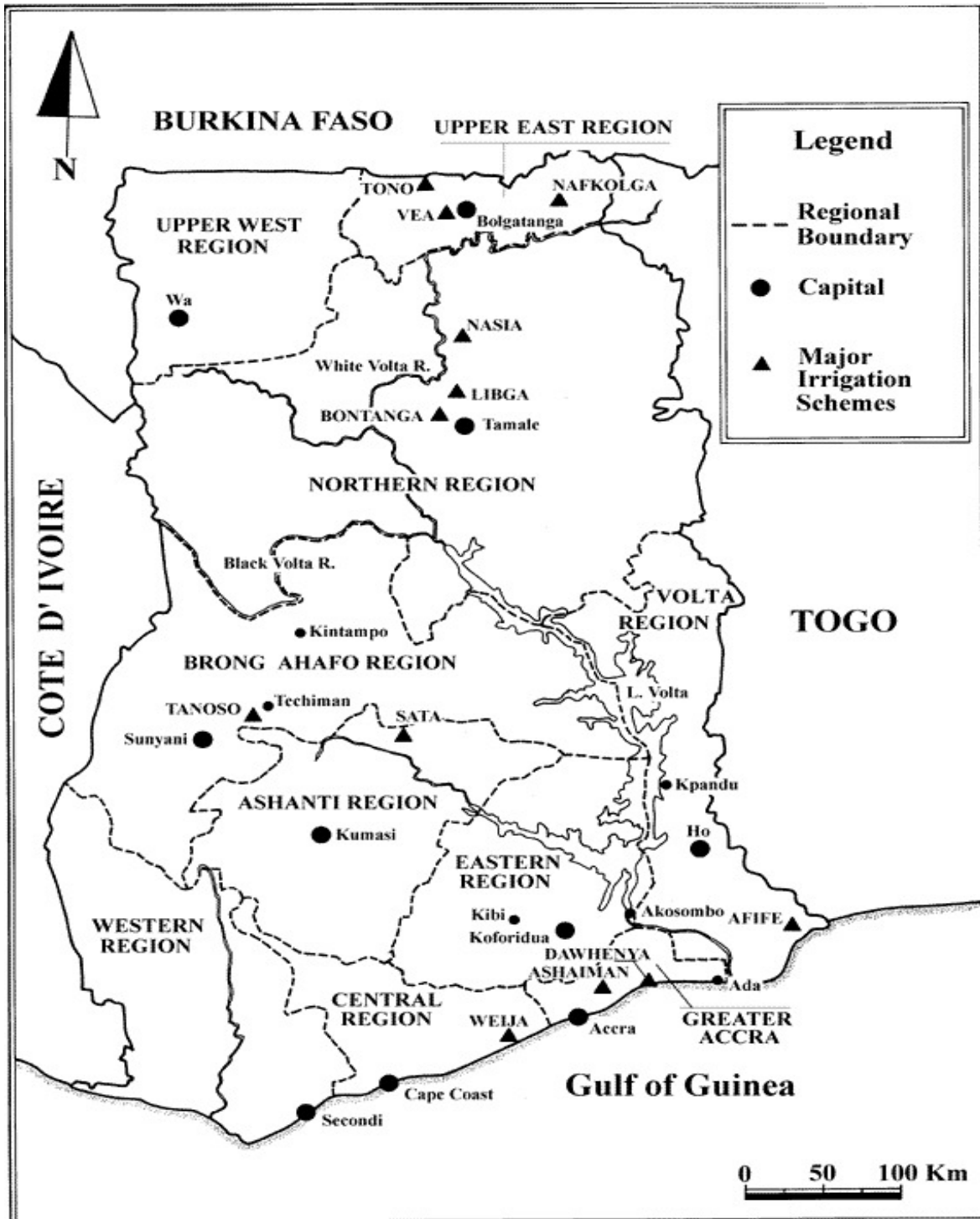
Located between latitude 5° 3' and 11° North and longitude 1° 12' East and 3° 15' West, the Republic of Ghana, with a total area of 238,540 km<sup>2</sup>, is set almost in the centre of the country lined up on the west of Africa. The country which is divided into 10 administrative regions is characterised by a north-south division in terms of living conditions and opportunities. Three of them comprising the Upper West, Upper East and Northern Regions constitute what is referred to as Northern Ghana or simply the North. The rest of the country includes the Brong Ahafo, Ashanti, Western, Eastern, Central Volta and Greater Accra Regions are designated as the South. The North is noted for its higher poverty level compared to the South. Agriculture is expected to enhance economic growth in much of the country but especially more so in the northern Ghana, where it is the most predominant economic activity (Figure 1).

Circumstantial to the dictates of the semi-arid climatic conditions in northern Ghana, rainfall is unreliable in terms of onset, duration, intensity and amount for production. Production is low and variable because of the use of rudimentary traditional methods and techniques, shifting cultivation farming systems and excessive dependence reliance on rain-fed agriculture. Seasonal food insecurity is widespread causing outmigration. Irrigated agriculture is important and unavoidable in

promoting agricultural growth. As a strategic approach to increase agricultural production and reduce rural poverty in the north, the government of Ghana, community based and non-governmental organisations have, hitherto, provided some irrigation facilities in the various regions in order to increase agricultural production to create wealth and reduce poverty (Figure 1). In the global perspective, irrigation has led to significant increase in food supply and raised millions out of poverty (Faurès et al., 2007). An increase in irrigation generates improved farm income which culminates in an increase in demand for local non-tradable goods and services. It offers labour opportunities to the poorest segments of the population, promotes local agro-enterprises and stimulates the agricultural sector as a whole (Lipton et al., 2003; Smith, 2004; Hussain and Hanijra, 2004).

This paper focuses on the Kassena Nankani District of the Upper East Region of Ghana. It is one of the poorest and drought prone areas of the country. It is there that the Tono irrigation scheme is located. This paper explores the conception of an irrigation-centred approach to increased agricultural production and poverty reduction through the case study of the Tono irrigation scheme. It examines the impact of the Tono irrigation scheme on agriculture production and rural poverty reduction in the Kassena Nankani District of the Upper East Region of Ghana. This is achieved through the analyses of the perceptions, views and experiences of the Tono irrigation farmers and non-Tono irrigation farmers. It also analyzes views of key informants as well as reports and earlier studies on irrigation-centred strategies to poverty reduction. The paper provides an empirical contribution to the on-going debate on the impact large scale irrigation schemes on poverty reduction in the Ghana generally, and the northern Ghana in particular. The paper sought to answer the following pertinent question: i) What is the nature of the irrigation technology and manner of operation of the Tono irrigation scheme?; ii) what is the contribution of Tono irrigation scheme to agricultural production and poverty reduction in Kassena Nankani District?; iii) what are the socio-economic benefits and prospects of the irrigation scheme for the participant farmers of the irrigation scheme?; and iv) what are the challenges faced by the stakeholders in the operation and management of the irrigation scheme?

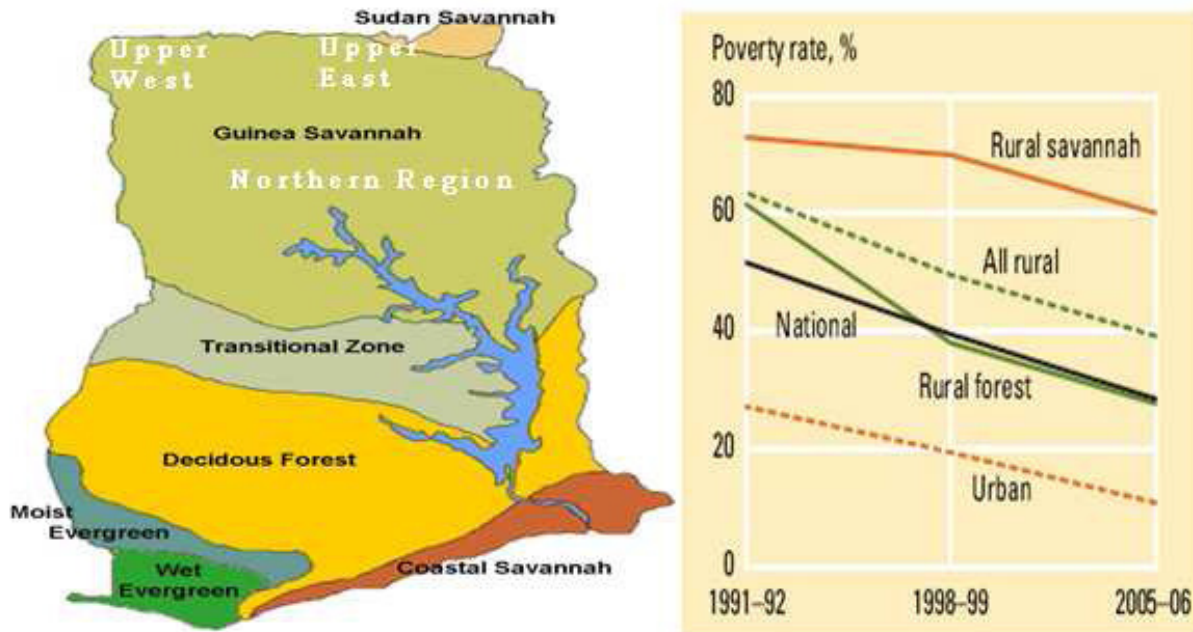
The motivation underlying this paper is featured by two basic reasons. Firstly, the Upper East Region of northern Ghana, of which Kassena Nankani District is apart, is considered the poorest region in the country. For more than a decade the level of poverty in the region continued to rise annually and now, four out of every 5 persons in that region are poor. The various reasons assigned to explain this precarious phenomena lack clarity and therefore require investigation. Secondly, the Tono irrigation scheme with a water storage capacity of 93 million m<sup>3</sup> and 24000 ha of irrigable is the largest irrigation scheme in the Ghana and the largest irrigation



**Figure 1.** Administrative regions and major irrigation schemes. Source: Donkoh et al (2013) This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/3.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

dam in West Africa is located in this region. Nevertheless, the region is only able to produce 44% of its food requirement and the remaining 56% is imported (MoFA,

2007). On grounds of these assertions, the paper assesses the impact of the introduction of the Tono irrigation scheme in Kassena Nankani District on



**Figure 2.** Ecological zones of Ghana and the rate of Poverty. Source: Adopted from FAO 2005; World Bank 2008; also cited in Anambama (2008).

agricultural production and subsequently poverty reduction as case study in Ghana.

A wealth of literature exists on the examination of irrigation and its impact on poverty reduction and livelihoods in developing countries by authors to the inclusion of: Hussain et al. (2002), Kalunde (2008), and Ravnborg et al. (2007). However, very few studies have been done in this subject area in Ghana. The few carried out include Analysing growth options and poverty reduction in Northern Ghana (Diao, 2005), Economic growth in Northern Ghana, UER agriculture intensification (FAO/IFAD, 1989) and Analysis of Governance Structures for Water Resources Management (Birner, 2005) and more recently utilization of irrigation facilities by Inkoon and Nanguo (2011).

### Ghana's physiographic environment and poverty

Ghana receives average annual precipitation of 283.2 billion  $m^3$ . The mean annual rainfall is estimated at 1,187 mm with mean annual temperatures ranging from 26.1°C near the coast to 28.9°C in the extreme north (FAO, 2005). The distribution within the country is far from uniform, with the southwestern area better watered than southeastern coastal areas and northern regions. Rainfall received generally decreases as one moves from south to north. Annual potential evapotranspiration is about 1350 mm in the south and 2000 mm in the north. The larger part of the northern regions has mono-modal rainfall regimes, characterized by a single rainfall peak.

After peaking in August/September and continuing until the rise season is finished, rainfall has a rapid decline to a complete cessation (Friesen, 2002).

The northern region is characterized by uni-modal rainfall of short duration and excessive evapotranspiration allowing only 4 to 5 months of farming and 7 to 8 months of extended dry season. Thus, irrigation is needed there to enable farming during the long dry season. Generally, however, rain-fed agriculture may not be able to support the future population of the nation unless coupled with investments in the irrigation sector.

The Ghana has a diverse physiographic environment which can be sub-divided into six major agro-ecological zones; the Sudan savannah, the Guinea savannah, the Transitional zone, the Deciduous forest, the Coastal savannah and Moist/Wet Evergreen forest (Figure 2). This contributes to its suitability for the growth of tropical tree, root and tuber, leguminous, vegetable, horticultural and cereal crops. Nevertheless for increased agricultural production for export and domestic consumption, irrigation is indispensable. In fact, it is only in few areas of the Ghana that the climate is favourable for non-irrigated agriculture. Even in the south-western forest zone which has the highest rainfall, irrigation is essential for short season crops during the dry period. Located in the three northern regions are the Guinea savannah and Sudan savannah (Figure 2) which have different ecological zones in the southern regions. In the North, the unreliable rainfall distribution pattern that at times gives rise to complete crop failure that do occur in most of the area to

the tune of about one in every five years.

Reardon (1995) cited in Anambama (2008) argued that, poverty and environmental links are shown to differ from place to place based on environmental problems people face. On the basis of that assertion, it can be inferred that the trends of poverty in Ghana, to a large extent, is a reflection of the environmental problems arising from the physiographic characteristics of the country. The rainfall pattern in the northern regions is erratic and as a result they do not only suffer from drought but also experience high chronic poverty rate. The northern regions have a very short rainy season ranging from May to September and a rather long dry season (October to April) characterized by low and erratic rainfall patterns. The average annual rainfall received in the northern regions is approximately 1000 mm characterized by a single growing season. The mono-modal rainfall regime has its peak around August and is often associated with spells of floods and droughts that can occur in the same season. As result the three northern regions remain of the country dependent on low return food crop farming, low economic growth and the share of household income from nonfarm activities remain significantly lower than in the rest of the country and the Upper East Region is the most food insecure (ODI, 2005).

Poverty, defined as a condition of lacking money and the necessities, such as food, water, education, health care shelter and clothing, needed to successfully live is often measured in terms of daily incomes of US\$1.25 and US\$2.00 (UNECA, 2005). Poverty remains a persistent feature of many developing countries, despite over a century of debate and action and over forty years of international aid to transform the livelihoods of the poor. The concern for poverty eventually culminated in the setting of the first millennium development goal which is to enhance agricultural production and reduce poverty especially in the rural communities (Austere, 2004). In 2000, the United Nations Organization adopted the millennium development goals renewing global commitment of member States to reduce poverty and the worst forms of human deprivation. According to the UNDP (2008) poverty rates in Sub-Saharan African remain as high as 51%.

The most recent sourced data indicates that overall poverty in Ghana stood at 30 and 53.6% considering the daily income levels of US\$1.25 and US\$2.00 respectively (UNDP, 2007). Northern Ghana, comprising of Northern, Upper East and Upper West Regions have been described as the most poverty-stricken and hunger spots in Ghana recording 52, 70 and 88% incidence of poverty respectively in 2005/2006 (UNDP, 2007). The high incidence of poverty in these areas have been attributed to heavy reliance on rain-fed agriculture, subsistence farming and exclusion from trade (Aryeetey and Mckay, 2004; ODI and CEPA, 2005; NDPC, 2003). The unreliability of rainfall, particularly in the north, is of concern because of the implications for the incidence and dimensions on poverty.

## MATERIALS AND METHODS

### Study area

The Kassena-Nankana District lies within the Guinea Savannah woodlands ecological zone in Ghana. It is one of the nine (9) districts in the Upper East Region of the Republic of Ghana (Figure 3). The District is generally low-lying with an undulating topography. The drainage system of the District is constituted mainly around the tributaries of the Sissili River. It is one of its tributaries - the Asibelika River, which has been dammed to provide the Tono irrigation facilities. There are some dugouts and ponds in the district which are used to water livestock and irrigate crop farms in the dry seasons.

The climatic conditions are influenced by two air masses namely, the north east trade winds (harmattan) and the south western trade winds (monsoon). The harmattan wind is felt between the months of November and April. Temperature during this period ranges between 42°C in the day and 18°C in the night. The district experiences the south western trade winds air mass between May and October. This brings the precipitation averaging 950 mm per annum to the area good enough for the production of both cereals and root crops.

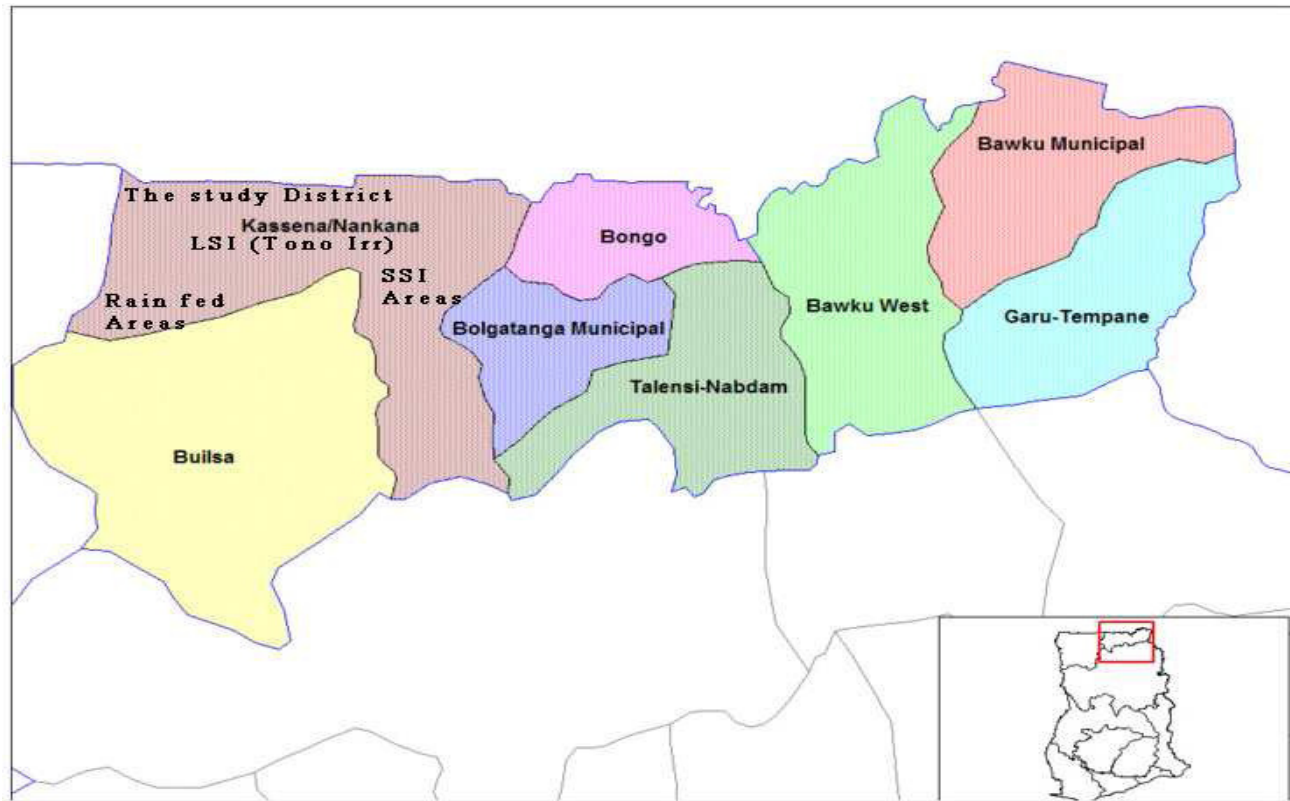
Two main types of soil are present within the district namely the savannah ochrosols and groundwater laterite. The northern and eastern parts of the district are covered by the Savannah ochrosols, while the rest of the District has groundwater laterite. The Savannah ochrosols are porous, well drained, loamy, and mildly acidic and interspersed with patches of black or dark-grey clay soils. This soil type is suitable for cultivation of cereals, legumes and vegetables which accounts for the arable land sites including most parts of the Tono Irrigation Project sites where both wet and dry season farming activities are concentrated.

To adapt to the problems caused by the vagaries of the climatic conditions, The Tono Irrigation Scheme in the Kassena-Nankana District in the Upper East Region is an intervention measures to promote an all-year round agricultural production. The scheme employs as much as 68.7% of the economically active population of the District (GoG, 2010). That notwithstanding, the district still records a prevailing poverty incidence of 88% (NDPC, 2009). Food security is as low as 1.3% with 15% of the population having limited access to sufficient and nutritious food as compared to a national average of 5% (WFP, 2009).

### Tono irrigation scheme

The Tono irrigation scheme is large scale irrigation project executed by the Ghana government through the Irrigation Company of Upper Region (ICOUR), a state enterprise. The construction of the dam began in 1975 and was not completed until 1985. The government of Ghana funded the project with loans obtained from the Canadian and British governments. The scheme was built by Taylor Woodrow, an international construction company based in Great Britain. The management of the project was initially the responsibility of Tate & Lyle Engineering Services, another British multinational which operated on behalf of the Irrigation Development Agency of Ghana until 1981. In 1981, after a military take-over of the reigns of government in Ghana, the expatriate management left and the project came under the control of a Peoples Defense Committee (PDC). In 1983, the PDC transferred its powers to a newly established parastatal, the Irrigation Company of the Upper Region (ICOUR).

The Tono irrigation scheme (Figure 4) is a reservoir or storage-based gravity-fed irrigation System. Water from the earth dam or reservoir is diverted to the fields by gravity through intake structures and canal systems. The canal system is the furrow in typology. Furrows are small channels which carry down the slope between



**Figure 3.** Map of Kassena-Nankani District.

the crops grown row ridges. In this system, water from an earth dam or reservoir system is diverted to the fields by gravity through intake structures and canal systems. The crops are grown on the ridges between the furrows. This method is suitable for all row crops and crops that cannot stand in water for long periods in the range of 12 to 24 h. Such crops include maize, sunflower, sugarcane, soya beans, tomatoes, vegetables, fruit trees and citrus.

As at the time of completion of the Tono irrigation scheme in 1985, it was Ghana's largest irrigation scheme. It comprised a 5 km long dam, which created an artificial lake with a surface area of 1860 ha. It had a water storage capacity of 93 million m<sup>3</sup> of water, 37 million m<sup>3</sup> of which could be used for irrigation. The irrigation infrastructure development and the preparation of farm plots involved clearing, leveling, and bonding. The original layout targeted the development of more than 2400 ha of irrigable land. The irrigation plots were served by main canals (left bank and right bank) with an overall length of 42 km and a network of laterals and sub-laterals of a further 210 km and a total of 120 km of roads were created to provide (Asare, 2002; Salifu, 1998).

The Tono irrigation farmers, under the terms of the project were enjoined to some assistance from ICOUR in the form of input supplies such as fertilizers, seeds and pesticides, and paying back after harvest. Also, farm machinery to the inclusion of tractors, combine harvesters and other farm implements were to be leased to farmers for a fee. Apart from these, there are the location advantages of a fairly flat and gentle sloping land and abundant labour supply especially during the dry season when no rain-fed agricultural would be possible. The soils are also typical of the savannah ochrosols, quite conducive for the cultivation of rice, sorghum, tomatoes and vegetables. However, despite these facilities, the impact of the irrigation scheme on sustained agricultural production and poverty reduction is not easily obvious.

### Research approach

The study adopted a treatment and controlled approach. In such a study, a control population is identified, which has similar characteristics and performance to the study population and is expected to experience secular trends or sudden changes similar to the study population (Grimshaw et al., 2000). Two groups of samples namely; the treatment group and control group were identified. The experimental group comprised the direct beneficiaries of the scheme as irrigation farmers and the control group, farmers who engaged in irrigation in the district but outside the Tono irrigation scheme.

### Data sources

Secondary data on irrigation in Ghana was gathered through a scan of: i) pertinent research materials emanating from professionals from Ghana Irrigation Development Authority, International Water Management Institute, International Food Programme Research Institute, University for Development Studies, and Kwame Nkrumah University of Science and Technology (KNUST) Kumasi; ii) Irrigation Company of Upper Region (ICOUR), the Kassena-Nankana District Assembly and the Ministry of Food and Agriculture; and iii) collation of information from online publications and reports on the subject area.

Primary data was collected through a field survey. Although the irrigated cultivated crops in the Kassena-Nankana District include maize, soya beans, tomatoes, vegetables the field study purposefully selected and covered tomato growing farmers. This is

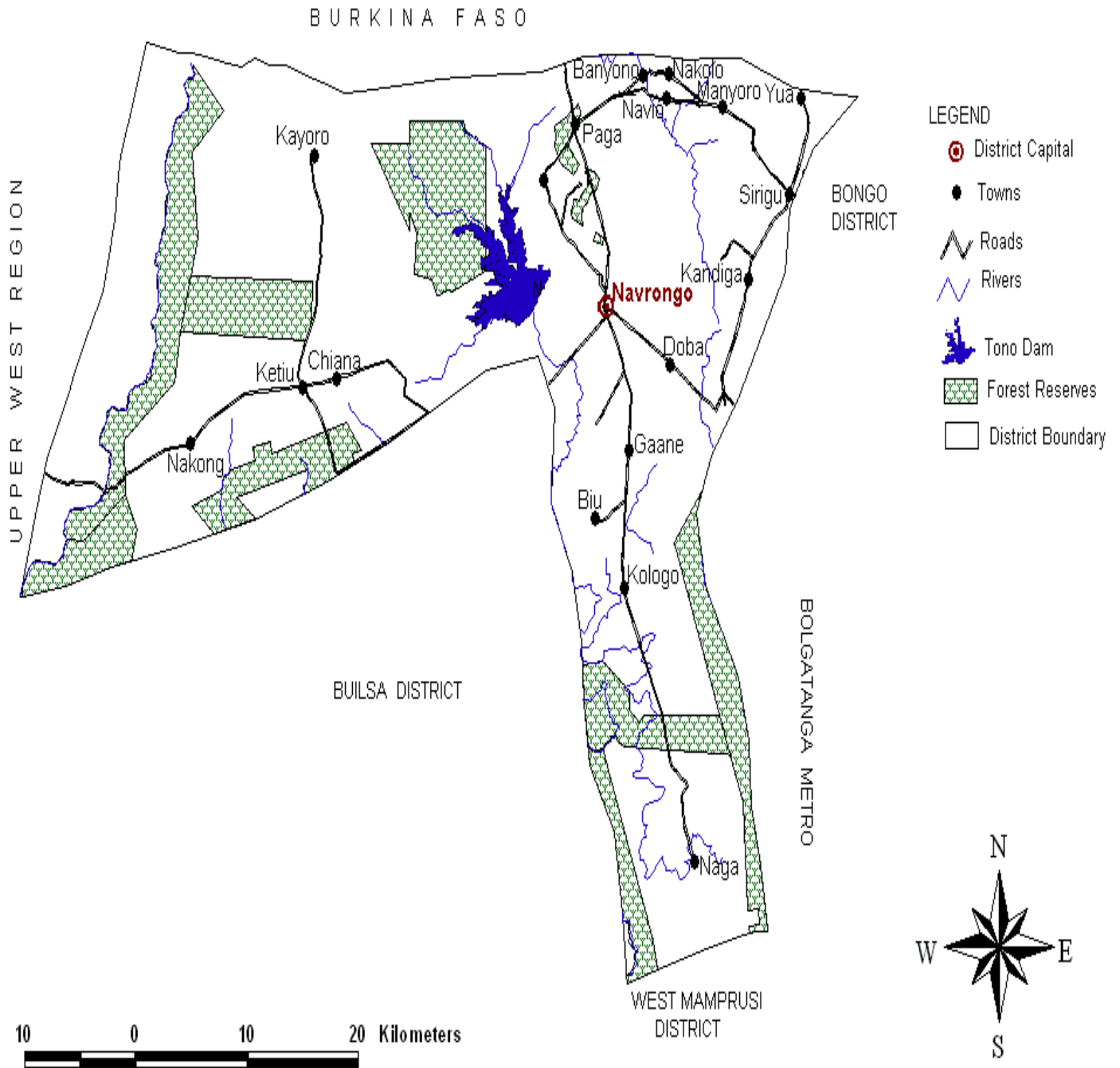


Figure 4. Map of the Kassena-Nankana District Showing the Tono Dam. Source: Kassena-Nankana District Assembly, 2010.

because tomato growing is the most dominant irrigation cropping activity in the district. of the Tono irrigation scheme and those outside the scheme but in the Kassena-Nankana District. It included primary data/information from the irrigation farmers and related institutions. For primary data, scheduled-structured questionnaires were prepared to elicit information from individual farmers and the staff of the ICOUR, the District assembly and Ministry of Food and Agriculture. From the farmer questionnaires information sought included on land acquisition, farming methods, technical assistance received, irrigation water supply, produce marketing and benefits derived with regard to household economic situation, food security

and ensuing challenges.

**Sampling**

The sampling frame for the study comprised all the farmers at the Tono irrigation scheme area in the Kassena-Nankana District during the 2011 irrigation cropping season (November and April) who are beneficiaries of the package programme and irrigation farmers, non-beneficiaries outside the scheme area.

The conventional statistical model,  $n = N/1+N(a)^2$  where;

$n$ =sample size;  $N$ =sample frame; and  $\alpha$ =margin of error, was used to derive the sample for the study. Reference to the experimental group,  $N$  is the total population of the Tono irrigation farmers that was 1,328 and the sample taken at a 10% margin of error gave 93 farmers for investigation. In a similar manner, a sample of 86 farmers out of the other irrigation farmers (control group) across the district but outside the Tono irrigation scheme was obtained from a sampling frame of 623 counts during the reconnaissance survey.

Simple random and snowball sampling were adopted. The simple random sampling requires that each member of the population has an equal chance of being selected as subject. This was possible with the Tono irrigation farmers because each farmer has a designated plot. Each subject was selected independently of the other members of the population. Each plot was assigned a unique number. These numbers were placed in a bowl and mixed thoroughly. The investigators then picked the numbered tags from the bowl until the sample size of 93 farmers were obtained. The farmers whose plots were picked by the researcher constituted the subjects for the experimental group for the study.

Snowballing is a non probability sampling technique was purposively used to identify and interview the control group. The distribution of the control group was not in any identifiable patterned order. By snowballing technique, the investigators began with one case and based on information about the interrelationships from that case and subsequent ones, other cases were identified and the process was repeated. After the sample selection, the investigators went around to interview the first identifiable irrigators outside the Tono irrigation scheme who, then after, referred to other irrigators of their kind in the district for contact and interview. The investigators were mindful in ensuring a fair spread out of the 86 interviewees across the district.

## RESULTS AND DISCUSSION

### Operation of the irrigation scheme

The study examined the operation and utilization of the irrigation scheme to the benefit of project farmers, taking into consideration ease of access to land, farm practices, production, through to marketing of produce by irrigation farmers in the district. Comparisons are made of the focus and control groups to measure the extent to which the project contributes directly to the income and socio-economic conditions of project farmers and their dependents.

### Land acquisition

In Kassena-Nankana District as all elsewhere in northern Ghana, communal land ownership is the norm. Once land has been cultivated by a family, it is recognised as the property of the family which is inheritable. New lands can be acquired from the village chief or Tindana (traditional landlord) (Birner et al., 2005). For the irrigation farmers outside the Tono irrigation scheme, family land was the major source of acquisition. The land tenure situation at the Tono scheme was quite different. According to ICOUR, the land was formally state property, but it is now rented out to scheme farmers on 5 years basis with priority given to farmers who were displaced during the construction of the infrastructure.

Acquiring arable land for cultivation under the Tono irrigation scheme was not much of a difficulty if the farmer could pay the service fees for the use of the infrastructure. A village committee made up of selected beneficiary farmers manages and leases 81.6% of the irrigable land to farmers fairly. The rest of the land is managed by ICOUR resulting in equal access to irrigable land. Similarly, farmers of the control group had no difficulty in acquiring land for cultivation. As much as 72.1% of them cultivated on inherited farmlands.

### Farming methods

Only 25.8% of project farmers adopted capital-intensive approach involving the use of tractors to cultivate while intermittently engaging the services of hired labor. However, the introduction of intensive farming left the farmers vulnerable. This was because they lacked the capital base for the start-up and operation and the support services delivered was untimely for their work. The situation of the control group respondents was a little different. While 3.5% of respondents adopted the capital-intensive approach, 12.8% adopted both methods when necessary. The low patronage of the capital-intensive system by both groups is attributed to the high cost of renting farm machinery coupled with the low access to credit facilities.

### Crop financing

The management of ICOUR has the responsibility of assisting project farmers in terms of material inputs, technology transfer and credit. Under its Credit and Marketing Agreement Scheme, the company provides farmers with fertilizer, seedlings and/or land preparation services to which farmers are to repay after harvesting either in cash or kind. A large proportion (92.5%) of project farmers did not have access to credit facilities and depended on family and friends to finance crop production. Likewise, 89.5% of control group respondents do not have access to credit to finance crop production. The farmers' inability to access credit could partly be attributed to lack of collateral security.

A branch of Ghana Commercial Bank and a rural bank in the district capital give credit to agricultural producers on conditions that need to be met. Farmers need to provide collateral security for the loan and must also be in groups but most farmers find it difficult to meet these conditions. The interest rates to the tune of 25 to 35% are too high and make repayment difficult. According to Booth and Mosley 2003, availability of credit and finance often unlock a constraint on the ability of households to hire labour and buy inputs. The Tono irrigation farmers applied fertilizer, used insecticides and herbicides and grew improved seedlings which ICOUR insists on their use and play active role in securing them. The inability to



access to credits negatively affected agricultural production. This is because the farmers, poor as they were, could not purchase all the necessary inputs for their farms. According to Konings (1986), the low yield most peasants obtained from their small plots coupled with the increased production costs, made it simply impossible for some peasants to repay their loans to the bank. As a result, the peasants concerned could no longer obtain, or would no longer apply for, new loans from the project.

### **Technical assistance**

Irrigation farmers of the treatment and control groups relied on technical assistance from the district Agricultural Extension Services Division of Ministry of Food and Agriculture in the form of extension know-how, supply of subsidized fertilizers, jumping machines and farm implements, provision of improved tomato seedlings. Up to 61.7% of the project farmers had access to the technical services rendered by these officers compared to 41.9% of the control group farmers who indicated receipt of assistance. Many irrigated farmers, therefore, relied mostly on accumulated experience rather than the usual extension services. The Tono irrigation scheme had a farmer population of 3,000 at the service of three agricultural extension agents. The length of the main canals in Tono is 42 km. The long distances make the work of the extension officers difficult. According to Seidu Al-Hassan (2008), the limited number of extension agents negatively affects farmers' technical efficiency. He noted that Government support to irrigation projects in the country has almost stopped. Apart from the removal of fertilizer subsidy in the early 1990s by the government, the Government of Ghana no longer provides farm machinery (tractors, ploughs, harrows, power tillers and seed) to irrigated farmers. Irrigation projects in the country have also witnessed retrenchment in project management staff as a result of recent government labour policy aimed at controlling government expenditure. To enhance the access to technical assistance some of the farmers have to be trained as lateral leaders to complement the efforts of the project extension agents in the delivery of support services. The implication is that a community-based approach is important in the management of irrigation projects.

### **Irrigation water supply**

As crucial as water supply is to irrigation farmers, 57% of the project farmers interviewed responded in the affirmative that the water supply to their farmlands is regular and adequate. The water situation with control group farmers is somewhat different. The sources of irrigation water are hand-dug wells, rivers and dams. Farmers do not pay for any form of charges but dig up wells through organized communal efforts. As much as

76% of the control group as against 43% of the experimented (project) group farmers found difficulty accessing irrigation water for cultivation. According to Seidu Al-Hassan (2008) the irrigation facilities are old and are characterized by poor irrigation water control consequent upon the few extension agents and lack of maintenance.

### **Crop storage**

Up to 20% of the project farmers interviewed are engaged in vegetable production, which is easily perishable. As much as 46.2% of these farmers captured in the study do not have any form of storage facilities for their produce. The 53.8% of farmers who stored their produce in silos, rooms or barns are cultivators of rice, maize, onions and other non-perishable crops. The control group has a more serious situation with storage since 83.2% of them are vegetable crop farmers. The farmers' inability to store their produce compels them to sell the produce at very low prices to avoid loss. Tomatoes are perishable, requiring special storage and transportation facilities. Little consideration is given to improved post-harvest handling practices despite the perishable nature of the products. The perishable nature of the crops provides leverage to middlemen (and -women) to influence prices. The inadequacy of storage and processing facilities means that produce has to be sold as soon as the crop matured.

### **Marketing of farm produce**

Access to ready market for farm produce has been a challenge to farmers under the Tono irrigation scheme as well as for the farmers outside it. Up to 52.7% of project farmers do not have ready market for their farm produce. Similarly, 67% of the control group respondents do not have ready market for farm produce. An in-depth interview with respondents and management of ICOUR revealed some of the reasons accounting for the market failure. Abayale Juliana, a tomato seller from the Navrongo central market had this to say:

*"...customers prefer farm produce from Burkina Faso and other places to farm produce from Tono irrigation scheme because, unlike the Tono farmers the Burkinabe farmers and other farmers use organic manure for production giving the crops quality taste...."*(Personal communication, 07/01/11).

The manner in which Tono irrigation farmers sell their produce could also be a cause of their failure and vulnerability. Whilst 61.3% choose to sell their farm produce at the market centre, 21.5% choose to sell their produce by the roadside at the mercy of passers-by. The farmers do not have ready market to sell their perishable produce. Customers, therefore, dictate prices because farmers have no means of storing these perishable

**Table 1.** Income of farmers.

Income	Experiment Group		Control Group		Total sample	
	No.	%	No.	%	No	%
Low income	32	34.4	48	55.8	80	45.0
Medium income	55	59.1	38	44.2	93	51.5
High income	6	6.5	-	-	6	3.5
Total	93	100	86	100	179	100

Source: Authors' Fieldwork.

products. Marketing of produce is often a problem. This is an area controlled by middle women who often through calculated efforts (like controlling the number of vehicles used to convey the produce) offer ridiculously low prices.

Lack of food processing and storage facilities as well efficient distribution systems mean bumper harvests often go waste at great cost to the farmers. There is also low logistic support from central government as well as minimal commercial sector involvement.

Irrigation farmers in Ghana are market-oriented by virtue of the nature of crops they cultivate and the fact that they consume a smaller share of what is produced. Nevertheless they have limited marketing channels or market participants. The paucity of alternative marketing channels and market participants allows few buyers to bid the price down. The purchases are also usually on a credit basis at extremely low predetermined prices. The variability and uncertainty of output prices complicate farmers' production decisions. Anambama (2008) and Ellis and Ade (2005) notes that, the factors constraining food crop marketing include low fluctuating price, high transport cost, untimely payment of farmers for their produce, high input cost, and unavailability of input and lack of credit.

### Management of Tono irrigation project

Management of the project is jointly managed by ICOUR and the beneficiary farmers. Up to 51.6% of respondents indicated their involvement in the operation and maintenance of the project in various ways. These include their involvement as members of village development committees (10.8%), decision making through public forums (20.4%) and provision of labor services during sub-canal cleaning and maintenance (21.5%). The rest of the 47.3% did not indicate any form of involvement due to personal reasons. Farmers' involvement in the management of the project contributed largely to the success of the project.

The very approach of implementing irrigation schemes was in the past, was the top-down approach, making farmers see irrigation as government project thus giving them no sense of responsibility (Kyei-Baffour, 2008). During Ghana economic structural reforms the 1980s,

ICOUR tended to reduce its operations in the irrigation scheme. Although it is still responsible for the overall maintenance and repair work in the project, although the poor condition of the project infrastructure is an indication of the low level of effectiveness of project management.

ICOUR continues to provide technical services, to run farm trials and occasionally promotes new seed varieties, but many of its services mainly benefit commercial farmers (Laube, 2007). This is due to the fact that most employees of ICOUR especially at the middle and senior level of administration despite regulations prohibiting any large farming by staff members are very active commercial farmers themselves (Tonah, 1993). The number of staff working in the Tono project dropped from 152 in 1988 to 55 in 1991 (Laube, 2007) and has since not seen any improvement.

### Direct benefit of Tono irrigation scheme to farmers

#### *Income levels of farmers*

According to Inkoon and Nanguo (2011), income generation is largely the main reason for undertaking irrigation farming, though all of them also indicated supplementing their family food needs. During the study, farmers were classified into three groups based on their seasonal income comprising low income of less than GH¢500 (US\$278); medium income of between GH¢ 501- 1000 (US\$279-556) and high income of above GH¢1000 (US\$556). For the overall sample of the 179 farmers, only 3.5% of the farmers are within the high-income group (Table 1). The low and medium income categories in each case constituted 45.0 and 51.5% respectively. In the experimental group, most (59.1%) of the farmers are in the medium income category. Only a paltry 6.5% are in the high income with rest (34.4%) low-income earners. In the control group, no high-income earners were recorded. The majority (55.8 %) are low income with the rest (44.2 %) settling in the medium income group.

With the institutional and technical assistance given out to project farmers by management of ICOUR and MoFA coupled with the availability of irrigation water, it is expected that project farmers when compared to the

control group reap an appreciable difference in income. The indication is that the direct impact of the project on the income levels of project farmers is far from that anticipation. It has a rather modest effect on the livelihood of the project farmers and their dependents caused by their poor marketing strategy.

### **Household economic situation**

The farmers' perception of their current household economic situation was assessed to evaluate the project impact on their household living conditions. Well over half (55.9%) of the sampled project farmers were dissatisfied with their current household economic situation and declared their current state as desperate. The situation within the control group is worse, a higher proportion of 61.8% were dissatisfied with the state of their household financial condition. Under the project, the situation of some project farmers was precarious and beyond definition. Adoctor Attiru Gilbert, a pioneer beneficiary of the Tono irrigation project put it as follows:

*"Today, Tono is no more beneficial as it were when we started farming in the early 1980's. One could buy a motor bike with income from one season, some even built houses because of Tono, but today, we are engaged in the farming because we do not have anything else to do..."*(Personal communication, 08/01/11).

A cross examination was done through focus group discussions to establish if respondents observed any improvement in the household financial condition compared to five (5) years ago and if this improvement could be attributed to the irrigation farming under the project. In response, focus group participants indicated that they had experienced improvements over the last five years but not much as anticipated.

### **Food Security**

One major finding revealed is the limited impact of the Tono irrigation project on food security. Due to the absence of storage facilities for the large perishable produce, farmers are compelled to sell their produce at low prices to avoid loss. Subsequently, food becomes scarce and expensive in the district shortly after harvesting since the produce cannot be stored for future consumption. The high cost makes access to food difficult for the rural poor. As confirmed by the 2003 Core Welfare Indicator Questionnaire (CWIQ) survey, 57.9% households in the district find difficulty meeting their food needs as compared to 12.8% at the national level (GSS, 2008).

### **Migration**

As one of the largest public irrigation facilities in West African (FAO, 2007), the Tono irrigation engages an average of 1,380 young people seasonally in all year agriculture. This has reduced the number of youth who migrate to the urban areas in southern Ghana in search of better employment opportunities. However, due to its associated challenges the income generated from irrigation farming is not enough to reduce the number of youth who out-migrate annually by a significant proportion. This is evident by the statistics from the Ghana Statistical Service indicating a net migration of -43 for 15 to 19 age cohort who are basically the youth and future leaders of the district (KNEDA, 2010). Obviously, the impact of the Tono Project has had moderate effect on youth's desire to out-migrate for employment and better living conditions.

### **Challenges of irrigation farming**

Many reasons can be attributed to the little impact of irrigation farming under the Tono irrigation project to the livelihood of farmers in the district. The study identified peculiar constraints and challenges accounting for the gap between farm productivity and farm income.

#### **Production challenges**

On the production side, the challenges facing project farmers is the poor supply of irrigation water to farmlands. While irrigation water is vital for crop production, as high as 43% of the project farmers were dissatisfied with the supply of water. Farmers complained of irregular flow, and broken sub-canals. This puts farmers in situations where crops get dried up due to lack of water thus affect yield and subsequently income. Farmers' inability to access credit for crop financing posed another challenge. Although farmers are aware of loans provided by IFAD/ADB at 18% interest per annum, uncertainty about yield puts farmers in a dilemma as to whether they can pay back loans collected or not. The survey revealed that technical assistance from agricultural extension officers is inadequate. Up to 38.7% of the Tono irrigation farmers do not have access to extension services at all. Against this background, farmers are faced with the problem of crop diseases, pest attacks and ignorance on modern farm practices among others. This is attributed to weak operational capacity of the institution in the form of technical expertise, inadequate logistics and delayed release of funds from central government.

#### **Marketing challenges**

On the marketing side, farmers' major challenge is

market failure. While farmers record bumper harvest at the end of each farming season, getting neither ready market nor target market for these produce is almost impossible. Farmers also face fierce competition from Burkinabe irrigation farmers cultivating along the White Volta River basin. Farmers from both Tono and Burkina Faso have a common target market; market women from southern Ghana, who have served as the major buyers of Tono produce since the inception of the project. In recent times, unlike the Tono farmers, Burkinabe irrigation farmers use manure and organic nutrients in the production of their crops. This makes buyers purchase more produce from Burkinabe farmers than Tono farmers. This is the main reason why buyers from southern Ghana prefer produce from Burkinabe irrigation farmers to Tono irrigation farmers. Lack of storage facilities compels farmers to sell their perishable produce at very low prices to avoid losses. In such situations, farmers are unable to earn significant profit from the huge capital investments put into their farms thus further entrenching the already existing poverty situation.

Farmers in Upper East and for that matter the Tono irrigation scheme, appear divided as to whether traders prefer tomatoes from Burkina Faso because the tomatoes are of a better quality and transport better or the farmers are more responsive to the traders' needs. Lead boys may also encourage traders to bypass Upper East for Burkina (Robinson and Kolavalli, 2010, p. 20). "Lead boys" provide an important way for farmers to connect with traders and naturally prefer to source tomatoes closer to main roads, where there are sufficient growers to fill a truck. Lead boys in the Upper East appear increasingly to prefer to take traders to Burkina Faso to source tomatoes. This may explain why none of the farmers in the Tono sell more to the local markets.

## CONCLUSIONS AND RECOMMENDATIONS

Ghana is not self-sufficient in agricultural production, making adequate food and industrial raw material availability all year round a difficulty because of the predominance of rain-fed agriculture. As a result, poverty is posing a great challenge to development. During periods of good rains, agricultural products abound but inadequate storage facilities result in losses of perishable crops. Inadequate agro-processing facilities for products also contribute to the vulnerability of farmers in the country.

Investment in irrigation infrastructure constitutes an important poverty reduction strategy since it can boost agricultural production by reducing the risks associated with rainfall variability and unreliability. Irrigated agriculture comprises an increase in the supply of water by artificial means through the use of water control technology allowing for the drainage to dispose of excess water.

Although some modest gains have been made towards poverty reduction through irrigation, more efforts need to be made. At the Tono irrigation scheme in Kassena-Nankana District, many of farmers had limited access to farm credit, technical assistance, hardly used, insecticides and high yielding seed varieties and inadequate ready market for their produce. Addressing these challenges squarely has the potential of directly contributing to poverty reduction in the Kassena-Nankana District and Ghana in general. The attendant actions will not only increase the farmers' production and incomes, but will also enhance their opportunities to diversify their income base, to reduce their vulnerability to the seasonality of agricultural production.

The district's economy is vulnerable since it is prone to droughts like all elsewhere in the northern Ghana. The desire for food security, poverty reduction, and employment in the district characterized by mono-modal and highly variable rainfall distribution make irrigation development an inevitable strategy. Apparently, the district has a comparative advantage, due to its strategic geographic location in the country. With a readily functioning road transport system, it has access to West African sub-regional markets, abundant land and water resources for the accelerated development of irrigated agriculture. The potent comparative advantage is not yet realized in terms of competitive advantage. The following recommendations are suggested to revitalize Tono irrigation Scheme and irrigation sector in the district: i) strengthen the irrigation institutions and organizations; ii) step up capacity building initiatives for the farmers and iii) promote farmers' access to ready markets. Specific measures that need to be implemented include the following specific propositions.

### i) Strengthening the irrigation institutions

#### *Management reforms*

There is the need for a renewed focus on the irrigation sector in the local economy by crafting smallholder-friendly irrigation reforms within the context of the Tono irrigation scheme. Some balance between the large-scale commercial farming at the Tono irrigation scheme and the smallholder-oriented irrigation development in the rest of the district focused on rural poverty reduction and food security is necessary. Emerging institutional arrangements, which include public-private partnerships and contract farming, can assist in effecting the balance. The management of irrigation system by ICOUR has not been a viable in ensuring sustainable irrigation in the district. With the reduction in government support, ICOUR spends almost all of its funds on staff salaries and wages, leaving very little for irrigation organization and management. It is necessary to also effectively and efficiently support and expand private irrigation in the

district with the costs borne by the beneficiaries rather than the State.

The Government of Ghana is committed to its ongoing decentralization process across board, including Ministries, Departments and Agencies (MDAs) and Metropolitan, Municipal and District Assemblies (MMDAs). Equally, irrigation sector institutions need to adhere to the principle of subsidiarity, with management responsibilities of public infrastructure devolved to users to the greatest practical possible extent, ensuring public participation in decision making at all levels.

### ***Bureaucracy***

If new approaches are to be successful, government will need to direct funds towards training existing staff, attracting new talent through forward-thinking curricula and realistic remuneration packages, as well as building the capacity of all stakeholders (including the irrigation bureaucracy). The initiatives should include a review of engineering courses in universities and other stakeholder educational institutions, conducting in-depth training workshops for farms and irrigation officials, or revamping Ghana Irrigation Development Authority to empower its workforces.

### **ii) Capacity building for the farmers**

#### ***Intensify farmer-centred vocational training***

There should be emphasis on farmer education and training that will help them to understand the socio-economic conditions governing their farming activities. The education package needs to include the provision of farmer field schools to expose them to farm record keeping, group dynamics, resources mobilization and irrigation management. Another way is to strengthen the capacity of rice farmers through farmer-centred training workshops geared towards managerial efficiency as well as resource use efficiency. This should be done in a collaborative manner involving the government, district assemblies and NGOs. The Ministry of Food and Agriculture should intensify its extension services programme by training and deploying qualified extension agents. The agents, in turn, should intensify farmer education about input use. The extension agent–farmer ratios, as well as extension contact with farmers in the study area, are low. There is, therefore, the need to motivate and train the existing extension agents to work more effectively and to train more agents.

#### ***Encourage use of organic manure***

As can be observed from the Chinese and the Burkinabe

experience, irrigated agriculture succeeded in reducing rural poverty through the adoption of innovative agricultural practices. It is suggested that Agricultural Extension Services Division and ICOUR organize training for irrigation farmers on the use of sewage sludge and manure. Sewage sludge can complement chemical fertilizer usage, going a long way to improve the quality of farm produce. These simple traditional but effective methods are the reasons for Chinese and Burkinabe success.

### ***Irrigation Entrepreneurship***

The way forward in the district and other districts with similar situations is for government to create policies that facilitate poor farmers becoming irrigation entrepreneurs. This involves farmers being trained to respond to challenges posed by volatile market conditions and climate change. It will make them their own security seekers and enterprising in market search and marketing. These entrepreneurial skills can be transferred to irrigation farmers through the efforts of well-equipped extension officers in the district and nationwide.

### ***Cultivation in phases***

As a strategy to ensure a ready market for tomatoes, the tomatoes' seedlings need to be nursed in phases. The reason why farmers do not get good market for produce is because many of the farmers nurse the tomato seedlings at the same time and harvest at the same time. To reduce the risk of market failure, farmers can crop in phases. While a group of farmers is encouraged to nurse in a month, a second group is encouraged to nurse in the following month(s). This will ensure that farmers harvest in different times reducing over production and ensuring the availability of vegetables all year round.

### **iii) Promote farmers' access to ready markets**

The Tono irrigation scheme was proposed by the first republican government administration in Ghana under Dr Nkrumah as first president. It was under its agricultural development policies to "provide the north with a large share of the national development fund than ever had been the case during the colonial administration" (Anambama, 2008). The scheme was therefore supply-driven with little consideration or conscientious regard to the demand side dynamics. It was probably, at best, assumed that the Northern Star Tomato Factory and urban centres in southern Ghana would provide a ready and sufficient market for the anticipated increased tomatoes production occasioned by the irrigation scheme. Within the context, some level of

industrialisation was considered for nation building, for diversification of the local economy in northern Ghana, where the development such infrastructure was very low (Codjoe, 2007). It was also intended that produce for the scheme would complement the local food shortages in the area caused by droughts in the region. The implicit view was that the peasantry food production in the region would be complemented that of the project farmers (Liebie, 2002). Experience has shown farmers producing for an assumed market that is very small or almost non-existent, that has retard development but also serves a disincentive for farmers. As Delgado et al. (1998) put it, resources are underemployed if there is insufficient demand to purchase the produce that emanate from the use of those resources because of remoteness or poverty. This assertion is relevant at the instance of the tomato cultivation in the Kassena-Nankana District especially at the Tono irrigation site where production usually exceeds demand. The perishable nature of the tomato crop and lack of storage facilities cause huge losses to farmers.

Under the circumstances the following recommendations are made:

The Ghana Irrigation Development Authority and Irrigation Company of the Upper Region, the Ministry of Food and Agriculture the District Assembly and Farmer Associations should work out i) a possible market supply opportunities to boarding schools and hospitals in northern Ghana; ii) initiate a market research targeting the urban market in Ghana and the sub-regional market in west Africa; and target and develop a Farmer-Factory Collaboration with Northern Star Tomato Company Limited in the Upper East Region. The factory can be resourced with large tomato storage facilities. This is to enhance the factory's ability to purchase and store larger quantities of tomatoes produced by project farmers.

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