The Reticulation Irrigation Scheme at Sankana, Upper West Region, Ghana: Current Usage, Productivity and Incomes

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Abstract

In 1961, the Ghana Government constructed a reticulation irrigation scheme at Sankana in the then Upper Region (now Upper West Region) with a potential irrigation area of 120 hectares, a 750 m wall length and a 25 m spillway weight to boost arable farming and inland fishing. A little over 50 years on, the present case study assesses usage, productivity and incomes resulting from the irrigation project. In June 2014, farmers' patronage of the irrigation water was investigated through the use of an interview guide, a questionnaire, a group discussion guide supported by key informant interviews with officials of relevant state institutions, transect walks and personal observation. At present, only 73 farmers depend on the stored water for irrigation of crops; 55 farmers were available for questioning; and there were nineteen fish farmers. For a farming season, the majority of farmers (58%) earn incomes between GH¢150.00 and 300.00, and on the scale of stable, moderate and unstable, 67% of farmers consider incomes to be moderately reliable. Moreover, less than 50% of the farmers utilizing the irrigation project are food secure. Also, 35% of participating farmers are involved in fishing and farming at the same time benefitting from the dual objective of the project. The study concludes that the reticulation irrigation scheme at Sankana is underutilized.

Keywords: Reticulation, irrigation, usage, productivity, income, Sankana

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Introduction

The agricultural sector is considered as one of the critical national assets in Ghana. Despite the recent oil find, agriculture employs the majority of the active labour force as well as contributes substantially to the Gross Domestic Product of the country (Amoah et al., 2014). However, limited access to water militates against agricultural productivity. Irrigation has therefore been identified as a promising remedy to boost levels of agricultural productivity (Xie et al., 2014). It is argued that the number one user of freshwater with irrigation withdrawals is the agricultural sector which represents approximately 70% of total water use globally (Fischer et al., 2007).

In spite of the crucial role of water in agriculture, Falloon and Betts (2010) argued that climate change threatens to reduce water resources as well as raise the demand for water for agriculture. To this end, securing adequate water for agriculture in the midst of the multiple competing demands for water (i.e., for domestic and industrial uses) by the burgeoning population is critical in order to meet the changing food demand (Knox et al., 2010). As a remedy, myriads of water-saving irrigation practices are adopted (Ye et al., 2013). One such water-saving technology that has been constructed for crop cultivation in Ghana – Sankana community, is the reticulation irrigation scheme.

Irrigation involves the supply of water to crops and animals to aid physiological growth and development. With regards to crops, irrigation provides water to meet the evapotranspiration needs. An irrigation system is described as reticulation if it entails storage and conveyance of water (Hood, 2008). The processes involved in a reticulation irrigation system are excavation of a basin for water storage or construction of a dam to obstruct running water (river or flood water) to create impounded water. Secondly, a network of aqueducts is constructed to convey the water from the reservoir to the arable lands. In an advanced form, sprinklers and drippers are used to serve the water on the crops, and excess or unused water returns to the storage. In the case of Ghana, either concrete channels or [poly (vinyl chloride)] PVC pipes are used to carry water from the aqueducts to the crops. The farmers of Sankana irrigation site depend on concrete canals or a furrow system and unused water does not return to the reservoir. That is, two aqueducts carry water from the reservoir/dam and empty the water into concrete canals. The water from the canals is carried to furrows which distribute it to the various portions of the farmlands. The excess water drains off.

Over the years, irrigated agriculture in Ghana has played a significant role, particularly in the rural economies of water scarce areas as well as the overall economic growth and development of the country. Significantly, the enormous reliance of rural based economies on water for agriculture to increase food production, provide rural income and improve food security is highlighted by Turral et al. (2010) and Faures et al. (2007). Furthermore, irrigation is crucial, mostly for horticulture, and seeks to maximize yield and quality to deliver continuous supplies of food, fruit and vegetables (Knox et al., 2010). Earlier studies (Hussain and Hanjra, 2004, Hussain, 2007, Saleth et al., 2003, Shah and Singh, 2004, Huang et al., 2005, Gebregziabher et al., 2009) have established the direct linkages between access to irrigation, in-

creased income and food security. This situation is highly visible and appreciated in the water scarce areas of the country: the Northern, Upper East and Upper West regions. The effects of erratic rainfall patterns and increased water demand for agriculture, particularly in the water scarce regions, have driven the need for irrigation facilities in the areas where the population is generally poor and predominantly peasant. Efforts to improve the lives of the people should focus on 'promoting and substantially increasing agricultural productivity so that the country can attain food self-sufficiency as well as facilitate the achievement of the Millennium Development Goal One (MDG1) which aims at eradicating poverty and hunger' (Amoah et al., 2014:79).

The reticulation irrigation scheme at Sankana was constructed to provide water for farming and fishing in order to increase food and employment for the local people. However, food insecurity and unemployment remain pressing issues at Sankana, aggravating the push-factors for out-migration. Hence, it is important that the scheme is turned around to achieve the stated goals. It is against this background that the present study seeks to investigate the current usage, productivity and income of the irrigation project and farmers. By doing so, the benefits, challenges and better ways of achieving the project goals would be revealed.

Literature Review

In the recent past, the importance of irrigation for the enhancement of agricultural productivity and wellbeing of farmers has stimulated much academic and policy interests. It is contingent on the recognition that irrigation plays a critical role in surmounting water scarcity for agriculture and other domestic uses. In view of this, irrigation has featured prominently in the development agenda in Ghana and other countries in sub-Saharan Africa. There is therefore a conscious effort by central and local governments to increase public investments in the sector, although the on-going smallholder-driven irrigation development that is largely based on water lifting technologies is not yet fully appreciated (Namara et al., 2014).

An earlier study by researchers from the International Food Policy Research Institute (IFPRI) shows that government expenditure on irrigation has a modest impact on economic growth and poverty reduction and that returns on investment in irrigation have been small (Pender et al., 2002, Fan et al., 2000, Rosegrant and Evenson, 1992). Further, it is argued that the underutilization and/or underperformance of some of the new irrigation infrastructure makes it inexpedient to replicate such projects due to high financial, environmental and social costs. Often, lack of maintenance, bad management and financial difficulties decrease the output of new irrigation infrastructure (Faures et al., 2007). Gebregziabher et al. (2009) also corroborate the argument that household surveys show correlation between irrigation and household incomes.

In many developing countries, management of existing irrigation schemes poses serious development, social and environmental challenges. Improvement of irrigation management in areas subjected to periods of water scarcity will therefore require good knowledge of the sys-

tem's performance over long time periods (Garcı´a-Vila et al., 2008). Already in sub-Saharan Africa, irrigation schemes do not form a significant portion of agriculture (Allen and Qaim, 2012). Hence, this region is heavily dependent on rain-fed agriculture. However, in many arid and semi-arid areas of sub-Saharan Africa, irrigation projects, no matter how low the number of operating schemes, present an alternative solution to low and erratic rainfall and extreme evapotranspiration (van Averbeke et al., 2011). What reinforces the need for irrigation developments is the combination of rapid population growth, increased competing multiple water demands and the periodic occurrence of drought in many developing countries (Van der Hoek et al., 2000, Tabbal et al., 2002). The optimum use of irrigation water should take into cognizance the irrigation management and the responses to water scarcity. To this end, Knox et al. (2010) succinctly argued that agriculture sits at the interface between the environment and society.

In recent years, large and small scale irrigation schemes have been constructed by many African countries in agro-ecological zones with little total annual rainfall (Chazovachii, 2012), highlighting the dependence of rural based economies on water for agriculture (Knox et al., 2012). The considerable attention focused on irrigation agriculture is because of its potential to help halve poverty and hunger in the world (Sijali and Mwago, 2011). Yet irrigated agriculture is facing rising competition worldwide for access to reliable, low cost and high quality water (Knox et al., 2012).

The line of action taken to achieve poverty and hunger reduction includes water management (medium and small-scale irrigation for households), large-scale irrigation as well as agricultural and irrigation extension services. Irrigation can also help reduce incidence of malaria by providing environmental control (through provision of intermittent irrigation) (Sachs et al., 2004). For the resource-poor African farmers, irrigation is likely to stabilize yield, reduce harvest losses, and sustain productivity and growth of agriculture (Sijali and Mwago, 2011). In Ghana, there is evidence in Siiru, Yeleyiri and Baliefili in the Wa West District where irrigation dams have caused statistically significant improvement in household income, food security and reduction in out-migration. Hence, Kpieta et al. (2013) argue for increases in irrigation establishment by the government of Ghana and NGOs to spread the benefits to other areas in the north of the country. Elsewhere, for example, at the Tono Irrigation site, some tomato farmers have improved livelihood security and reduced poverty as compared to a control group of non-irrigation users in the same area. As a result, Dinye and Ayitio (2013) add that irrigation farming holds good prospects for reducing poverty in the Upper West Region where every four out of five persons is poor.

If irrigation culture is to be adopted and made part of the daily farming and livelihood activity of African farmers, then, the age of the farmers, incidence of tractor use, access to land, off-farm income activities and agricultural extension services are the socio-economic factors that need to be considered carefully (den Berg, 2013). Furthermore, adoption of irrigation farming by Africans is related to ownership of the project. Due to the high investment in infrastructure, irrigation schemes are carried out by African governments or NGOs. Often, governments transfer ownership to local communities for utilization and management purposes. In

the specific case of Zimbabwe, community management has resulted in segregating farmers into three groups: 'gold-class', middle and poor irrigators (Mombeshora, 2003).

According to Knox et al. (2012), another critical aspect of ensuring efficiency of irrigation projects is the farmers' ability to understand the on-farm irrigation management which is disaggregated into three constituent parts, namely water resources (including water delivery), crop and soil management and application equipment. The first stage (irrigation network and equipment) involves focusing on three factors – water pressure, water use, and irrigation uniformity. Low water pressure is identified as the most pervasive irrigation fault. This situation is caused by the extension of irrigation schemes without paying sufficient attention to the impacts of increased demand on pump capacity, the distribution network, and equipment performance. The result is poor application uniformity with adverse impacts on crop yield and quality. Regular checks on pressure and the volumes of water delivered to particular fields for comparison with manufacturers' guidelines for pumps and in-field equipment are therefore recommended. The second stage (crop and soil management) ensures that water applications are managed (scheduled) according to crop water requirements, avoiding over-irrigation and/or surface run-off. The final step is to demonstrate the use of 'best practice'. Best practices that have proved over time to lead to more efficient irrigation project include, consistently holding irrigation highly within farm management activities, ensuring that the farmers have detailed knowledge of farm soils from an irrigation perspective, monitoring each irrigation event, using objective monitoring tools to schedule irrigation, and remaining open to new irrigation ideas (Knox et al., 2012).

Study Area

The study area, Sankana is located at 10° 12' 0" North, 2° 35' 0" West, surrounded by a beautiful scenery of igneous rocks and shares land boundaries with Nadowli, Changu, Kaluri, Nyembale, Gyile, Papu, Perintabo and Gbanko, all communities belonging to Nadowli-Kaleo District of the Upper West Region of Ghana. Generally, the land is undulating, rising from 150 m to 300 m with spot heights of 600 m (Survey Department, 1972). The area enjoys a single rainfall regime for a period of six months (May-October) with a total annual rainfall of 1,000-1,150 mm; the remaining six months constitute the dry season. The highest temperature occurs in March (36^{o}C) and the lowest in August (27^{o}C), with relative humidity of 70-90% during the rainy season and 20% during the dry season (Dickson and Benneh, 1988).

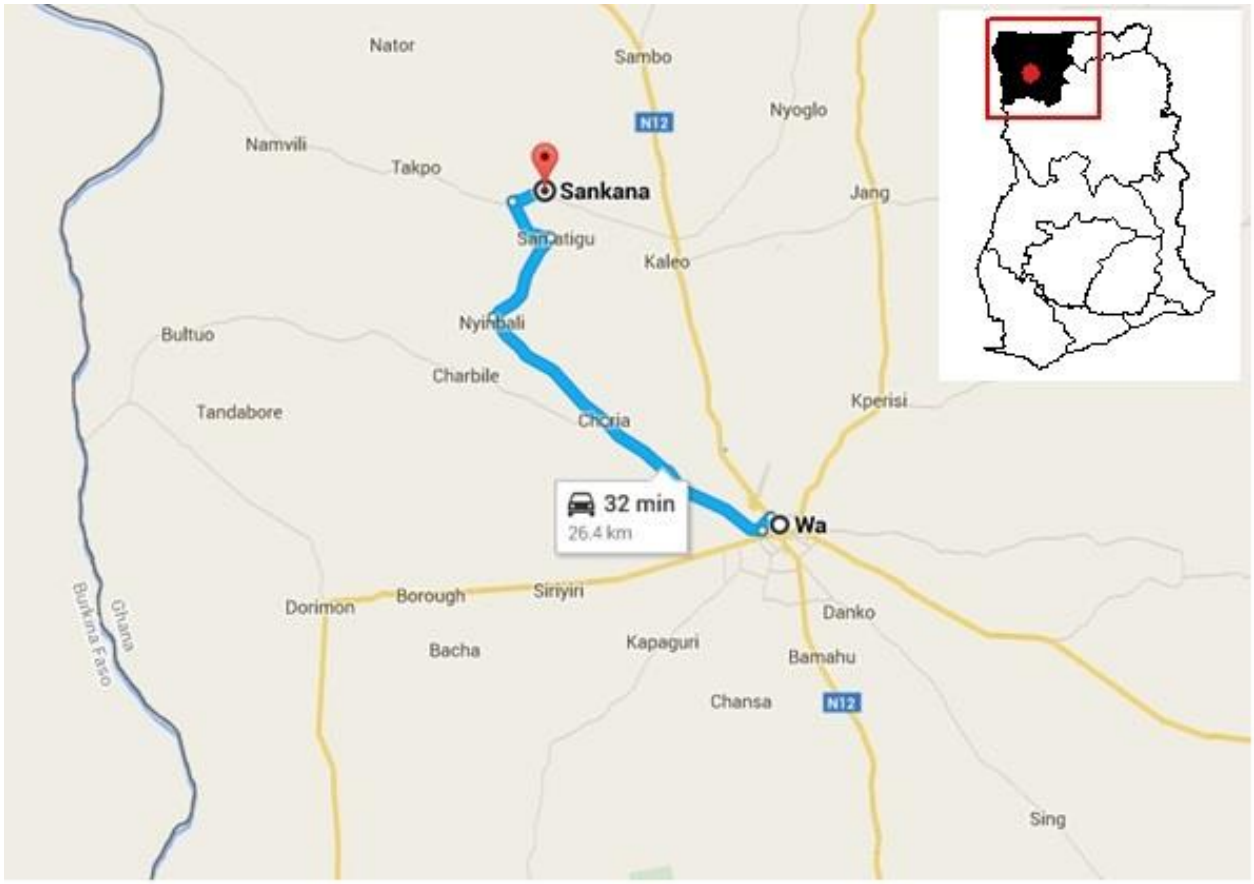

Figure 1. Relative location of Sankana in the Upper West Region
Source: (www.google.com.gh/maps/dir/Wa/Sankana: accessed on 24th April, 2015)

The tropical continental climate supports tussock grass of different heights which are highly inflammable during the dry season; and fire resistant and deciduous trees, notably kapok, shea, baobab, mango, dawadawa, cashew, black berries (Haara), red berries (Zumprinhi), teak, acacia and neem, which are characteristic of the guinea savannah (Dickson and Benneh, 1988). The Government of Ghana impounded nine rivers (Piirikuja, Vile, Kulmaara, Pa, Gbolomo, Kulpieni, Zuziebole, Naa and Bulo) to create the reticulation irrigation system consisting of a dam for fishing and two aqueducts to transport water for arable farming purposes. The project was completed in 1999. Figure 1 shows the location of the study area.

Study Methods

In an attempt to examine the current usage, productivity and incomes resulting from the irrigation project at Sankana, primary and secondary data were collected from farmers and relevant state institutions respectively. Primary data was generated through key informant interviews with the operations manager of the irrigation scheme, the regional director of fisheries, the assemblyman, the chair of the farmers' association and the secretary of the fishermen and fisher folk association. A questionnaire was administrated to 55 crop farmers. For the focus group discussions there were two groups, with the first group comprising 12 fish and crop

farmers and the second group consisting of nine workers of a fish hatchery. Personal observation was also used. All the 55 farmers were drawn from the Sankana community. Statistical Package for Social Scientists (SPSS) 18.0 version was used to carry out descriptive analysis for central tendency and dispersion. In terms of crop productivity, measurement was based on the use of the indigenous scale "*olonka"* a measuring basin popularly used in Ghana for measuring farm produce, and counting the number of tubers or pieces of other products.

Results

The study is based on the male to female ratio of 0.58 : 0.42; four age cohorts of 17-29 (0.33), 30-39 (0.33), 40-49 (0.27) and 50-59 (0.07); a religious faith profession ratio of 0.64 : 0.20 : 0.16 for Christianity, Islam and African Traditional religion respectively; educational background (no formal education (0.42), primary school (0.36), secondary school (0.16), tertiary (0.04) and others (0.02)); and, occupation of respondents (farming (0.89), fishing (0.02), petty trading (0.02) and farming and fishing combined (0.07)).

Figure 2 shows the percentage of farmers cultivating the various irrigated crops. A farmer tends more than one crop and the crops are grown separately on the plots of land in the form of a miniature monoculture on a continuous cropping basis.

Income levels were categorized as GH¢20.00 – 100.00 (low), GH¢150.00 – 300.00 (medium) and above GH¢300.00 (high), with a respective ratio of 25% : 58% : 16%. Farmers ranked the reliability of the income on a scale of stable, moderate and unstable generating the ratio of 7% : 67% : 26% correspondingly. Majority of the farmers on a 'yes' is to 'no' ratio of 98% : 2% claim there is improvement in household incomes resulting the use of the irrigation project.

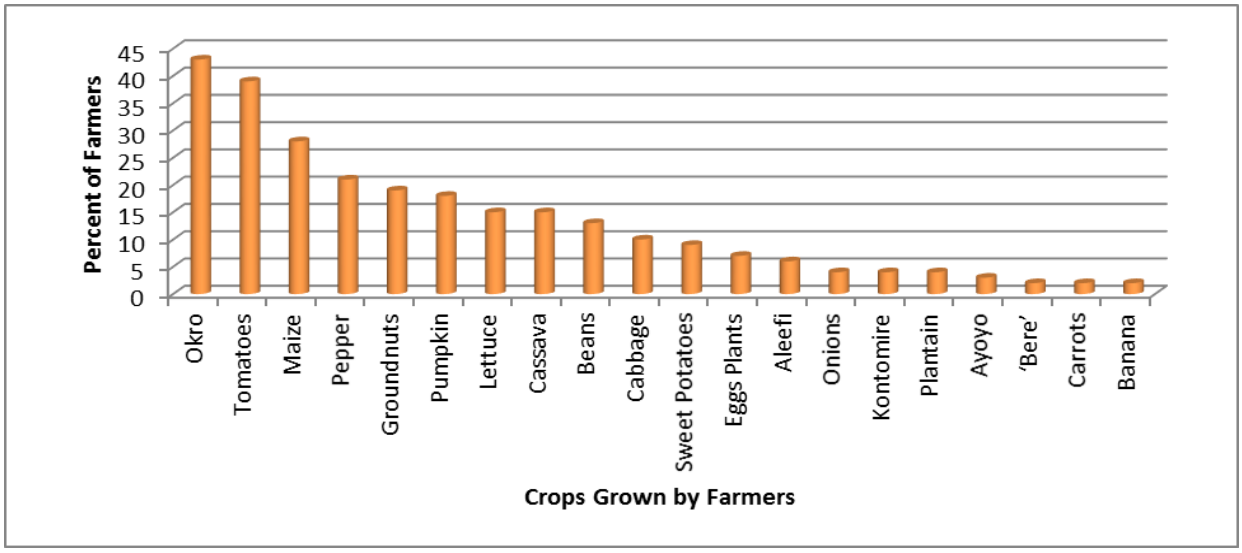

Figure 2. Irrigated crops grown by farmers at Sankana

Farmers grow a single crop on the same piece of land whether it is less than ½ acre, two acres or three acres (Figure 3).

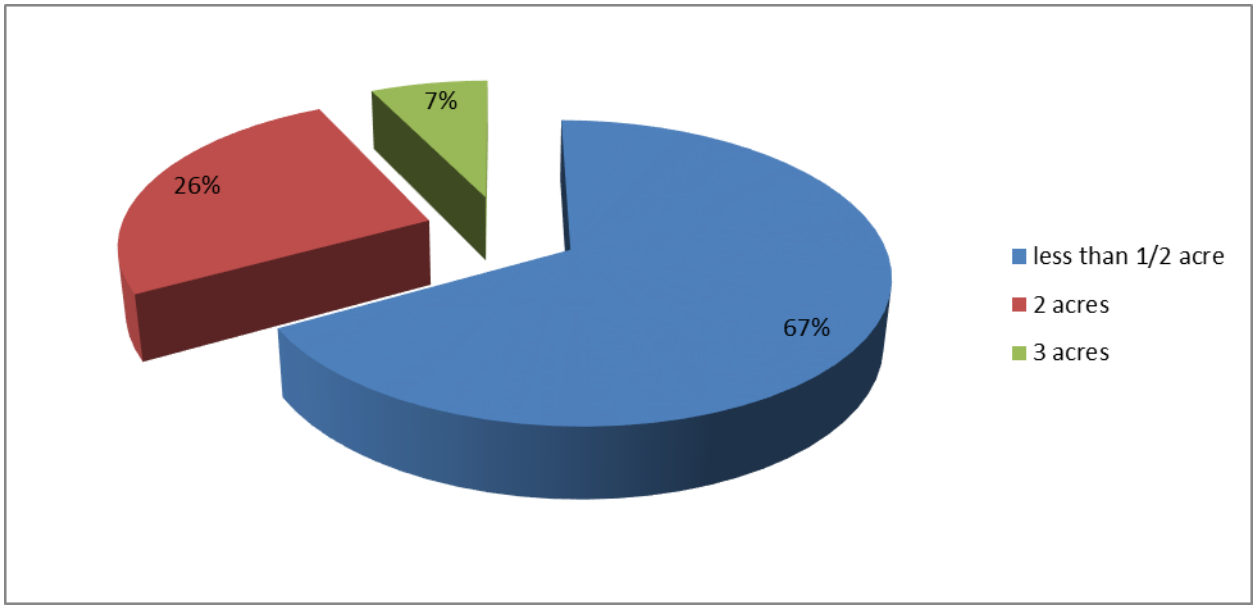

Figure 3. Percentages and sizes of land area under crop cultivation by farmers

Figure 4 shows the relationship between household income levels and area of land under crop cultivation. There is correlation between income level and land size. Low income level (GH¢20-100) dominates on less than ½ acre lands, medium income levels (GH¢150-300) on 2 acre lands and high income levels (GH¢300 plus) on 3 acre lands.

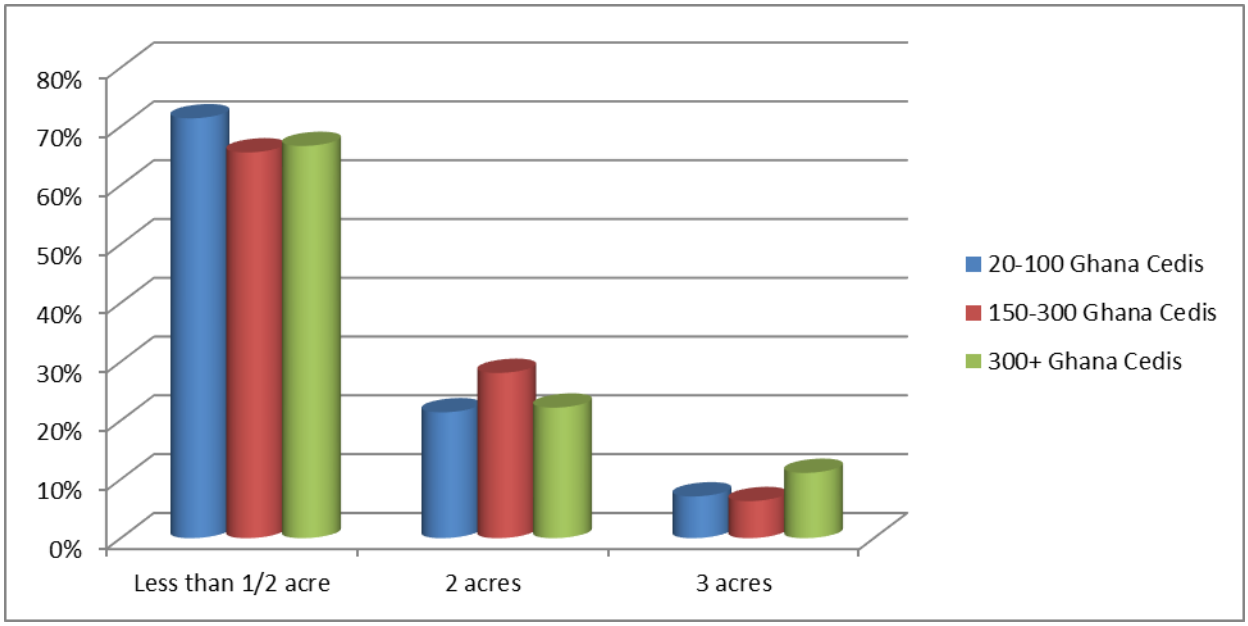

Figure 4. Relationship between income levels and acre of land under crop cultivation

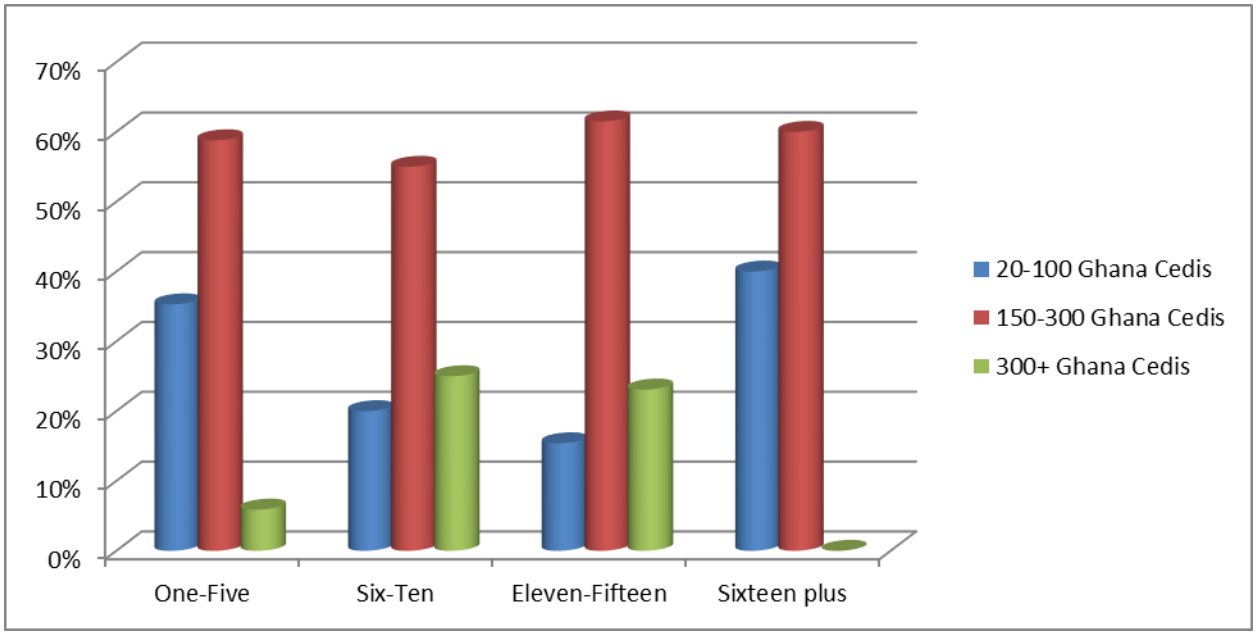

Figure 5. Association between income levels and household size

Figure 5 shows the relationship between incomes accruing from the irrigation farming and household size, where household means the people who eat from the same pot. The dominant income level in the four categories of household size is below GH¢150. Very large households (16 and above) do not earn very large income (GH¢300.00 plus).

Figure 6 reveals the linkages between income levels and housing types. On a scale of low, medium and high income levels, low income (GH¢20-100) dominates the mud house type as expected; the high income (GH¢300 plus) leads in the brick house type. Unexpectedly, the low income (GH¢20-100) dominates in the blocks house type. Farmers in such houses carried out farming activity just to keep themselves busy or occupied. Incomes for maintaining block houses might have come from other occupational engagements or remittances. The study does not suggest that the houses may have been built with income from irrigation farming.

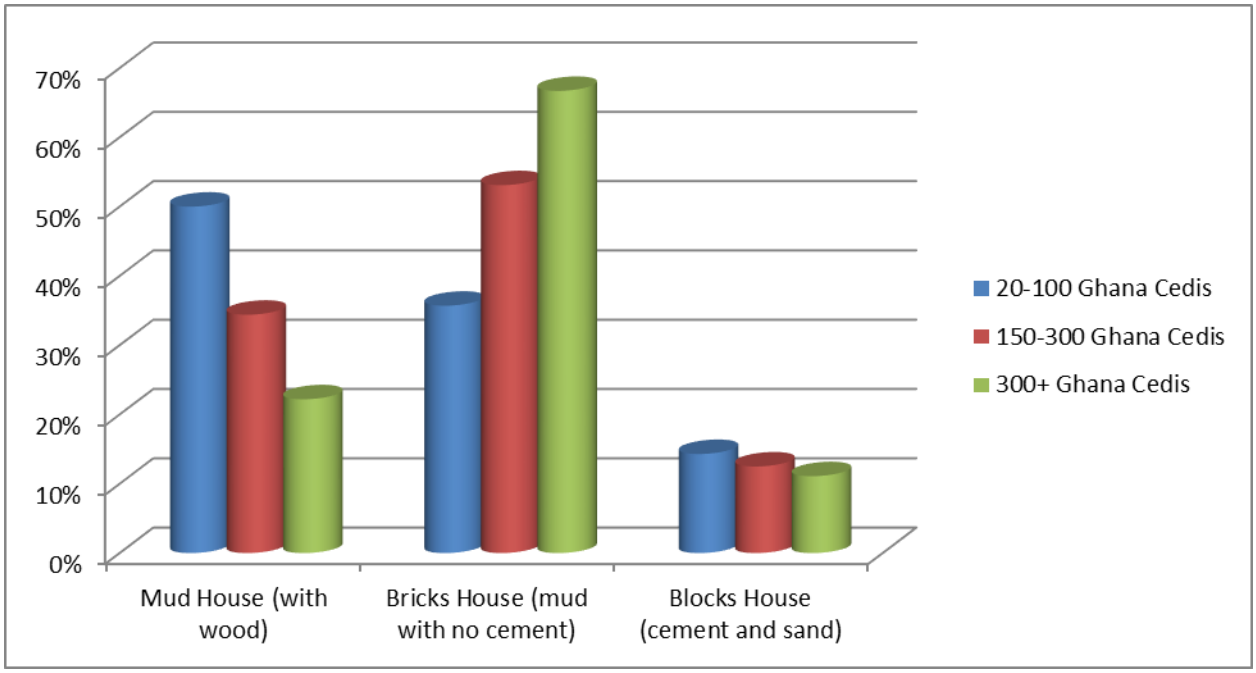

Figure 6. Relationship between income levels and housing type and

The accruing incomes are spent on farmers' immediate needs. In all, 35% of farmers use their income for family upkeep, 24% for family upkeep and school fees, 13% re-invest income in farming, 13% spend their income on both family upkeep and re-investment in farming, 9% use their income for all the categories mentioned and 7% spend the income on school fees only. Figure 7 shows itemized income expenditure of farmers, fisher folks and petty traders. Fishing only as well as petty trading is carried out mainly to take care of family upkeep. Irrigation farming has six major expenditure items for the income accruing from farming.

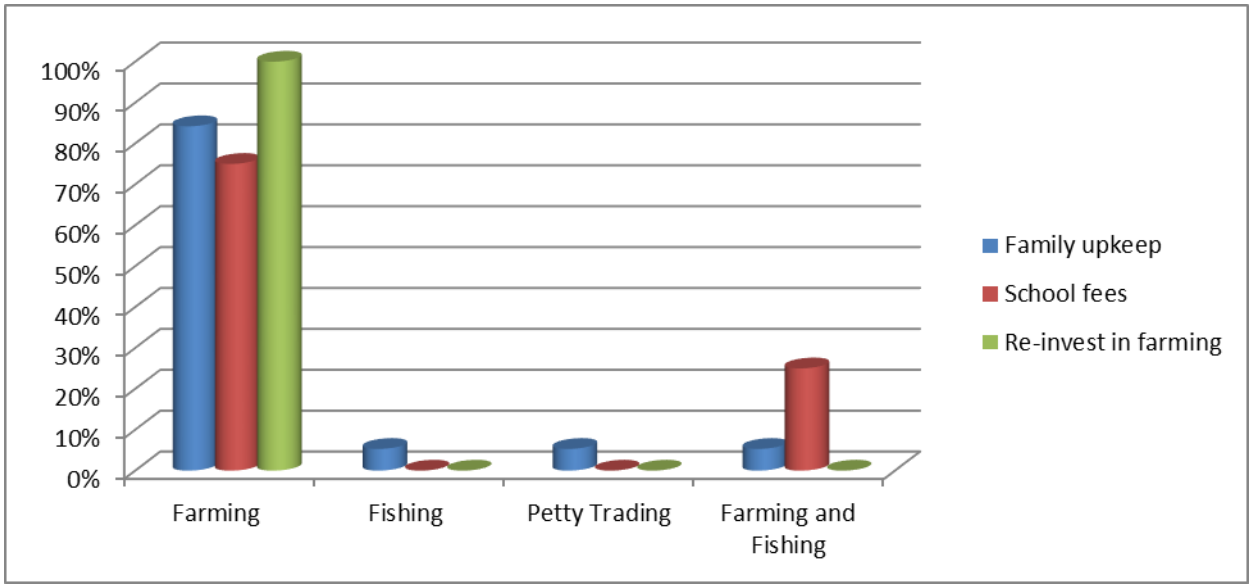

Figure 7. Relationship between income expenditure items and farmer groups (Total N = 55)

Figure 8 shows the relationship between income outlays and household size. Larger household size (16 plus) has four expenditure items as against five expenditure items of the other household groups (1-5, 6-10 and 11-15).

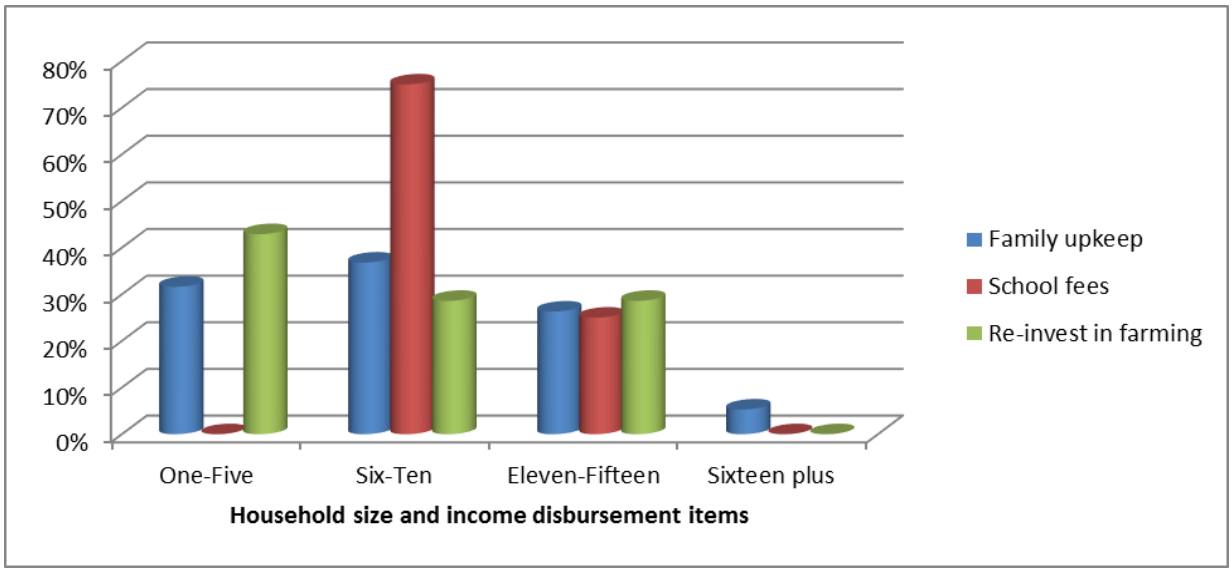

Figure 8. Relationship between expenditure items and household size

Figure 9 shows farmers' perspective on food security with respect to availability of food to the farming family. The inability to feed the family from farming activity represents vulnerability, while, "food secure" indicates food adequacy in quantity and quality.

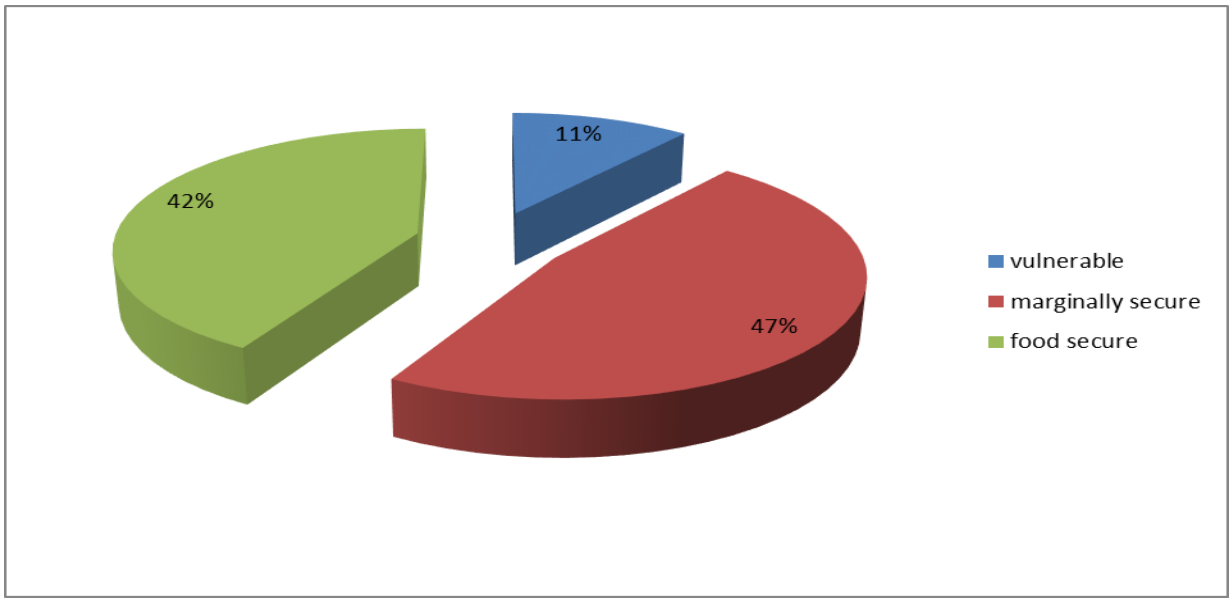

Figure 9. Farmers' viewpoint on family food security

Figure 10 shows family food security and household size. The smaller household size (1-5 persons per household) rather indicated food security vulnerability (inability to feed the family from farming activity). The six-ten persons per household was dominated by marginal food security vulnerability while those with eleven-fifteen and sixteen persons plus were found to be food secure. The smaller households have limited access to family labour, hence, labour-to-output relationship will show limited output as compared to large households (16 plus). Besides, the expenditure items of the smaller households were more than those of the large households.

Figure 11 shows the linkages between food security at the family level and gender. Food security vulnerability is dominant among male respondents while marginal vulnerability of food security prevails among female respondents. A possible explanation is the tendency of the male farmers to grow crops mainly for sale.

Two variables: gender and "food secure", were subjected to chi-square test analysis. The null hypothesis used is Ho: there is no statistically significant association between the two variables and the research hypothesis Ha: there is a statistically significant association between the two variables on the condition that if the p-value is less than 0.05, then the test statistic is statistically significant.

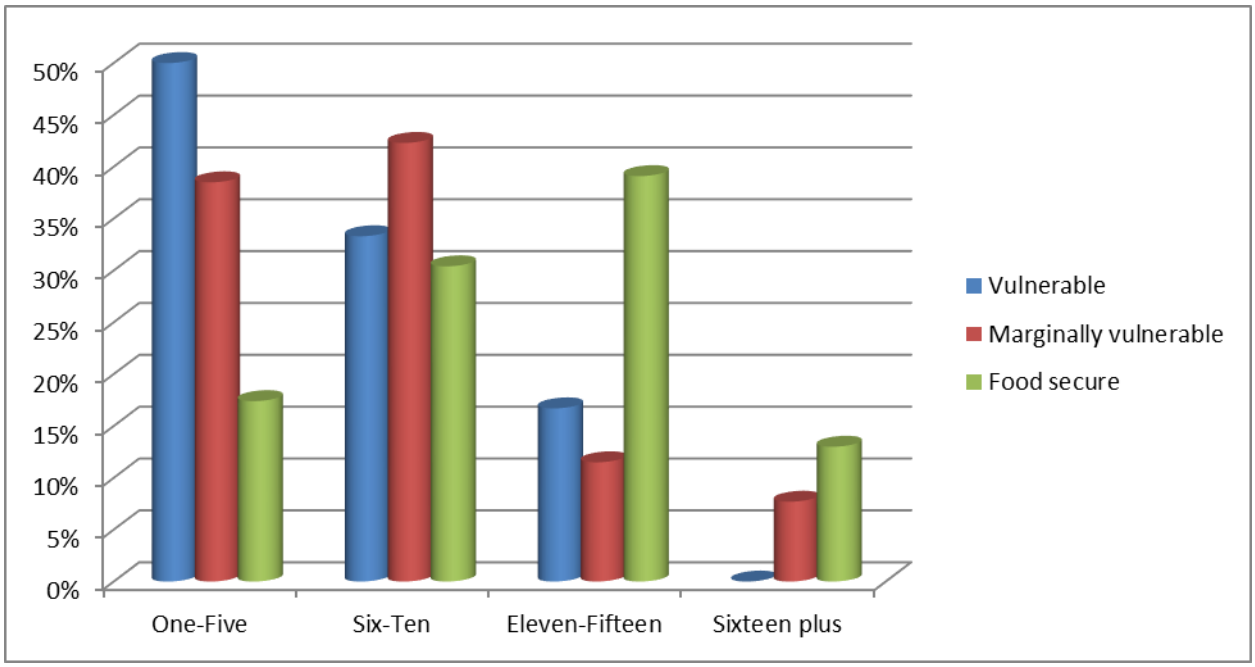

Figure 10. Relationship between family food security and household size

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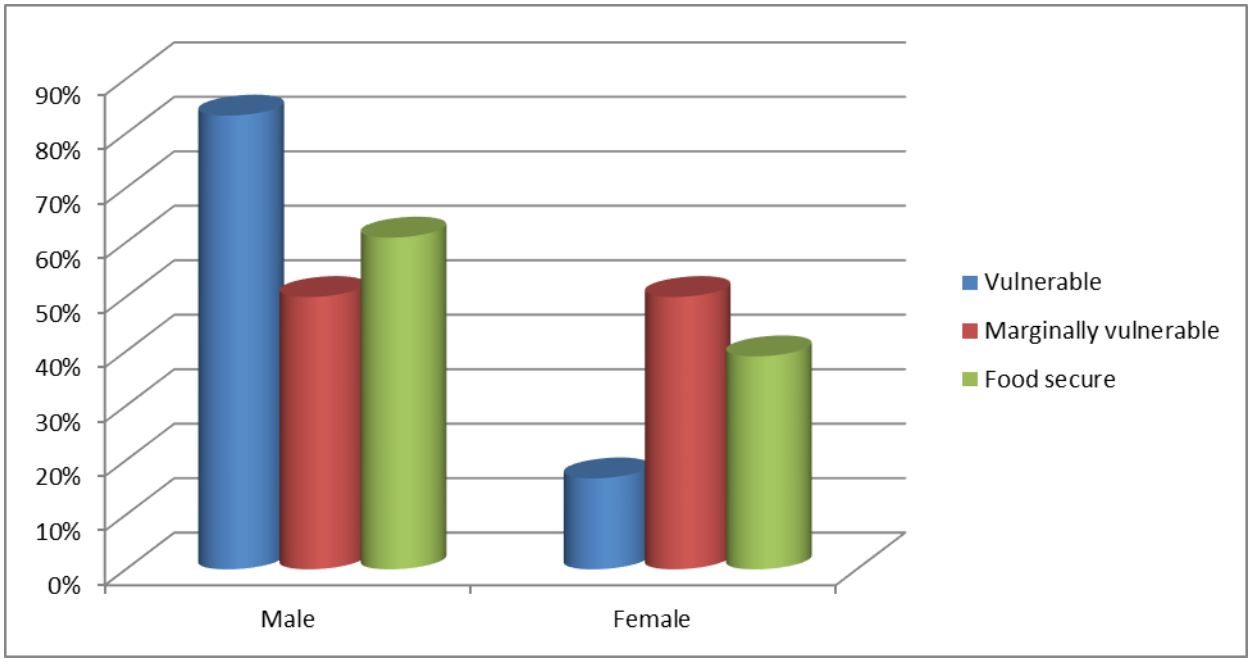

Figure 11. Relationship between family food security and gender

The association between gender and farmers' worry about getting enough food from the irrigation project reveals a p-value of 0.139 which is greater than an alpha level of significance of 0.05, hence, there is no statistical relationship between the two variables, that is, the available data does not support the relationship between gender and farmers' worries over the irrigation project's ability to provide enough food.

The number of hunger episodes experienced by farmers of the irrigation project in relation to gender shows a p-value of 0.172 > 0.05, hence, gender and the number of hunger occasions are not related statistically.

The association between gender and preferred food provided by the irrigation project reveals a p-value of 0.163 > 0.05, hence, the two variables (gender and the preferred food) are not statistically associated.

The linkages between gender and whether farmers' families eat less food as result of low productivity from the irrigation project shows a p-value of 0.927, much greater than 0.05, hence, there is no statistical association between gender and farmers' family eating rate.

The study further displays no statistical association between gender and the absence of food shortages with a p-value of 0.163 > 0.05. There is not enough evidence against the null hypothesis to ensure its rejection.

The motivation for farmers' investment in irrigation farming at Sankana was their desire to supplement their income (45 respondents, representing 81.8%), to supplement food (9 respondents, constituting 16.4%) and to generate physical activity – hobby (1 respondent making 1.8%).

The farmers are confronted with a number of challenges. For about 31 respondents (56.4%) the biggest challenge is canal malfunction leading to inability of the water to arrive at the farmlands. Nematode infestation was reported by 12 respondents (21.8%), declining soil fertility by 5 respondents (9.1%), decreasing fish population in the dam by 3 respondents (5.5%) and other challenges such as difficult transportation to Wa market, lack of storage facility, and unavailability of effective demand in the community by 4 respondents (7.3%).

Also, the farmers suggested some solutions to the challenges. About 31 farmers (56.4%) requested regular maintenance and repair of malfunction canal. With regards to nematodes, treatment with agrochemicals with the support of agricultural extension service was suggested by 9 farmers (16.4%), stocking the dam with more fish through fish farming was proposed by 8 farmers (14.5%), government support in terms of subsidies on chemical fertilizers was demanded by 2 farmers (3.6%) and other solutions such as provision of storage facilities and improvement in prices were suggested by 4 farmers (7.3%).

Discussion

In summary, the farmers grow several crops using the water from the reticulation irrigation system; by doing so, the problems created by rain-fed farming under extremely challenging conditions are overridden (Blench, 2006). The majority of the farmers (78%) grow okro/okra (*Abelmoschus esculentus*), 71% cultivate tomatoes (*Solanum lycopersicum, Lycopersicon esculentum*) and 51% produce maize (*Zea mays*) because the three crops are major food staples of the people and hence a ready market is provided, mainly by the urbanized regional capital, Wa, which is about 26.4 km away from the production centre (Sankana), about 32 minutes' drive on the Wa – Lawra road. In Ghana, okra is the fourth most widely used vegetable (Amartey, 2013). It is therefore not surprising that okra is the most extensively grown crop at Sankana irrigation area. Demand for tomato exceeds supply; as such, Ghana imports tomato at least six months of the year (Amartey, 2013), implying a ready market for this crop. Generally, maize produced in the Upper West Region for sale enjoys urbanized markets in south-central Ghana (Blench, 2006). In the Upper West Region, smallholder maize farmers sell about 24% of output and keep the remainder as food for the farming family (Musah et al., 2014).

The farming system is based on small land holdings of less than half an acre, where half acre equals 0.202342821 hectares (1 acre = 0.404686 hectare). Other studies found small land

holdings to be two hectares or less (Musah et al., 2014, Wood, 2013). Smallholder farming is characterized by low usage of external inputs, particularly chemical fertilizers (Buah et al., 2010) and practices bush fallow or continuous cropping under polyculture (mixed cropping or intercropping) and monoculture (single crop) (Wood, 2013).

Income generation, which is the main focus of the farmers, is generally low; the majority of the farmers (58%) earn between GH¢150.00 and 300.00 during a cropping season (that is, US$39.3185 – 78.6370, at the 10th April, 2015 exchange rate of 1 USD = 3.81500 GH¢, xe.com). According to Senadza (2011), on-farm income constitutes the largest portion (59%) of total farmer income. In essence, farmers needed a top up income from non-farm activities. Whenever on-farm income is the only source of family income, the resultant income inadequacy may lead to poverty. In the Upper West Region, average household annual income is estimated at US$65.00 (Kuwornu et al., 2014). Hence, farmers earning US$39.3185 – US$65.00 fall within the poverty headcount. Only farmers earning between US$65.00 and US$78.6370 fall outside the poverty line. The income deprived farmers spend their earnings on the most pressing needs of the family, which include family upkeep, re-investment in farm activities and school fees of farmers' wards.

Income levels were found to be statistically associated with size of land holdings, household size and housing types. In terms of household numbers, larger households made significantly larger incomes as a result of availability of free household labour to till the land. The findings are in line with the local Ghanaian desire for larger families to carry out farm work. Also, farm incomes were statistically related to housing type. Brick houses (made from mud bricks without cement and roofed with corrugated zinc sheets) were occupied by households which earned medium incomes, which are higher than incomes of households living in mud houses. Households with the best type of housing (block houses) do not take irrigation farming very seriously. Such households undertake irrigation farming as a hobby. The findings add to those of van Averbeke et al. (2011:806) that small holder irrigation schemes have contributed positively to rural livelihoods and poverty alleviation in South Africa.

Besides crop farming, the dam with a water surface area of 30 hectares provides an opportunity for fishing. About 35% (19 farmers) do fishing as well as hold oversight responsibility over the pond. There is a contractual agreement between the fisher folk and the regional directorate of the Ministry of Fisheries and Aquaculture Development. Responsibilities of the Directorate include maintenance of fish hatchery and supply of fingerlings to fish farmers and other state owned ponds by the Ministry, while the fishermen do fishing and provide protection for the pond. Income from fishing is irregular and not substantial. The combination of crop farming and fishing is intended to increase farming income and spread economic risk (Baba et al., 2013); however, the dual advantage is not reaped by 65% engaged in only crop farming.

Food availability throughout the year to meet farming family requirement is crucial. Under vulnerable situations, as expressed by 11% of respondents, there are worries about obtaining enough food and/or preferred food, as well as concerns about the family eating less food in a day. Marginally secure farmers are able to supplement food from the market or through social networks while food secure families rely on farm produce and farm income without difficulties. The study revealed that fewer than 50% of farmers using the Sankana irrigation scheme are food secure.

The results from the chi-square analysis on gender and food security revealed that there is not enough evidence against rejection of the null hypothesis (there is no statistically significant relationship between the two variables). Hence, the null hypothesis is maintained as available data does not support its rejection. Gender categories (male and female) were cross-tabulated with food security indicators of farmers' worry about getting enough food from the irrigation project; how often hunger was experienced by farming families; whether families are fed by preferred food stuffs produced by the irrigation farming; whether families eat less food in a day; and whether families have experienced no food shortage at all. At the alpha level of significance of 0.05 (95% confidence level of acceptance), all five indicators of food security tend to produce p values higher than the alpha value, resulting in the failure to reject the null hypothesis.

The study reveals several benefits. The farmers enjoy the variety of food produced by the crops, about 20 different crops in all. The income accruing from irrigation farming is spent on family upkeep, children's education and re-investment in the farm. In addition, some farmers are occupied throughout the year with farm work involving physical activity. Above all, water is available for farming and other domestic uses throughout the year. The findings on the benefits of the local irrigation scheme agree with those of Chazovachii (2012:229).

The farmers are challenged seriously by the breakage of the aqueduct and canals, nematode infestation, dwindling fish population in the dam and other problems such as transportation, lack of storage facilities and low market prices of farm produce. Due to low returns from the irrigation farming activity, re-investment of farm income involves low payments made to labour for land preparation and minimal reliance on improved seeds due to cost involved. Therefore, no farm income is reserved for repairs or maintenance of aqueducts or canals. Farmers expect the government to do repairs and maintenance of the reticulation system, probably due to the huge cost involved and because the government is the owner. Farmers are not treating nematodes with agrochemicals. Also, they are not using the services of available agricultural extension staff. Supply of agricultural extension personnel to the districts is more or less a national problem as some districts lack the services altogether. There is indeed little use of agrochemicals. Patronage of agrochemicals is expected to increase productivity and improve quality of the farm produce. Again, the farmers expect the government, through the Ministry of Fisheries and Aquaculture, to re-stock the dam with a variety of fish species. The farmers seem to think the dam will naturally increase fish population, as fish farming practices, particularly feeding the fish in the dam, are not carried out by either the farmers or the

Ministry in charge. Farm produce would have to be carted to the market in Wa. Transportation and storage facility problems imply that farmers are forced to release the goods at the prevailing market price, whether favourable or not. The study findings on reticulation irrigation challenges coincide with a case study in Zimbabwe (Nhundu and Mushunje, 2010). Other findings on challenges faced by irrigation users of Tono in Ghana include 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 (Dinye and Ayitio, 2013:119).

Conclusion

Considering the size of the irrigation dam (30 ha), the availability of land surrounding the project and the number of farmers involved in the scheme (73 smallholder farmers), the study concludes that the reticulation irrigation scheme at Sankana is underutilized. One of the unfulfilled benefits of the irrigation project is the creation of paid jobs, particularly for the youth who could not afford to own irrigable plots. Other benefits such as increased crop production, remunerative prices and maximum net returns as well as abundant and secure food supply are not realized due to underutilization of the irrigation project. Hence, balanced nutrition for the community members from the irrigation farm produce, if achieved at all, could not be widespread because of the low patronage of the project. Also, if there is any impact on rural poverty reduction it could not be enjoyed by many beneficiaries considering that only 73 farmers (out of whom 55 were readily available for interview) use the irrigation project. Moreover, less than 50% of the farmers utilizing the irrigation project are food secure and only 35% of participating farmers are involved in fishing; that is, benefitting from the dual objective of the project. Ninety-eight percent of the farmers attest to moderate improvement in family income accruing from the use of the irrigation water for farming. Although the reticulation irrigation scheme at Sankana is generally beneficial to the participating farmers, only a progressive increase in the number of participating farmers would justify the huge cost of construction. We also conclude that for the usage, productivity and farmers' income to increase at the reticulation irrigation scheme at Sankana, the financial returns from the irrigation would have to guarantee high quality crops, as suggested by Knox et al. (2012).

Furthermore, irrigation projects established in the 1960s used a top down implementation approach as the newly independent state (Ghana) took a paternalistic position and established projects for the people. Hence, current participatory development and beneficiary ownership embodied in a bottom up approach were missing in the 50 year old irrigation projects. Although existing farmers' associations try to make up for participatory development, public or state ownership is still what pertains, and this situation is partly responsible for issues of underutilization, lack of maintenance and unsustainable practices.

However, it is not appropriate to compare the old irrigation schemes, which operate under government ministries, with or without the support of NGOs, to donor funded irrigations such as Tono and Vea in the Upper East Region. Such comparisons would discourage the maintenance instead of bringing good/best practices to bear on the old irrigation schemes.

Recommendations

The Ministry of Fisheries and Aquaculture Development should pursue alternative uses of the pond, such as creating a recreational facility for holiday makers, while finding ways to provide incentives that will make the use of the irrigation project for crop and fish farming more attractive to the indigenous people and thereby increase the number of beneficiaries. Because land tenure insecurity reduces long-term investments, such as irrigation technologies (Shah et al., 2002), we recommend a further study to investigate land tenure arrangements and other possible factors responsible for the low patronage of the scheme. In the light of the findings from this study, it is recommended that extension programs that provide relevant information about the reticulation scheme be effectively disseminated to farmers to encourage and increase their use of this irrigation scheme.

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