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Nexus Between Smallholder Irrigation Farming and Farmers' Livelihood Outcomes in Ghana's Guinea Savannah

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ABSTRACT

The aim of the study was to relate small-scale irrigation farming and farmers' livelihood outcomes using the poorest District in the Upper West Region of Ghana. The livelihood implications of rural farmers remain inconclusive across the literature. Mixed methods and primary data consisting of key informant interviews, household questionnaires and personal observation were used for the study. Data were obtained from 120 farmers drawn from 173 farming households living in four (4) small-scale irrigation dams' communities. The results revealed a significant source of supplementary income and household food is provided by smallholder irrigation farming. The results further revealed that farmers employ a plethora of technologies including the use of mulch to stem soil moisture loss, livestock manure and chemical fertilizers to remedy soil productivity decline as well as hand-dug wells to supplement the reduction in irrigation water. However, the results revealed that irrigable land is not accessible to non-land owning ethnic groups. Access to irrigable land should be the number one consideration in siting irrigation facilities in Ghana.

INTRODUCTION

Global demand for food, fibre and feed is growing with about 700 million extremely poor people mainly living in rural areas, 800 million people are faced with chronic hunger and 2 billion people suffer from micronutrient deficiencies (FAO, 2017). A new trend in the increasing food demand is the preference for milk, meat, fruits and vegetables which have much higher water footprints making agriculture both a cause and a victim of water scarcity (FAO, 2019). In addition to water scarcity for agriculture, the sector faces stiff competition over water use from industry and domestic water users (Pereira, 2005; Namara *et al.*, 2010). People living in water and food scarce areas are to seek amelioration through the application of irrigation. Water scarcity is solved through water-use efficiency methods and improvement in regional water productivity; whilst, food security targets crop physiological responses in irrigation systems (Kang *et al.*, 2017). Water-use efficiency is responsible for the quantity and quality of crop yield in irrigation farming (Yang *et al.*, 2017). Therefore, water-saving methods and optimal irrigation schedules are suggested as solutions to influence food security (Liu *et al.*, 2017). In the presence of consequential global climate change and the associated local climate change and impacts, drought pressure is high with differential impacts on

crops and agricultural systems. In response to climate change adaptation, highly efficient cultivation methods are anticipated (Hai-dong *et al.,* 2017). However, elsewhere in Africa's dryland areas, the emphasis is on rainwater harvesting and accumulation for irrigation with no or limited recourse to water-use efficiency and crop physiology. It is within this context that the current paper discusses drylands' people, mainly, smallholder farmers "the magicians" and the transformations in their agricultural livelihood outcomes through the use of irrigation.

About 60% of Africans earn their livelihood from agriculture (Kidane *et al.,* 2014). The agricultural sector is the source of income generation and labour employment for many Africans and the lack of skills of the African poor people makes agriculture the main avenue for livelihood and survival (Rehman *et al.*, 2016). On Sustainable Development Goal 1 (SDG 1), the United Nations (UN) Secretary General has called for greater efforts to boost incomes, alleviate poverty and build resilience for those living in poverty, especially in Asia and Sub-Saharan Africa where many people are faced with a plethora of challenges including hunger, food insecurity and malnutrition (Agula *et al.,* 2016). The situation is aggravated by lack of access to credit, extension services and the inability of smallholder farmers to afford these services (Appiah-Nkansah, 2009; Benin *et al.,* 2012; Dittoh *et al*., 2013; Akudugu *et al.,* 2016; Agula *et al.,* 2016; Mumin, 2017; Peprah and N-yelkabong, 2017; Apuri *et al.,* 2018; World Bank, 2018).

There are direct and indirect relationships between irrigation agriculture and rural livelihoods. In Ethiopia, small-scale irrigation has increased agriculture output, household income, jobs and empowering community members to participate in decision-making (Mengistie and Kidane, 2016). In the same country, access to small-scale irrigation has led to an increase in the mean household income of irrigator households whilst non-irrigation users recorded a lower mean household income (Ayele *et al.,* 2013). The study further argued that households with access to irrigation have a lower probability of being poor than non-irrigating households. Also, households using any type of irrigation recorded a significant increase in mean total gross household income than non-irrigating households. In Tanzania, 70% of respondents who have access to irrigation schemes have subsequently reduced indebtedness previously caused by poverty (Chiwaya, 2013). Elsewhere in South Africa, the role of irrigation development has been acknowledged as a tool for reducing poverty and increasing economic growth. This has led to the government investing massively in the irrigation sector (Phakathi, 2016). Hence, governments across Africa are relentlessly investing in water harvesting strategies to make water available for irrigation (Mnyenyelwa, 2008; Akudugu *et al.,* 2016).

In Ghana, about 1.8% of renewable water resources are withdrawn and about 66.4% of it is used for irrigation with the remainder for domestic and industrial uses. Although irrigation in the country is on record to have started about 1880, it is dominated by groundwater irrigation systems, river or stream irrigation and small reservoir systems which use various lifting and pumping technologies, managed by Ghana Irrigation Development Authority; which has made very limited contribution to the agricultural sector (Namara *et al.*, 2010). In specific terms, only 11% of all paddy rice is irrigated and irrigated vegetables are about 50% (Mendes *et al.,* 2014). The northern part of Ghana receives the lowest rainfall with a single maximum produced by southwest monsoon winds (Acheampong *et al.,* 2014). After that, the area comes under the northeast trade winds with its attendant dry, dusty and hazy conditions. Humidity reduces to about 8%; whilst, daytime temperature rises to 40^{o}C and falls to about 21^{o}C at night. Evapotranspiration is high with water percolating downwards to develop underground water (Peprah, 2018a). In the absence of water for irrigation, a majority of the populace (mainly farmers) are redundant during the dry season. Hence, the Government of Ghana's irrigation policy is to increase the number of small ponds for irrigation in northern Ghana for the dry season farming (Kpieta *et al.,* 2013; Acheampong *et al.,* 2014). Already, about 138 of such water-holding facilities exist in the Upper West Region (Namara *et al.,* 2011). However, it is argued by others that such facilities were to make water available in the dry season for village dwellers and not necessarily for irrigation purposes (Kpieta *et al.,* 2013). In the specific

instance of a reticulation irrigation facility (Sankana Irrigation Dam), it is underutilized by its beneficiaries (Peprah *et al.*, 2015). This raises concerns as to whether smallholder farmers in rural communities are reaping the benefits of small-scale irrigation dams. The area under study, Wa West District, has the Yeleyiri, Baleofili and Siiru dams which are drained by the Black Volta River (Kpieta *et al.,* 2013). Despite these opportunities for irrigation farming, the District is the poorest among 11 districts which constitute the Upper West Region of Ghana (Ghana Statistical Service, 2014b).

At the international level, this study will contribute empirical literature on the relationship between small-scale irrigation and smallholder farmers' livelihood outcomes and at the national level as well as provide useful insights to guide the implementation of the revised irrigation policy of providing one irrigation dam per village.

MATERIALS AND METHODS

Description of the Study Area

The study was conducted in the Wa West District of the Upper West Region, Ghana. The Wa West District was established by the legislative instrument (LI 1751) in 2004 with Wechiau as the District Capital in the Upper West Region of Ghana. It lies between latitudes 9º 40' N and 10º 10' N and also between longitudes 2º 20' W and 2º 50' W (Figure 1). Relative location of the District indicates its southern borders with Sawla-Tuna-Kaliba District (Savannah Northern); north borders with Nadowli Kaleo District, east borders with Wa Municipal and Burkina Faso in the west. The District covers a land size of approximately 1492 square km and is about 15km away from Wa Municipal (Ghana Statistical Service, 2014a). The vegetation is the wooded savannah grassland with major trees such as shea, dawadawa, kapok and baobab with little or no canopy. Shrubs of varying heights and luxuriance and grass cover during the rainy season. The grasses turn brown and wither while the trees shed their leaves during the dry season. Smallholder farmers combine crop and animal production, mainly, maize, millet, cowpea and groundnut with guinea fowls, cock and hen, ducks, turkey, sheep, goats and pigs. Fishing in the Black Volta River offers supplementary livelihood to farming. Women engaged in pito brewing, shea nuts processing into butter and shea nuts collection, drying and de-husking for sale. The District hosts Wichiau Community Hippopotamus Sanctuary and gallery forest for ecotourism (Peprah, 2018b). Despite these opportunities, the Wa West District remains the leading poverty endemic district in the Upper West Region.

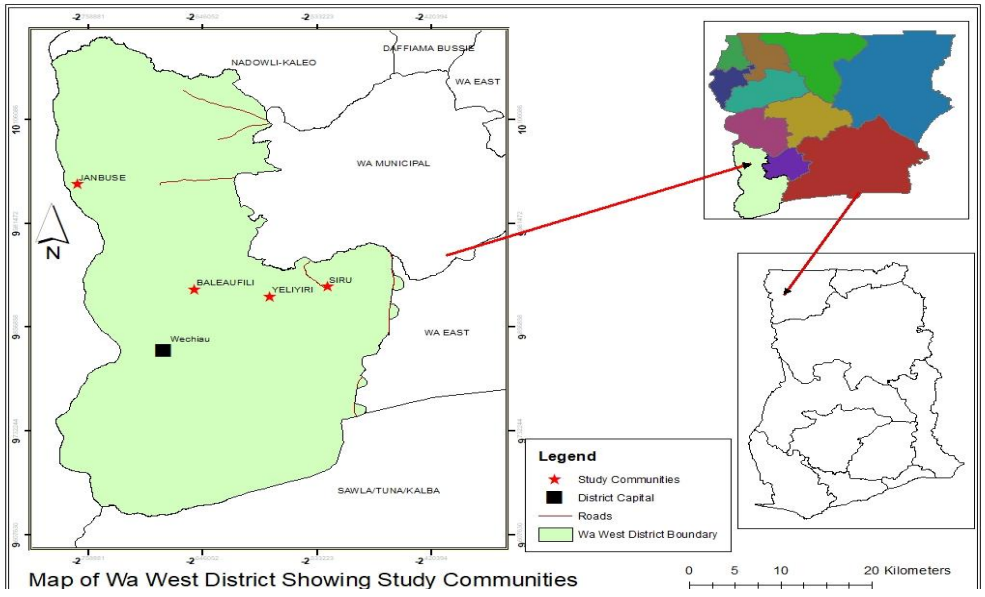

Figure 1: Map of Wa West District and Study Communities

Source: Adopted and modified from Ghana Statistical Service, 2014a

Research Design

A cross-sectional survey design was adopted because it allows for the combination of both qualitative and quantitative approaches (Neuman, 2014). The study used a mixed methods research approach by employing qualitative and quantitative techniques in the analyses and presentation of data. The need to understand how local communities embrace irrigation agriculture and consequential implications on their livelihoods informed the adoption of a mixed methods approach in this study. This gives room for a deeper understanding of local communities' perspectives on the contributions of the existing small-scale dams to enhancing irrigation agriculture for the betterment of their livelihoods. Thus, both quantitative and qualitative variables were obtained from the study participants which assisted in presenting a clearer picture of the position of irrigation agriculture in the study area. The mixed methods approach minimizes biases that could have occurred by adopting a one-sided approach because methodological complementarity is strongly harnessed (Creswell, 2014).

Data Collection Methods and Tools

The study used primary data collected from the field using household questionnaire, key informant interviews and personal observation. The household questionnaire contains both closed and open-ended questions focused on respondents' socio-demographic characteristics, their participation in subsistence agriculture and irrigation farming, major crops cultivated and income accrued from both streams of livelihood trajectories. Besides, the challenges small-scale irrigation farmers faced and strategies employed in addressing some of these challenges were sought. In all, 120 smallholder questionnaires were distributed to household heads in the 4 selected small-scale irrigation farming communities and duly retrieved with the aid of two data collection assistants. The decision to employ data collection assistants in administering the questionnaire was based on the factor that a majority of the study respondents had not had formal educations. As such, the data collection assistants took time to explain and get their understanding of each question before addressing it in the questionnaire. Furthermore, key informant interviews were conducted on known irrigators in the study communities. That is, the household questionnaires were supported with key informant interviews to gather in-depth responses from respondents engaged in irrigation farming. Two (2) known irrigation farmers were interviewed from each of the four communities, totalling 8 key informant interviewees for the entire study area. This enables the researcher to obtain the insider perspective of respondents on the contributions and tribulations of small-scale irrigation agriculture to their livelihood trajectories. Irrigation farms were also visited by the researcher to observe the nature and methods employed in farming.

Sampling of Study Participants

The sampling procedures used in selecting respondents for the survey were purposive and simple random sampling. Three small-scale dams' communities (Yeleyiri, Baleofili and Siiru) and one community (Jambusi) which depends on the Black Volta for irrigation farming were selected purposely for the survey. A simple random sampling procedure was used to select 120 household heads for investigation. The sample frame consists of 173 smallholder farmers who were selected from households in the selected communities. The 173 represents the total number of households found in the study communities as reported by the Ghana Statistical Service (2014a). The procedure for selecting the sample size of 120 household heads out of the sampling frame of 173 households follows a mathematical approach in Equation 1 as given by Yamane (1967):

$$\mathbf{n=\frac{N}{1+N(e)^2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Where: n = sample size; N= sample frame and e = error or significance level.
In this study, N = 173 and e = 5% = 0.05.

Therefore, $n = \frac{173}{1+173(0.05)^2} = 120$ household heads

Therefore, the required sample size for the study was 120 household heads. Furthermore, the sample size of 120 household heads was proportionally shared among the study communities (Table 1). The selection of the appropriate household was done by attaching codes (numbers) to the houses at the study communities and random numbers were, therefore, generated in excel to aid in attaining a simple random sample of the households for the study. Conversely, in the event of the existence of multiple households within a housing unit, the lottery method of randomization was used to select the desired household head. The household head is the major decision making agent of the household and has the greatest advantage of influencing other household members' choice of agriculture engagements including small-scale irrigation farming. This significantly influenced the researchers' decision to solicit information from them.

Table 1: Sample Distribution of Respondents

Name of Community	Household Number	Proportional Distribution of Sample Size
Yeleyiri	33	$\frac{33}{173}$x120 = 23
Baleofili	45	$\frac{45}{173}$x120 = 31
Siiru	39	$\frac{39}{173}$x120 = 27
Jambusi	56	$\frac{56}{173}$x120 = 39
Total	**173**	**120**

Source: Field Survey (2018)

Method of Data Analysis

Data were coded and entered into a spreadsheet (Statistical Package for Social Scientist version 20). All necessary cleaning and transformation were done before tables and figures were generated for the analysis. Background characteristics of respondents, contribution of irrigation agriculture to livelihoods and challenges faced by irrigators were analysed and presented using bar charts and frequency distribution tables. The descriptive statistics were supported by qualitative analysis. Qualitative data (responses) were classified into themes and presented as direct and indirect quotations to supplement quantitative data.

RESULTS AND DISCUSSION

By sex, a majority (80%) of the households was headed by males. In female headed households, women produced food crops to feed the family and sold surplus or part for very necessary family income needs. Male producers grow food crops mainly for sale to generate income to take care of basic family welfare needs (provision of housing, education and health). In such instances, the best farm produce that could fetch high prices is sold while the bad ones are left at home for food. About 72% of the respondents were involved in farming while masonry (3.3%) constitutes the least job stream in the study area. Also, the minimum age of the household heads sampled was 22 years with a mean age of 41.3 (Table 2). Conversely, the average number of persons per household was 8. Large family size has the potential to guarantee constant labour supply and thus increase farm productivity. Previous studies on smallholder farmer households showed skewed male respondents (Apam, 2012; Peprah *et al.,* 2015). However, elsewhere in northern Ghana, in Busa for example, female respondents dominated in an irrigation study (Mumin, 2017). Some studies such as Appiah-Nkansah (2009) and Kpieta *et al*. (2013) pointed out the availability of cheap labour for agriculture in northern Ghana but cited unpredictable rainfall patterns and lack of financial and technical support as drawbacks that prevent the youth (active labour force) from fully participating in farming.

Table 2: Socio-demographics of Respondents

Sex	Frequency	Percent (%)
Male	96	80.0
Female	24	20.0
Total	**120**	**100.0**

Occupation	Frequency	Percent (%)
Carpentry	11	9.2
Teaching	8	6.7
Farming	86	71.6
Masonry	4	3.3
Driving	11	9.2
Total	**120**	**100.0**

Descriptive Statistics	N	Minimum	Maximum	Mean	Std. Deviation
Age of Respondents	120	22	58	41.27	9.100
Household Size	120	1	21	7.88	3.651
Number of Students	120	1	9	3.18	1.650

Source: Field Survey (2018)

Furthermore, the educational status of respondents (Figure 2) indicates that 38.3% of the respondents had no formal education and 10% are tertiary education certificate holders. The educational status of the respondents may have several implications on respondents' outlook and level of embracing irrigation agriculture. Mengistie and Kidane (2016) found that formal education plays a significant role in household decision making. Educated household heads are placed in a better position to critically evaluate the benefits of irrigation technology (Ziba, 2015). However, higher educational attainment may also offer a platform for these rural folks to access jobs in the formal sector and this may attract them away from engaging in agriculture and its related sectors such as irrigation farming. In such a scenario, the contribution of these educated persons to agricultural productivity may be inadequate.

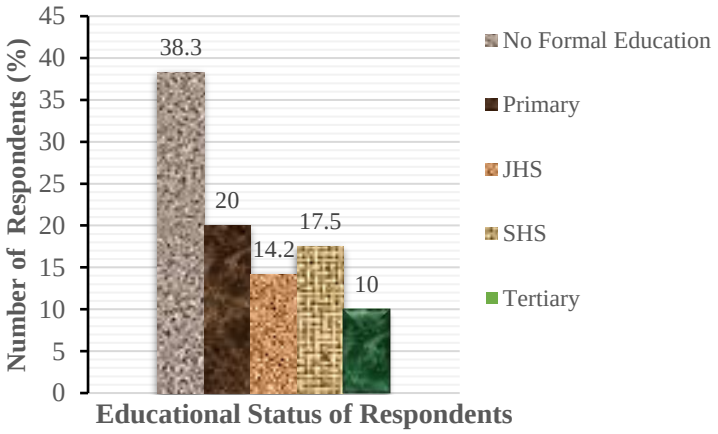

Figure 2: Educational Status of Respondents
Source: Field Survey (2018)

In Figure 3, a majority (99.9 %) of smallholder farmers cultivates maize, while a small proportion (2.5%) of them cultivate millet. They are mainly food crop producers, particularly, cereals and legumes. Similar crops have been found to have been cultivated by smallholder farmers across sub-Saharan Africa (Azam-Ali, 2007, Peprah *et al.*, 2015). Besides, roots and tubers have been cultivated in the study communities as a majority (80.8%) of the respondents grows for it to become yam. Considering the number of crops involved thus cereals, legumes and roots and tubers, the support from irrigation farming can

potentially lead to meeting the SDG 1 (Target 1.1 – by 2030, eradicate extreme poverty for all people everywhere, currently measured as people living on less than $1.25 a day) and SDG 2 (Target 1 – by 2030, end hunger and ensure assess by all people, in particular the poor and people in vulnerable situations, including infants, to safe, nutritious and sufficient food all year round) at the District level. However, the farming system practiced by the respondents is mainly the mixed cropping type. Increased food productivity of smallholder farmers may guarantee the attainment of food security in third world countries (Mozumdar, 2012).

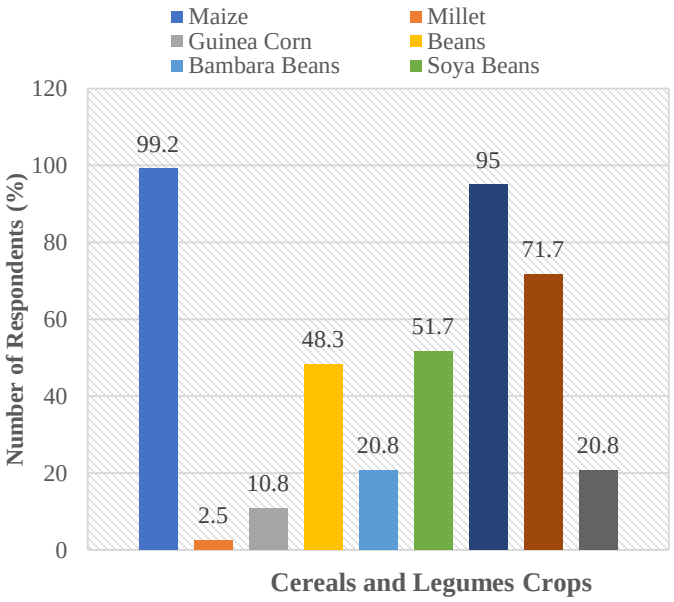

Figure 3: Major Food Crops Cultivated by Smallholder Farmers
Source: Field Survey (2018)

Also, 55% of the respon**Error! Hyperlink reference not valid.**dents engaged in irrigation farming. Participation in irrigation agriculture appears to be beneficial (Table 3). Increased participation in irrigation farming holds several prospects as it provides additional household income, food supply, female economic empowerment and poverty reduction strategy (Peprah *et al.*, 2015; Mengistie and Kidane, 2016; Akudugu *et al.*, 2016; Agula *et al.*, 2016; Mumin, 2017). On the contribution of subsistence farming to household income (Table 3), the mean annual income of respondents stood at GH₵ 2323.3333, (approximately $464.66666) while a farmer could make a maximum of GH₵ 4000.00 ($800.00) or a minimum of 500.00 ($100.00) annually (at $ 1= GH₵ 5 as at January 2019). However, the small farm holdings may limit the incomes these farmers realize. On the other hand, through irrigation farming, respondents can accumulate a mean annual income of GH₵1090.9091 (approximately $218.1818.2); with a minimum income of GH₵600.00; a maximum income of GH₵2000.00 ($1= GH₵5 as at January 2019). This suggests that irrigation agriculture has contributed significantly to household income and the general standard of living in small-scale dams' communities. Thus, smallholder irrigation farming is a supplementary income stream to small-scale dam communities. This has positively affected the livelihood outcomes of the dwellers (e.g. poverty reduced as income increased). That is, irrigator households are provided with the opportunity of adding more income to their household income. These findings strongly concur with various scholarly findings on the contributions of irrigation agriculture across local communities (Ayele *et al*., 2013; Kpieta *et al*., 2013; Acheampong *et al.*, 2014; Kidane *et al.*, 2014; Peprah *et al.*, 2015; Mengistie and Kidane, 2016; Akudugu *et al.*, 2016; Agula *et al.*, 2016; Mumin, 2017). Thus, to boost incomes among smallholder farmers, there is a need for them to repeat cropping during the dry season. Additionally, irrigation agriculture engages the smallholder farmers all times. Thus, the number of working days for irrigators are bound to increase and subsequently increase output. This can be achieved by identifying major pathways through which irrigation agriculture can be made accessible to all smallholder households.

Table 3: Income Streams of Respondents

Participation in Irrigation Farming			Frequency		Percent (%)
Yes			66		55
No			54		45
Total			**120**		**100.0**
Descriptive Statistics	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
Income (farming)	120	500.00	4000.00	2323.3333	819.50829
Income (irrigation)	66	600.00	2000.00	1090.9091	283.78067

Source: Field Survey (2018)

Table 4 shows that farmers cultivate maize (13.3%) and a few farm rice (2.5%) under irrigation. Also, the major vegetable crops include okro/okra, aleefy, pumpkin, ayoyo, pepper and tomatoes. The majority of farmers (80.8%) cultivates okro/okra and the least percentage (4.2%) undertakes onion farming. In terms of exotic vegetables such as lettuce, cabbage, carrot, green beans and green pepper; some 54.2% cultivate lettuce and 2.5% grow green beans. The major cultivated crops are okro/okra and pepper which are similar to the major crops grown by irrigation farmers at the Sankana irrigation area in the Nadowli District (Peprah *et al.*, 2015, Naaderi and Dinye, 2017).

Table 4: Major Crops Cultivated Under Irrigation

Cereals	Frequency	Percent
Maize	15	13.3
Rice	3	2.5
Vegetables (Local)		
Okro/Okra	65	54.2
Tomato	52	43.3
Onion	5	4.2
Pepper	60	50.0
Ayoyo	43	35.8
Pumpkin	53	44.2
Aleefy	51	42..5
Vegetables (Exotic)		
Cabbage	60	50.0
Lettuce	65	54.2
Green Pepper	5	4.2
Green bean	3	2.5
Carrot	5	4.2

Source: Field Survey (2018)

The decision to grow exotic vegetables is influenced by demand in the local market place (Mumin, 2017). A key informant intimated:

"My good friend, it is not easy cultivating these exotic crops, our concentration is on traditional crops. In the case of cabbage cultivation, we purchase seeds and seedlings from dealers in Wa, the Upper West Regional capital. Cabbage seeds are not openly propagated like our traditional okro or maize whereby one can harvest and store the seeds for use in the next planting season. Also, growing exotic crops comes with the use of various agrochemicals including the application of chemical fertilizers. Besides, it takes about 3 months to fully mature and if you are someone

who wants money immediately to solve pressing issues, you will prefer growing pumpkin and beans leaves which mature within just two months or less. But I must admit that these foreign crops fetch more money than the traditional ones. I raised closed to GH₵4,000 and used the money to acquire a motorbike to facilitate my movement" ($ 1= GH₵ 5 as of January 2019) (Key Informant Interview (KII) at Yeleyiri, 2019).

This suggests that given the needed support, smallholder irrigation farmers in the study communities can diversify their farming practices, and types of crops grown towards improving their living standard. A further manifestation is that smallholder irrigation farming could result in livelihood outcomes (human well-being and capabilities improved).
The study found crops such as banana and plantain on some irrigated farms but responses did not include such crops (*Musa spp.*). A lead farmer at Siiru had this to say: *"We do not consider banana and plantain (Musa spp.) as irrigated crops because we grow these crops to produce shade and not fruits. However, if they bear fruits we use as food. These crops belong to southern Ghana and not the north"* (KII at Siiru, 2019).

Figure 4 shows the challenges of smallholder irrigation farmers. They include access to credit (financial capital), access to irrigable land (natural capital), poorly developed irrigation facility (physical capital), reduction in the volume of irrigation water and destruction of farm by livestock, particularly, cattle. These findings corroborated with the findings of past studies (Appiah-Nkansah, 2009; Kpieta *et al.*, 2013; Naaderi and Dinye, 2017; Mumin, 2017).

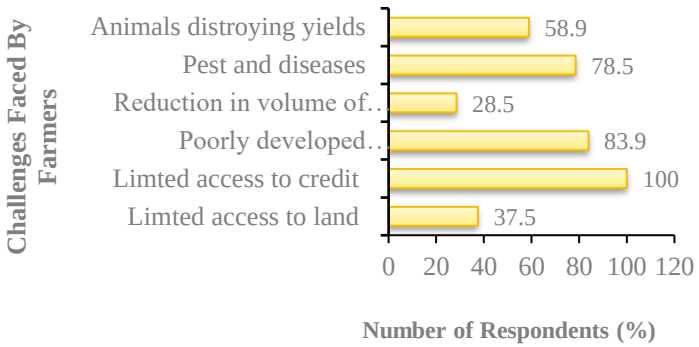

Figure 4: Challenges Faced by Small-scale Irrigation Farmers
Source: Field Survey (2019)

Also, a key informant had this to say:
*"We do not own this land. It belongs to the tendamba (landlords) who are of the "A" tribe. I hope you understand their perception of us from the "B" tribe. They treat us as settlers on their land. This seriously affects whatever activity we 'the strangers' may want to do on the land regarding farming, building and other landed property. We are seven in our household; myself, my husband and our five children who are all grown-ups. We have access to only an irrigable area of not up to 1 acre whilst the land is lying there untouched. I will suggest you tell the government to buy the area under irrigation to make it accessible to whoever wants to do farming" (*KII at Yeleyiri, 2019).

This finding corroborates with that of MoFA (2011) on ethnic discrimination on the use of land contributing to low productivity in the smallholder agricultural sector of Ghana. Farmers resort to the use of various coping strategies to remedy the challenges of irrigation farming (Figure 5). Some 89% work to reduce soil moisture by practicing mulching. About 48.2% have constructed hand-dug wells to gain access to additional water resources. Also, 87% manage declining soil productivity by applying livestock manure; while, 80.3% use chemical fertilizers for the same purpose. The fencing of farms is done by 30.3%. They use residue from guinea corn to prevent livestock grazing on the farms.

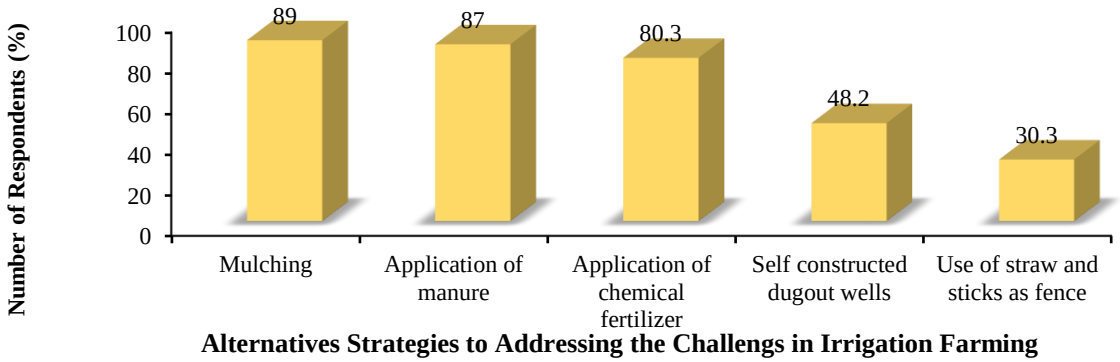

Figure 5: Alternative Strategies to Addressing the Challenges in Irrigation Farming

Furthermore, respondents indicated the use of some indigenous methods in combating the prevalence of pests and diseases. Farmers apply ash on pumpkin and okro/okra. Traditional pesticides are made from a combination of herbs and water. A farmer intimated on his solution to armyworms attacks on his maize farm:

"I started with some agrochemicals 'pesticides' which were generally believed to be good for killing these worms but failed. Many types of agrochemicals I used did not destroy the worms. Fortunately, a friend told me he used a concoction made from leaves of the neem tree (Azadirachta Indica) and hot pepper and it worked. So, I tried it and it worked magic for me. It is easy to prepare; grind a mixture of neem leaves and hot pepper together and mix with water; then, apply the concoction to the affected crops and all the worms will die" (KII at Baleofili, 2019).

This suggests that local farmers are innovative and with the needed technical and financial support, local farmers will be able to overcome the challenges facing them in the agricultural sector, towards increasing productivity thereby improving their livelihood. This is a further indication that smallholder irrigation farming ensures sustainable livelihood outcomes (livelihood adaptation, vulnerability and resilience enhanced). Also, the various efforts at solving the irrigation farming challenges are indications of sustainable livelihood outcomes with natural resource base sustainability ensured.

CONCLUSIONS AND RECOMMENDATIONS

Most smallholder irrigation farmers cultivate on an irrigable land of not more than half an acre and thus, total output is low. Academics should focus on the challenges facing smallholder irrigation farmers to identify the gaps and assist them to adopt coping strategies towards improving their livelihood outcomes. This study contends that if smallholder irrigation farmers in the Wa West District receive the needed support from all parties concerned to expand and operate on a medium to large scale basis, income from irrigation agriculture can match with or even surpass that of subsistence farming. Poverty levels in the Wa West District continue to increase, suggesting the need to put in place supplementary and alternative livelihood strategies that are long lasting and sustainable in the District. Smallholder irrigation agriculture has proven to be a dependable livelihood strategy particularly in water scarce areas across Ghana. In the Wa West District, the results of this study show that irrigation farming serves as a supplementary source of income to subsistence households in the study communities. It is a major source of food, particularly fresh vegetables like okro/okra, tomatoes, cabbages, lettuces and cereal crops like maize and rice. Thus, irrigated agriculture positively influences livelihood outcomes across smallholder irrigator households in the Wa West District. However, limited access to credit, poorly developed irrigation systems, pests and diseases, fluctuation in the volume of water of reservoirs, and limited access to irrigable lands prevent irrigation farmers from expanding their farm sizes to increase

productivity. To remedy some of these challenges, smallholder irrigators should resort to the application of indigenous and improved land management practices such as application of manure, mulching, construction of individual dugout wells, and application of chemical fertilizer. However, the biggest challenge of access to irrigable land remains a forlorn hope for non-land-owning ethnic group 'settlers'. The study concludes that given the needed support, smallholder irrigation farming has the potential of alleviating poverty among smallholder households in the Wa West District towards attainment of livelihood outcome and contributes to achieving SDG 1, target 1.1, and SDG 2, target 1. To make these happen, water security is needed. Hence, the study recommends that the Government of Ghana through the Ghana Irrigation Development Authority (GIDA) should continue to construct small irrigation dams and acquire irrigable lands in small-scale dams' communities to ensure sustainable irrigated agriculture in the district.

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