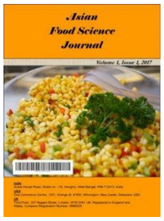

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Farmers' Perception on Irrigation Farming and the Factors Influencing Access to and Size of Irrigable lands in Northern Region, Ghana

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Authors' contributions

This work was carried out in collaboration among all authors. Author SK conceptualized the study, led the data collection and write-up of the manuscript. Author AJI was involved in the data processing and initial draft of manuscript. Author WA led the data analysis and the write-up of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Aim: The impacts of climate change and variability requires proactive and reactive adaptation. The high reliance of farmers on rainfed agriculture leads to their high vulnerability to climate change. As an agrarian economy, irrigation farming system is an essential proactive and/or reactive strategy for the increasing erratic rainfalls in Northern Ghana. This study analyzed the perceptions of smallholder farmers on irrigation farming and the factors that influence access to and size of irrigable lands among communities in the catchment of two irrigation dams.
Study Design: The study adopted a multi-stage sampling procedure.
Place and Duration of Study: The study was conducted in the Northern Region of Ghana. The data for the study was collected in 2014.
Methodology: Through a multi-stage sampling, a cross-sectional data was collected from 240 smallholder farmers. These included both irrigation farmers and non-irrigation farmers. The data was analyzed through switching regression and descriptive statistics.

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Results: The result revealed that water unavailability is not a major challenge to most irrigation farmers. The farmers engaged in irrigation vegetable farming mostly for cash purpose and also perceived a high demand for vegetables, especially in the dry season. From the farmers perception, group membership, distance to irrigable land, cost of irrigable land, leadership characteristics and nativity significantly influenced access to irrigable lands. From the econometric result, experience, farmer group, credit, extension, labour availability and age had significant influence on irrigation farming while education, experience, extension, sex and labour availability significantly influenced the acreage cultivated by the vegetable farmers.

Conclusion: The study concluded that, while there is high market potential for irrigated produce, access to and the size of irrigable lands are significantly determined by a mixed of factors. Therefore, while farmers are encouraged to go into irrigation vegetable production, government's policies such as 'one village one dam' should be effectively implemented to realize the needed results.

Keywords: Access; irrigation farming; irrigable land; perception; northern region.

1. INTRODUCTION

Agriculture development is key to Ghana's economic development. Over a decade now, Ghana's economy has witnessed economic transformation from agricultural led economy to a service led economy. The sector contributes 18.9% to Ghana's Gross Domestic Product (GDP) in 2016 as against 25.3% in 2011 [1]. This notwithstanding, the sector remained vital as 51.5% of households in Ghana own or operate a farm [2], contributing directly to food security and providing foreign exchange to the country through export of both traditional and non-traditional agricultural commodities. Farming is the major economic activity in the rural areas of Ghana, particularly in rural savanna where about 93% of the households engage in farming [2]. However, low productivity and inefficient water usage are having significant threats to the livelihood of these rural households. The sector is also dominated by smallholder farmers who depend on natural resources, particularly, rainfall for production [3]. According to [4], smallholder rain-fed farming using elementary technologies controls the agricultural sector, accounting for 80% of total agricultural production. As at 2012, only 0.4% of Ghana's arable land is under irrigation [5]. Nonetheless, irrigated agriculture contributes 30% of the total agricultural production of the country [3]. As a result of high dependence on rainfall, the agriculture sector face high impacts of climate change. Despites Ghana's economic development in recent times, poverty and food insecurity continuous to be high in the northern parts of the country than the southern parts [6]. This is not isolated to only Ghana since [7] reported that poverty is persistent among many small scale farmers in sub-Saharan Africa (SSA). The high dependence on agriculture by northern households predisposed them more to the negative consequences of climate change on food security.

Climate change impacts on agriculture are continuously evident. The rains are becoming increasingly erratic and temperatures becoming higher. According to scholars, climate change would have devastating effects on crop yields and increase the prevalence of crop pests [8]. For instance, maize yield is expected to reduce by 7% in 2020 and as high as 55% in the year 2050[9]. Not only food availability and accessibility would be affected as a result of climate change but also, food utilization, as food safety and health complications from food consumption would be affected [8]. Barimah et al. [9] explained that although not exclusive, climate change (particularly, decrease in rainfall and increase in temperature) have a major role in the observed declining yields of most major crops. The impacts of climate change on food production require urgent, continuous and efficient adaptation. Over the years, farmers have adopted several proactive and reactive adaptation strategies. These include crop diversification, changing variety and planting dates as well soil and water conservation strategies [10- 13]. One of such major proactive adaptation measures is irrigation farming. As noted by [14], the incidence of erratic rainfall has created uncertainty for agricultural production which highlights the need for irrigation.

Irrigation is the supplementation of precipitation by storage and transportation of water to the fields for the proper growth of agricultural crops [15]. It is the artificial application of water to the soil and is usually used to assist in crops production in dry areas and during periods of inadequate rainfall. Irrigation is man's idea to supplement rain fed agriculture in order to farm in seasons of no rain to get food to feed himself. Thus, irrigation farming is the means to reduce the risks in farming, ensure high yields as well as make production possible throughout the year [16]. Irrigated agriculture in Africa is under renewed attention in relation to food security and poverty reduction. Ghana's increasing population means that there are more mouths to feed. Therefore, sustainable and all year-round food production is necessary.

Empirical studies have shown that irrigation play significant role in increasing productivity, poverty reduction and improving livelihood of rural households [17- 21]. It empowers households to generate more income, increase their resilience and transform their livelihoods [22]. Irrigation minimizes uncertainties in production especially those relating to bad weather conditions [20]. Often cited as an innovation, irrigation can improve rural livelihoods, food security, and poverty reduction [23,24]. Moreover, [25] emphasized the huge potential of irrigation farming to limit food insecurity and release millions from chronic poverty. [26] also estimated that irrigated rice farmers are 92.7% efficient while rainfed rice farmers are 83% efficient.

The Ministry of Food and Agriculture [27], has indicated that Ghana's growing and urbanizing populations along with the changing dietary preferences called for more diverse range of food and industrial crops and this could be achieved under irrigated conditions to obtain higher quantity and quality. The development agenda of Ghana is also grounded on accelerating agricultural growth and reducing poverty. Irrigation development in the country is powered by Accelerated Agricultural Growth and Development Strategy (AAGDS) which operate under Agriculture Sector Services Improvement Project (AgSSIP). The strategy recognizes comprehensive policy for irrigation to guide development in the sub-sector. The AAGDS has specified role for the Ghana Irrigation Development Authority, the role of irrigation related research and technology transfer and priority targets in small and micro-scale irrigation schemes.

Even though agriculture has the potential of reducing poverty and creating employment, this can still not be achieved without an improvement in the water resource use. A major challenge of agricultural production in Northern Region is water scarcity for agricultural purposes. As a result of this, irrigation development is seen as a channel of sustaining food production in the region. Food production in the region has not been consistent with population growth, resulting in food insufficiency and leading to low income and high poverty levels among households in the region [28]. Recognizing the effects of climate change and the positive role of irrigation in food security, the Government of Ghana is rolling out a policy known as one-village, one-dam (OVOD). This policy aim to ensure an all year round food production in the three northern regions of Ghana. Although this is expected to make significant impact on food production in the country, there are primary information that must first be made known to make the policy successful. One of such information is the factors that actually influence farmers' decision into irrigation farming. This is important because, the primary assumption is that farmers would go into irrigation farming once the facilities are made available. This assumption is fallacy and may have negative consequences on irrigation policies such as OVOD. Previous studies model irrigation adoption decisions using econometric models. Although these are vital, the frameworks through which these are evident requires in addition, the assessment of farmers own assessment of the factors that influence their irrigation farming decisions. This study therefore aimed to complement econometric analysis on the factors that influences access to irrigable lands with farmers' perceptions on these factors in the Golinga and Botanga irrigation sites in Northern region of Ghana.

2. METHODOLOGY

2.1 Study Area

The study was conducted within the catchments of Botanga and Golinga irrigation sites, located in the Northern Region of Ghana. Northern region is one of the ten (as at the time of the study) regions of Ghana and located in the northern part of the country. The region was then the largest in terms of land mass and covered an area of 70,384 square kilometers. It is located within latitude 9.5434°N and longitude 0.9°57°W. The region shared borders with four other regions in the country which includes Upper East and Upper west in the north and Brong Ahafo and Volta regions in the south. The northern region also shared borders with two West African countries (Republic of Togo and Ivory Coast to the East and West respectively). The Northern Region is much drier than southern part of the country as a result of its closeness to the Sahel and Sahara areas with the dry season starting in November and ends in March/April. The vegetation of the region is predominantly grassland with drought resistant trees like baobab and acacia. It has a single rainfall season which starts in May and ends in October with the rainfall ranging between 750 to 1050 mm per annum. The region also experiences varied night and day temperatures. Night temperatures can be as low as 14°C and as high as 40°C during the day. The region is drained by Black and White Volta Rivers and their tributaries which includes Nasia and Daka rivers. The main economic activity in the region is agriculture. Fig. 1 is the map of Northern region, showing the location of the two irrigation sites considered in this study. The Botanga irrigation scheme is located within 9°30" and 9°35"N and longitude 1°20"and 1°04"W [29] while Golinga is located within latitude 09°15 and 10°02 N, and, longitudes 0°53 and 1°25 W" [30].

2.2 Sample Size and Sampling Procedure

A multi-stage sampling procedure was employed in selecting respondents for the study. Golinga and Bontanga irrigation sites were selected using purposive sampling procedure at the first stage. This was because, these are the well-developed irrigation sites in the region. In the second stage, three communities within each irrigation catchment areas were selected randomly. In the final stage, stratified sampling was used to put farmers into irrigation and non-irrigation farmer categories. A simple random sampling was then used to select 120 farmers from each stratum; given a total of 240 farmers. Primary data was then collected from the selected individual farmers through the use of questionnaire which was administered by trained research assistants.

2.3 Data and Data Analysis

The data collected for this study was analysed using quantitative and qualitative approaches, by employing STATA and SPSS software, respectively. Generally, these are the common analytical software used in socioeconomic analysis. Qualitatively, a set of factors that were predetermined and tested during pre-testing stage of the questionnaire were provided to the farmers. The farmers were then asked to indicate their perceptions on the effect of each factor on access to irrigable land in the two irrigation sites. This involved a four-point likert scale. Descriptive statistical technique (mean)

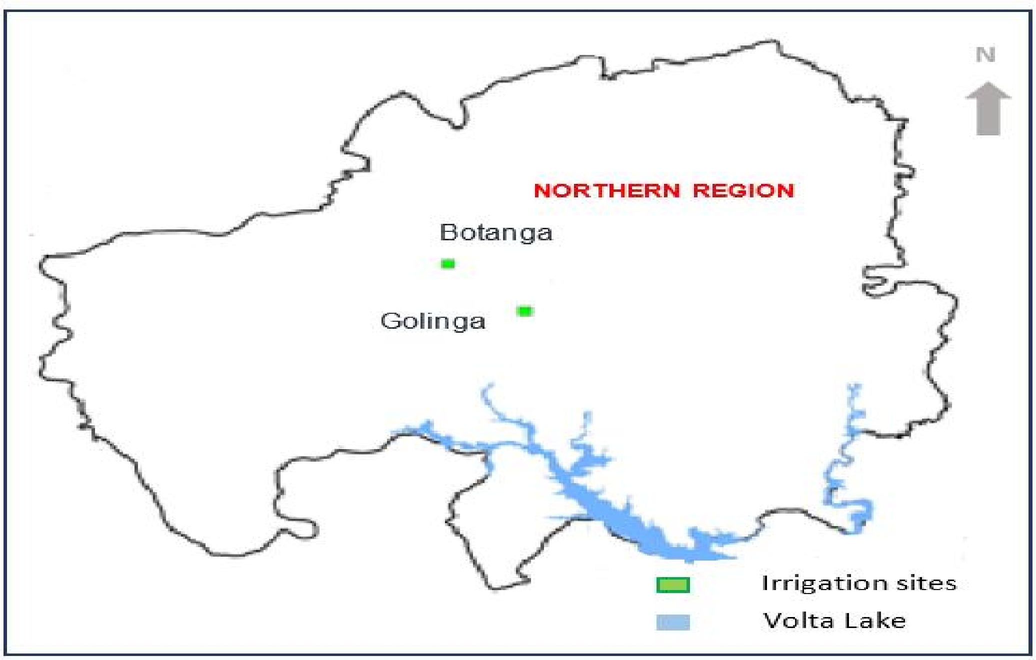

Fig. 1. Map of Northern region showing the location of the two irrigation sites

Table 1. Definition of variables

Variable	Definition
Age	The total number of years of a farmer from birth to the survey time
Education	The total number of years of formal education, starting from primary one
Experience	The number of years a farmer had cultivated vegetables
Farmer group	Dummy: 1 if a farmer belonged to a farmer group, 0 if otherwise
Credit	Dummy: 1 if a farmer accessed credit in the production year, 0 if otherwise
Sex	Dummy: 1 if a farmer is a male and 0 if female
Off-farm	Dummy: 1 if a farmer engaged in an off-farm economic activity, 0 if otherwise
Extension	Dummy: 1 if a farmer had accessed extension service, 0 if otherwise
Labour	Dummy: 1 if a farmer perceived availability of labour, 0 if otherwise
Irrigation farming	Dummy: 1 if a farmer engaged in irrigation vegetable production, 0 if engaged in rainfed vegetable production.
Farm size	The total acreage of vegetable production in the production season.

was employed in the analysis of this data in order to assess the perception of farmers. A chi-square test was estimated to determine the significant representation of the mean perceptions of the farmers.

Quantitatively, a switching regression was estimated to determine the factors that influenced both the decision of a farmer to engage in either irrigation vegetable production or rainfed vegetable production and the land size the vegetable farmers cultivated under both production regimes. The advantage of the switching regression over estimating a binary (probit/logit) model for the irrigation farming and a separate linear regressions for land allocation under both regimes is that it corrects for the effects from the correlating error terms in these three models. Therefore, the switching regression was estimated simultaneously through maximum likelihood. We adopted the movestay approach by [31].

Given that farm size is a function of some independent variables, x_i;

$$y_i = \beta x_i + u_i \quad (1)$$

Then, the decision under the two regimes of vegetable production is given as;

$$I_i = 1 \quad if \quad \gamma Z_i + \varepsilon_i > 0 \quad (2)$$
$$I_i = 0 \quad if \quad \gamma Z_i + \varepsilon_i \leq 0$$

Therefore the farm size function under the two regimes is defined as;

$$y_{1i} = \beta_1 x_{1i} + u_{1i} \quad (3)$$
$$y_{2i} = \beta_2 x_{2i} + u_{2i}$$

From these, the three error terms (ε_i, u_{1i} and u_{2i}) assumed a trivariate normal distribution with mean vector zero and a non-unitary covariance matrix.

Empirically, equations 2 and 3 are redefined in equations 3 and 4, respectively, and the variables defined in Table 1.

$$Irrigation\ farming = \gamma_0 + \gamma_1 Age + \gamma_2 Education + \gamma_3 Experience + \gamma_4 Farmer\ group + \gamma_5 Credit + \gamma_6 Sex + \gamma_7 Off-farm + \gamma_8 Extension + \gamma_9 Labour \quad (4)$$

and

$$Farm\ size = \beta_0 + \beta_1 Education + \beta_2 Experience + \beta_3 Farmer\ group + \beta_4 Credit + \beta_5 Sex + \beta_6 Off-farm + \beta_7 Extension + \beta_8 Labour \quad (5)$$

3. RESULTS AND DISCUSSION

3.1 Descriptive Statistics

Table 2 shows the descriptive statistics of the respondents. From the result, 70.4% of the vegetable farmers were males and 29.6% were females. Specifically, the results obtained showed that majority (73.3%) of the farmers who had access to irrigable lands were males while the remaining 26.7% were females. On the other hand, 67.5% of the non-irrigation farmers were males and 32.5% were females. Generally, [32] asserted that land is owned by males while the female farmers are mostly given land rights by their husbands. From their study, [33] concluded that men are often into farming than women. Farmers who had access to irrigable lands were relatively older than non-irrigators. The mean age for the irrigated farmers was 35.6 years while the non-irrigators had a mean age of 30.5 years.

Table 2. Descriptive statistics of the respondents

Variable	Irrigators	Non-irrigators	Pooled
Age (mean years)	35	30	32.5
Sex (% of males)	0.73	0.68	0.7
Marital status (% of married farmers)	0.93	0.82	0.9
Education			0.0
No formal education (%)	86.7	80.8	83.8
Primary (%)	3.3	3.3	3.3
JHS (%)	6.7	9.2	8.0
SHS (%)	0.8	5	2.9
Tertiary (%)	2.5	1.7	2.1
Experience (number of years in vegetables farming)			0.0
1 – 5 years (%)	28.3	74.2	51.3
6 – 10 years (%)	42.5	15.8	29.2
11 – 15 years (%)	8.3	5.0	6.7
16 – 20 years (%)	10.8	0.8	5.8
Above 20 years (%)	10.0	4.2	7.1

On the average, 93% and 82% respectively of irrigation farmers and non-irrigation farmers were married. The plausibility is that the married farmers are able to complement each other in terms of farming activities and also, the demand for vegetables may be higher in married farmers' households than in the single farmers' household. Table 1 also shows that, majority of both irrigation and non-irrigation farmers (83.8%) had no formal education. Out of the remaining 16.2% who had formal education, 7.9%, 3.3%, 2.9% and 2.1% had up to Junior High School (9 years formal education), primary (6 years formal education), Senior High School (12 years formal education) and tertiary (15 or more years of formal education) respectively. Generally, education is an important factor necessary for human capital development and thus needed to enhance the productivity of the farmers. As noted by [34], formal education enabled farmers to improve on their managerial abilities. Nonetheless, agriculture in Ghana is dominated by the less educated.

With regards to experience in vegetables farming, most of the farmers have been into irrigation farming for not more than 10 years. While 80.5% of the vegetable farmers had cultivated vegetables for 1-10 years, only 19.6% did cultivate vegetables for more than 10 years. On the average however, a farmer under irrigation vegetable production have been cultivating vegetables for 10 years 9 months, while the average farmer under rainfed have been cultivating vegetables for 5 years 5 months. Among the groups, the highest percentage of the vegetable irrigation farmers had cultivated vegetables for 6-10 years (42.5%) followed by those who cultivated it for 1-5 years (28.3%). The reverse was the case of the non-irrigation farmers as the majority had cultivated vegetables for 1-5 years (74.2%) followed by 6-10 years (15.8%).

3.2 Sources of Water for Irrigation Farming

Table 3 shows the sources of water for irrigation purposes in the study area. Not surprisingly, 97.5% of the respondents used water from the Golinga and Botanga irrigation dams. On the other hand, 2.5% of the respondents had their source of water from the well. The respondents mentioned that due to the presence of the dam, they are the first to try new varieties developed by SARI. Moreover, the presence of the dam prevents both men and women from migrating to the cities for virtually non-existing jobs. This is consistent to other findings [32,35]. The money from irrigation farming can be used as credit for the major season farming.

Table 3. Sources of water for irrigation farming

Irrigation type	Frequency	Percentage
Well	3	2.5
Dam	117	97.5
Total	120	100.0

3.3 Water Accessibility

Availability of water and its sustainability is paramount for irrigation farming. This is because, irrigation farming requires the direct supply of water to a farm land. From Fig. 2, 95.8% of the respondents agreed that there is available water to support irrigation farming throughout the year. It can therefore be concluded that, water is readily accessible by most of the farmers, enabling them to do effective irrigation during the dry season. On the other hand, 4.2% of the farmers mentioned that the accessibility of water is low. This is probably due to the reason that buying of pumping machine for irrigation is expensive. Farmers therefore resorted to the use of buckets in watering their vegetables, and this could explain their indication of the difficulty in accessing water. This is contrary to the findings in [36] who found that 49.1% of the respondents indicated water unavailability as a challenge to irrigation farming.

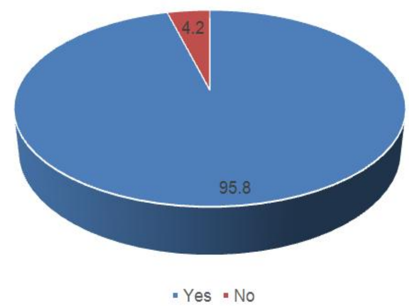

Fig. 2. Water accessibility by irrigation users

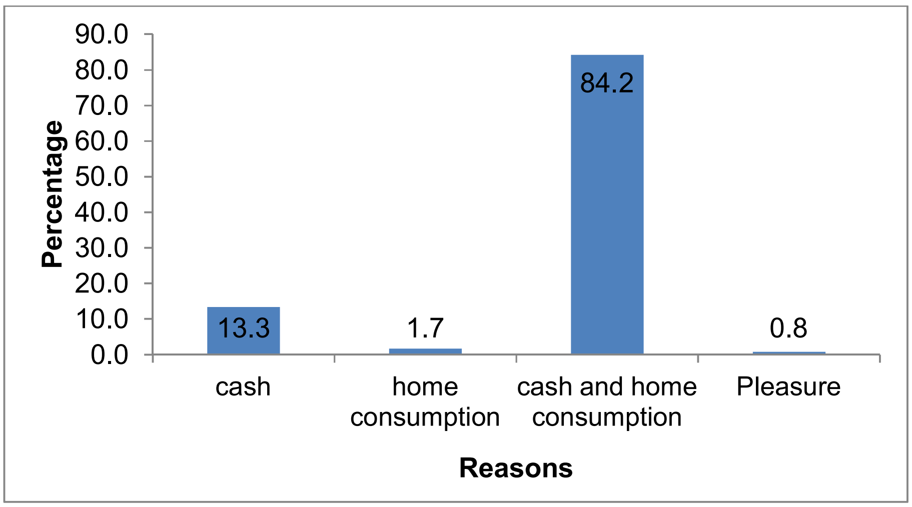

Fig. 3. Reasons for vegetable irrigation farming

Table 4. Farmers perception on the factors that influence access to irrigable farming

Factors	Adopters			Non-adopters		
	Mean	Chi Sq	Sig	Mean	Chi Sq	Sig
Educational level	1.83	36.33***	0.000	2.22	153.20***	0.000
Group membership	2.12	122.75***	0.000	2.3	128.73***	0.000
Distance from home to irrigation site	2.05	193.60***	0.000	2.09	194.73***	0.000
Sex	1.88	215.25***	0.000	2	278.00***	0.000
Cost of irrigation land	2.12	120.92***	0.000	2.45	181.50***	0.000
Access to credit	1.86	95.67***	0.000	2.21	196.83***	0.000
Age	1.89	147.67***	0.000	1.94	230.25***	0.000
Marital status	1.81	141.25***	0.000	2.23	130.37***	0.000
Being an opinion leader	2.36	94.58***	0.000	2.73	181.67***	0.000
Being an indigene	2.38	112.00***	0.000	2.57	197.92***	0.000
Religion	1.68	112.58***	0.000	1.65	101.50***	0.000
Being a chief	2.73	46.58***	0.000	2.94	163.08***	0.000
Financial position/ Occupation	2.35	89.70***	0.000	2.32	137.00***	0.000
Being a farmer	2.38	107.75***	0.000	2.41	133.75***	0.000

**** indicates significance at 1%*

Table 5. Econometric analysis of factors influencing irrigation farming and vegetable land size

Variable	Irrigation farming decision		Irrigators		Non-irrigators	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
Education	0.022	0.027	0.003**	0.023	-0.055	0.044
Experience	-0.064***	0.017	0.037**	0.018	-0.004	0.025
Farmer group	-0.730***	0.231	0.924	0.274	0.328	0.358
Credit	-0.849***	0.282	0.782	0.345	-0.408	0.321
Sex	0.040	0.215	0.144	0.205	1.166***	0.398
Off-farm	-0.024	0.192	0.137	0.188	0.135	0.352
Extension	-0.077**	0.039	0.093*	0.060	-0.150***	0.036
Labour	0.021**	0.011	0.043**	0.012	0.059***	0.020
Age	0.001***	0.008				
Constant	0.637	0.319	-0.692	0.219	-2.112	0.679
/lns1	0.062	0.086				
/lns2	0.506	0.070***				
rho_1	-0.922	0.038***				
rho_2	-0.156	0.334				

LR test: Chi square=12.12, Prob > chi2 = 0.0005; Wald chi2(8)= 49.32, Prob > chi2= 0.000
****, ** and * indicates significance at 10%, 5% and 1%, respectively*

Table 6. Perceptions on irrigation vegetable production

Perception	Yes		No	
	Freq.	%	Freq.	%
It is more profitable	94	78.3	26	21.7
There is high demand for the product	117	97.5	3	2.5
It is more capital and labour intensive	80	66.7	40	33.3
It requires some level of skill	63	52.5	57	47.5
Land acquisition is difficult	70	58.3	50	41.7
The procedure is too long	55	45.8	65	54.2
Pooled	80	66.7	40	33.3

3.4 Reasons for Vegetable Irrigation Farming

The selected farmers are smallholder farmers. Like the cultivation of other crops, the purpose is to provide food and income needs of the households. From Fig. 3, majority of the respondents engaged in irrigation farming for both cash and direct consumption by households (84.2%). Specifically, 13.3% and 1.7% of the respondents engaged in irrigation vegetable production solely for cash and direct consumption, respectively. There are 0.8% of the farmers who engaged in irrigation vegetable production for pleasure. In the study area, farmers engage in crop production ones in year, therefore, farmers become idle after harvest in the dry season. In order to become effective and be engaged, these farmers go into dry season vegetable productiona. Bagson et al. [35] also revealed that 83% households practiced irrigation farming for household consumption and cash. Irrigation farmers get regular flow of income; otherwise, the farmers would have been idle and depend only on harvests from the rainy season. [37] also noted that cash from irrigation is a major source of security which can be used to meet some basic needs of the people. Vegetable consumption is high in northern Ghana as most households prefer leafy vegetables in particular. Therefore, to ensure an all year-round availability of vegetables, farmers may engage in irrigation vegetable production to meet these needs.

3.5 Farmers' Perception on the Factors Influencing Access to Irrigable Land

Perceptions is the process by which an information or stimuli is received from the environment and transformed into psychological awareness. Hence, respondents were asked to indicate their level of agreement on a list of factors that could influence access to irrigation facilities. The set of alternatives provided to the farmers were strongly disagreed (1), disagreed

(2), agreed (3) and strongly agreed (4). This means that lower mean estimates indicate farmers' disagreement while higher mean indicates agreement. A chi-square test was also conducted to test the representation of the mean responses to the entire sampled respondents. From the result (Table 4), all the mean estimates were significant indicating that these values represented the entire view of the sample investigated.

Farmers in both categories disagreed that education positively influence irrigation access, although non-irrigation users had a higher mean (2.22) than the users (1.83). This means that it does not matter the level of education, one can have access to irrigable lands or facilities in the study area. However, the respondents mentioned that proper education is needed to facilitate the use of the irrigation facilities although this may require non-formal education. Farmers in general also disagreed that group membership influences access to irrigation facility. They noted that access to irrigable land did not depend on whether or not a farmer belonged to a farmer group. It is only when a person gets access to the land at the site that he/she may decide to join the association that most irrigation farmers belonged to. Through a multinomial model, [38] also found no statistical effect of education on the adoption of irrigation farming as a climate adaptation strategy. [39] and [40] found that education have a negative effect on the decision to engage in irrigation farming.

Other factors that both irrigation vegetable farming adopters and non-adopters disagreed on were distance from home to irrigation site, sex, cost of irrigable land, access to credit, age, marital status, religion, financial position or occupation and being a farmer. Thus, in the view of the farmers, these factors did not have any effect on access to irrigation. This means that considering these factors for policy direction would not require targeting a specific group. For instance, it would be inappropriate to design a policy targeting a particular sex group to enhance irrigation access in the region. One would have expected that the cost of land for instance would affect the farmers' access to irrigation, but this was not the case. Empirically, [13] found a positive insignificant effect of age on irrigation farming, but a positive significant effect of credit on irrigation. Also, [39] found no significant effect of age, access to credit, farm and non-farm income on irrigation adoption. Contrary, [40] found that age, credit access and farm income had positively influenced farmers' decisions into drip irrigation. [41] also found no significant effect of age and distance to market on irrigation farming' decision.

Interestingly, while the non-adopters had means approximately three on 'being an opinion leader' (2.73) and 'being an indigene' (2.57), both adopters and non-adopters had mean values of 2.73 and 2.94 respectively on the factor 'being a chief'. This means that while the non-adopters agreed on the former variables as factors influencing irrigation access in the area, the adopters disagreed. However, on the latter, they both agreed that chiefs had a greater probability of getting access to irrigable land than the ordinary community member. It is practically impossible to deny a chief or an opinion leader of a community an access to irrigable land knowing that they are the custodians of the land. Definitely when a community member and a chief ask for land at the irrigation site from the one in charge of the dam (Chairman), the later will be preferred to the former. [41] also found that social capital improves the decision of engaging in irrigation farming.

3.6 Econometric Analysis of Factors Influencing Irrigation Farming and Vegetable Land Size

In addition to the perceptions of the farmers on the factors that influence access to irrigable land, a switching regression was estimated and the results presented in Table 5. This shows the determinants of irrigation farming and land size cultivated by irrigators and non-irrigators. The Wald chi square from the study was significant, an indication that at least one of the independent variables in the model is significantly different from zero. The correlation coefficients (rho) were both negative but significant for only correlation between irrigation farming and land size cultivated by irrigators. The negative significant relationship means that, vegetable farmers who chose to cultivate vegetable under irrigation cultivated lesser vegetable lands than a random individual from the sample would have cultivated. This supports the smaller irrigable farm holdings by irrigators relative to non-irrigators. From Table 4, the factors that significantly influenced irrigation farming were experience, farmer group, credit, extension, labour availability and age. While education, experience, extension and labour availability influenced the acreage under irrigation farming, sex, extension and labour availability influenced the vegetable farm size of non-irrigators.

Experience had a negative effect on irrigation farming decision but a positive significant effect on the farm size of irrigators. This means that farmers who have cultivated vegetable for several years are less likely to engage in vegetable irrigation farming. However, those experienced farmers who took the decision cultivated larger lands. Although the mechanisms through which experienced farmers have lesser irrigation farming decision is not clear, it is possible that these experienced farmers might have cultivated vegetables in the rainy season high enough to earn more income. It is not surprising that [42] had no significant effect of experience on irrigation adoption. The effect of farmer group on farmer's decision to engage in irrigation vegetable farming is negative and statistically significant. This could be due to the potential struggle for irrigable land among group members. Consistently, [42] and [43] also estimated that group members have lesser probability of adoption water pump irrigation. Access to credit reduces the probability of engaging in irrigation farming. This means that irrigation farming does not require substantial investment, hence, the farmers are able to invest their personal incomes into it. However, this does not rule out the vital role of credit in irrigation farming as there is a positive effect of credit on the land size cultivated by irrigators. Although insignificant in their model, [38] also estimated a negative effect of credit on irrigation farming. This is however contrary to [13] and [43]. Although extension access leads to a decline in the probability of a farmer engaging in irrigation farming, it positively influenced land size of irrigators and negatively influenced land size of non-irrigators. This mixed result of extension suggests that, to increase land allocation to irrigation farming, the provision of extension services is necessary. Contrary, [33] estimated a positive effect of number of times of extension contacts on irrigation adoption. Labour availability had significant effect on both the decision and land cultivated under irrigation and non-irrigation. This means that farmers who have available farm labour have high probability of engaging in irrigation vegetable production and farming large lands. This is plausible considering the important role of labour in agriculture. This is consistent with [13] and [39] who found household labour force to increase irrigation adoption. Age is used as the controlled variable in the model since it was expected that age can directly influenced access to irrigation land but not the size of land a farmer cultivates. Instead, experience can best explain land allocation. The result shows that age had a significant effect on irrigation farming. This means that the older farmers had a higher probability of engaging in irrigation farming than the younger farmers. This is consistent with the result of [43] but contrary to [42] who estimated a negative effect of age on irrigation water pump adoption. Generally, these significant factors supports the findings in Table 4 but provided further information on the direction of these effects.

3.7 Perceptions on Irrigation Vegetable Production

Six different characteristics were described to the farmers and they were asked to indicate which ones were true about irrigation farming in their opinion. This is provided in Table 6. Among these options given to the respondents 'there is high demand for the product' had the highest score of 97.5%. Following this was the number of farmers (78.3%) who indicated that irrigation farming is more profitable than rain fed vegetable production. These are conceivable considering the fact that vegetables in the dry season are highly patronized than in the rainy season where there is abundance of the vegetable; also affecting the price in the rainy season. Empirical studies such as [38,44,45] revealed that irrigation farming improves the welfare of the farmers. The least score was recorded for 'the procedure is too long' (45.8%). It would be observed that while all characteristics recorded scores more than 50%, 'the procedure is too long' recorded lower than 50%. In other words, while the majority agreed on all other characteristics, they disagreed with the later. This is in the right direction since with longer procedures (bureaucracy); farmers would become frustrated and opt not to go into dry season vegetable production.

3.8 Farmers' Perception on Output Differences among Irrigated and Rain Fed Farms

Table 7 shows the farmers' perception about the output difference between the two production regimes. It would be observed that the highest percentage of the farmers (46.7%) mentioned that vegetable production under rain fed produce more yield than under irrigation farming. This is contrary to the expectations of the research.

Various econometric results [46,38] suggested that irrigation farming gives higher yield due to more efficient control on these farms. Perhaps, this is because in the rainy season, microbial activities are very high through incorporating humus and organic matter into the soil. Consistently, [47] revealed that, more yields could be obtained from smallholder irrigation schemes than from rain fed agriculture on commercial basis. However, 20.8% of the farmers were unable to indicate which production system or regime gives a higher yield. From multiple response analysis, [36] revealed that 97.5% of their respondents indicated an increased crop yield under irrigation farming; 95.1% indicating that irrigation farming ensures food security while 49.4% indicated that irrigation farming leads to reduction in food prices.

Table 7. Perceptions on yield difference under irrigation and rainfed regimes

Response	Frequency	Percentage
Not certain	25	20.8
Irrigation	39	32.5
Rainfall	56	46.7
Total	120	100

4. CONCLUSIONS AND RECOMMENDATIONS

This study assessed the perception of farmers on factors that influence access to irrigation in the Northern region of Ghana. A multi-stage sampling procedure was used and a cross-sectional data was collected among 240 farming households for the study. Descriptive statistical and econometric techniques were used for the data analysis. The major reason for dry season vegetable production is for income and not direct household consumption. It can be concluded that water accessibility is not a challenge to irrigation farmers, therefore, given other production inputs, irrigation vegetable production could be improved in the region. From the farmers' perception, the analysis of the data has shown that all the farmers disagreed that education, distance from home to irrigation site, sex, cost of irrigable land, access to credit, age, marital status, religion, financial position or occupation and being a farmer influence access to irrigation. On the other hand, the farmers agreed that, group membership, distance to irrigable land, cost of irrigable land, leadership characteristics and nativity significantly influenced farmers' access to irrigable land. However, the econometric result showed that the factors that significantly influenced irrigation farming were experience, farmer group, credit, extension, labour availability and age while education, experience, extension, sex and labour availability influenced the acreage cultivated by the vegetable farmers.

The study also concluded that, there is high demand for vegetables all year round. Therefore, irrigation vegetable production can be harnessed to improve the livelihoods of the farmers in the region. A quite controversial finding from this study is that the farmers perceived higher yields under rainfed vegetable production than irrigation farming. Based on the conclusion of this study, the following recommendations are made:

1. Government's OVOD policy is in the right direction. However, youths should be encouraged to take advantage of such programs and engage in irrigation vegetable production. This would not only increase the income of households but also, reduce unemployment in the country.
2. Extension officers should organize informal education for farmers in the form of demonstrations and farm visits.
3. The role of political and social capital in access to irrigable lands requires that farmers should be encouraged to form or join viable associations.
4. Farmers are generally encouraged to go into dry season vegetable production to improve their livelihoods.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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