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Effect of Gender and Generation on the Adoption of Irrigation and Good Farming Practices in Bontanga and Golinga Irrigation Schemes in Northern Ghana

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ABSTRACT

This study examined the challenges faced by men, women, and different age groups in irrigation water management and farming practices in the Bontanga and Golinga irrigation schemes. The results of the study revealed that there are significant differences in irrigation and farming practices between men and women as well as between older and younger farmers. For men, the main challenges were; limited access to financial resources for investing in modern irrigation technologies and equipment, inadequate knowledge and awareness of sustainable farming practices and water management insufficient government support, and lack of policies tailored to their specific needs. For women, these were gender inequalities and limited access to land, water, and productive resources, lack of control and decision-making power over irrigation water allocation, and limited access to training and extension services to enhance their farming skills. Youth recognized limited interest and involvement in agriculture due to the perception of low profitability and lack of modernization, inadequate access to education and training opportunities in agricultural practices and water management, and insufficient support and mentorship programs to encourage youth participation in farming.

INTRODUCTION

Agriculture plays a significant role in driving development in various countries, particularly in developing nations (Kaini, 2020). By way of enhancing food security through increasing food production and enabling people to afford food, agriculture holds a crucial position in the economic activities and progress of agro-based economies (Pérez, 2017). However, proper irrigation water management and good farming practices guarantee food security and promote sustainable agriculture (Khatib *et al.*, 2017). Implementing effective irrigation water management techniques can assist farmers in cultivating crops using less water while minimizing problems with waterlogging and salinity (Ritzema *et al.*, 2008). Additionally, embracing sustainable farming methods can result in enhanced productivity, improved soil health, and decreased environmental impact (Devkota *et al.*, 2015). However, irrigation water farming practices can vary, depending on various factors, including gender and generation. Women and young farmers face unique challenges in accessing and utilizing resources such as land, water, and credit, which can impact their ability to adopt and benefit from improved irrigation water management and good farming practices (Baba, 2016; Benson *et al.*, 2017). Gender inequalities in the access of land and control over resources can hinder women's involvement in decision-making regarding irrigation water management and good farming methods.

Bonye (2022) noted that there are limited plots of land, and many people, especially married women who rely on their husbands, are denied ownership of plots of land within the same family household.

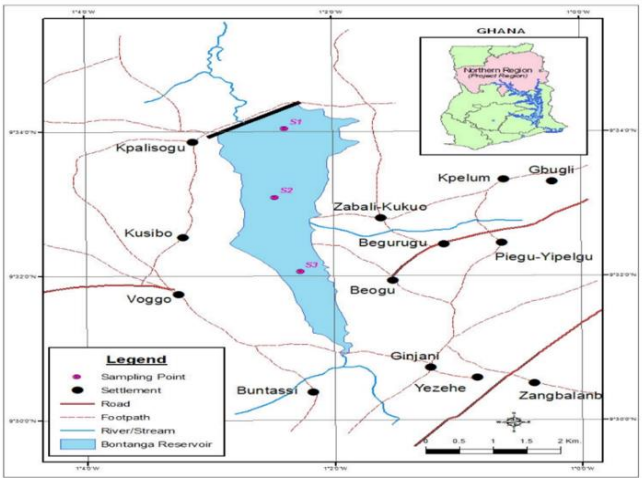
Therefore, women are expected to benefit from their husbands and it is believed that if women have their own land in an irrigation project, the overall productivity of the project will decrease as women will spend less time working on their husbands' farms. Contrary to the assumption that women cannot effectively manage their own farms, Zwarteveen (1997) found that women who were given their own plots of land were able to successfully manage their farms and still assist their husbands with their farm work. For instance, in Golinga and Bontanga irrigation schemes in the Northern Region of Ghana, where women were given plots to cultivate, improvements in both productivity and labor were observed (Braimah *et al.,* 2014). This suggests that women who have control over their own lands are able to effectively manage these, while also contributing to their husbands' farms. Additionally, when women have access to their own lands, their incomes and productivity levels tend to increase, leading to positive social outcomes.

Effective irrigation water management and proper farming practices are crucial in improving agricultural productivity and ensuring food security in Bontanga and Golinga irrigation schemes, as well as elsewhere in Ghana. However, differences in access to land and use of irrigation water and farming resources based on gender and generation can have a significant impact on the success of these practices. Therefore, this study sought to identify and describe the challenges of irrigation water management and farming practices of men and women, as well as old and youth in Bontanga and Golinga schemes for promoting fairness between gender and different age groups and their access to resources.

MATERIALS AND METHODS

Study Area

This study was conducted in the Bontanga and Golinga Irrigation Schemes in Kumbungu and Tolon Districts, respectively, both located in Northern Region of Ghana. The Bontanga irrigation project is the largest irrigation scheme in the Northern Region, managed by Ghana Irrigation Development Authority (GIDA). It is located in the Kumbungu District, 34 km northwest of Tamale, the regional capital. It lies between latitude N 9° 57' and longitude W 1° 02' (Abobi, 2019). The construction of the scheme began in the 1980s and was completed in 1986. The scheme incorporates an earthen dam, a spillway in the embankment, and control structure on the full capacity water level in the reservoir. The communities under the scheme's catchment area include Yipelgu, Saakuba, Wuba, Kpalsogu, Dalun, Voggu, Zangbalung, Bontanga, Gbulung, Kumbungu and Tamale. The people are predominantly Dagombas, with farming as the main occupation, operating small farm sizes, mostly on subsistence bases. The Bontanga River is a tributary of the White Volta and has the potential to irrigate 800 hectares, but only 495 ha are currently being used for agriculture. The irrigable area comprises 240 ha used for rice



cultivation and 255 ha used for upland vegetable production (Baba, 2016). The dominant soil type in the irrigable area is sandy loam, which is well suited for gravity irrigation.

Figure 1: Layout of Bontanga Irrigation Scheme (Source: Cobbina *et al.,* 2013)

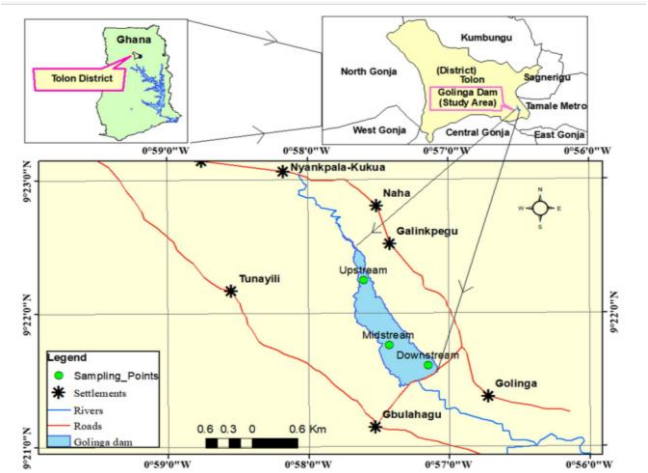


Figure 2: Layout of Golinga Irrigation Scheme (Source: Bekoe *et al.,* 2021)

Golinga is a small rural community located in the Tolon district in the Northern Region of Ghana.

The reservoir serves irrigation facility, community domestic water source,and fishing site with a potential irrigable area of about 192 ha. The developed area is about 40 ha. The mean depth of Golinga reservoir is 2.7 m. It is located in the Guinea Savanna agro-ecological zone, with two major seasons, rainy (April/May to September) and dry (October to March/April), with an average annual rainfall of 900-1100 mm. The reference evaporation rate can reach 7.1 millimeters per day in dry season (Abobi, 2019). The average temperature range during the wet and dry seasons at the study site is 20 to 30°C and 32 to 40°C, respectively. The predominant soil type in this area is sandy loam, which is well suited for irrigation using gravity (Adongo *et al.*, 2015). The communities benefiting from the scheme are Golinga, Gbulahagu, and Galinkpegu. The major crop cultivated under the scheme is Rice (*Oryza sativa)*. The minor crops grown are Okra (*Hibiscus esculentus*), Onion (*Allium cepa*), Pepper (*Capsicum frutescens*) and local leafy vegetables,'Aleefu' (*Amaranthus cruentus*), 'Ayoyo' (*Corchorus olitorious*) and 'Bra' (*Hibiscus cannabinus*) (Adongo et al., 2016).

Sampling Procedure

The study was conducted in March-April, 2023, in Bontanga and Golinga in Kumbungu and Tolon Districts, respectively, both located in Northern Region of Ghana. A multistage sampling method was employed. In the first stage, the selected irrigation schemes were stratified into three zones namely; Upstream, Middle stream and Downstream zones. In the second stage, actors across the three zones were grouped by gender and generation. In the third stage, appropriate sample size was determined from each stratum. In the fourth stage, simple random sampling was used to select individuals for interview using an interview guide and questionnaire. The total number of farmers sampled were 240 (Figure 3) The study area was spread across three zones according Water Users Association (WUA) within Gender and Generation. The totals of 40 farmers (Men and Female) were randomly selected from each zone of the schemes. Bontanga irrigation scheme have nine (9) cooperatives of water user association with 900 farmers, but in Golinga there was one (1) Water User Association with 195 farmers as described in Figure 3.

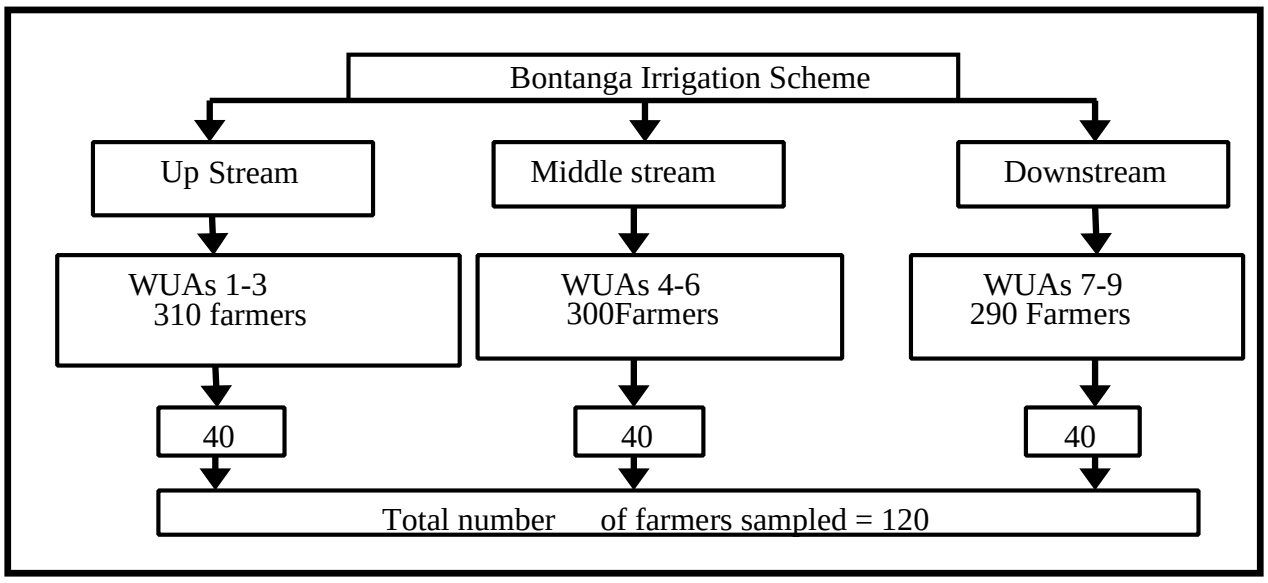


Figure 3a: Sampling Procedure and Sample Size for the Bontanga Irrigation Schemes
Source: Authors' Construct (2023)

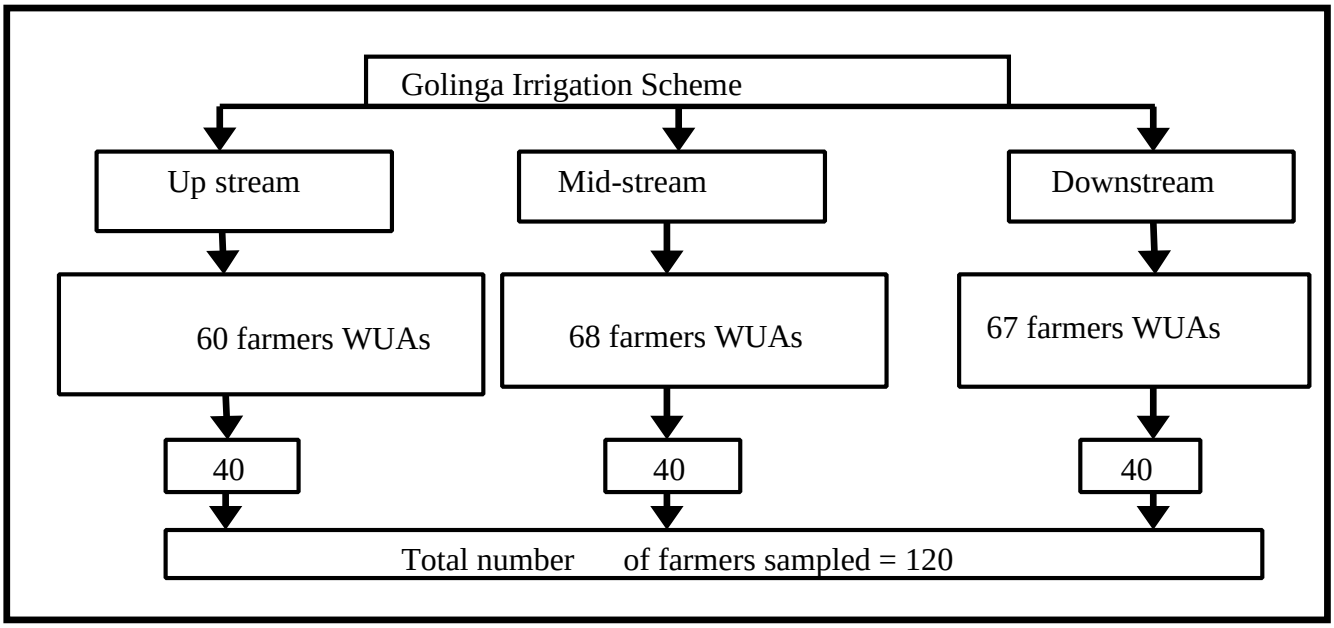


Figure 3b: Sampling Procedure and Sample Size for the Golinga Irrigation Schemes
Source: Authors' Construct (2023)

Data Collection

Secondary data were obtained through a comprehensive review of existing literature related to both irrigation projects. The quantitative and qualitative data from farmers and other key stakeholders, including water user associations, irrigation projects staff and management were collected. Personal observations and survey based on semi-structured interviews were used to gather primary data from smallholder farmers and experts in the field of irrigated agriculture and sustainable development. A multistage sampling method was applied to select farmers from each Zone in the two selected schemes (Water Users Association (WUAs)). The Leaders from each of the two schemes were interviewed to elicit their views on challenge and mitigation measures of IWM and famers' practices affecting agriculture, water users, physical and economic performance on both irrigation schemes.

Primary Data

The primary data collection tools included questionnaires and interviews using kobo collect software. Questionnaire administration, face-to-face interviews, and direct observation were employed. Survey questionnaires contained both close and open-ended questions. These were administered to farmers in the irrigation schemes within the study communities to obtain data on type of crops, planting dates, crop pattern, water application, source of water used, systems used in irrigation schemes, irrigation scheduling, water management, farmer organization, variable cost, and farming practices. Data on contribution of irrigation farming to household food security and output of different units were collected. Face to face interviews using an interview guide were conducted with key informants who have direct knowledge on the operations of the schemes.

Data Analysis

Data were checked and cleaned of errors to ensure accuracy and reliability. The software package used was SPSS version 20. The descriptive statistical analysis carried out in this study consisted of measuring frequencies, percentages, and inferential statistics performed were analysis of variance (ANOVA), means comparisons, and regression analysis using the SPSS version 20. These measurements were used to describe, examine the effect irrigation water management and farming practices in those irrigation schemes.

RESULTS AND DISCUSSION

Socio-demographic Characteristics of Farmers

The study interviewed a total of 240 farmers in Bontanga and Golinga Irrigation Schemes. From Table 1, the results of the study suggest that there are some differences in the gender distribution of elderly and youthful populations at Golinga and Bontanga. At Golinga, the older population is

slightly more male-dominated, with 53% of respondents being male and 47% being female. In contrast, the youthful population at Golinga is slightly more balanced, with 56% male and 44% female respondents. In Bontanga, the gender distribution of the elderly population is even more male-dominated, with 58% of respondents being male and only 42% being female. However, the gender distribution of the youth population in Bontanga is more balanced, with 52% male and 48% female respondents.

Table 1: Socio-demographic Characteristics of Farmers

Location	Variables		Gender			Percentage		
			Male	Female	Total	Male	Female	Total
Bontanga	Generation	Elder	55	40	95	58	42	79
		Youth	13	12	25	52	48	21
		Total	68	52	120	57	43	100
	Age	>20	0	0	0	0	0	0
		20-30	13	12	25	52	48	21
		31-40	18	16	34	53	47	28
		41-50	29	14	43	67	33	36
		51-60	11	7	18	61	39	15
		60<	0	0	0	0	0	0
		Total	71	49	120	59	41	100
	Level of education	None formal education	24	29	53	45	53	44
		Primary	17	6	23	74	26	19
		Arabic- Makaranta	12	5	17	71	29	14
		JHS	8	3	11	73	27	9
		SHS	7	2	9	78	22	8
		Post-Secondary/Tertiary	5	2	7	71	29	6
		Total	73	47	120	61	39	100
	Marital status	Single	7	1	8	88	12	7
		Married	50	53	103	49	51	86
		Separated	1	0	1	1	0	1
		Divorced	1	1	2	1	1	2
		Widowed	0	6	6	0	100	5
		Total	59	61	120	49	51	100
Golinga	Generation	Elder	41	36	77	53	47	64
		Youth	24	19	43	56	44	36
		Total	65	55	120	54	46	100
	Age	>20	2	2	4	50	50	3
		20-30	24	19	43	56	44	36
		31-40	20	8	28	71	29	23
		41-50	13	15	28	46	54	23
		51-60	5	10	15	33	67	13
		60<	1	1	2	1	1	2
		Total	65	55	120	54	46	100
	Level of education	None formal education	34	51	85	40	60	71
		Primary	4	4	8	50	50	7
		JHS	2	2	4	50	50	3
		SHS	8	5	13	62	38	11
		Arabic- Makaranta	1	0	1	1	0	1
		Post-Secondary/Tertiary	6	3	9	67	33	8
		Total	55	65	120	46	54	100
	Marital status	Single	5	6	11	45	55	9
		Married	53	47	100	53	47	83
		Separated	0	0	0	0	0	0
		Divorced	1	2	3	33	67	3
		Widowed	1	5	6	17	83	5
		Total	60	60	120	50	50	100

These findings may have implications for understanding the social and cultural dynamics of the communities. The majority of farmers engaged in dry season irrigation activities in Golinga and Bontanga were men, with 53% and 58% of the elder population, and 56% and 52% of the youth population respectively. The results from Bontanga Irrigation Project revealed that the 20.8% of farmers were below 20-30 years, 28.3% were between 31- 40 years, and 35.8% were

between 41-50, while 15% were over 51-60 years. Four age categories are chosen to group the sampled farmers into youth, working age, elderly farmers and senior farmers. in this case the age categories in difference stage, for youth adult 20-35, middle-aged 36-50 and senior 51-60 years old. However, the results from Golinga Irrigation Project showed that 35.8% were below 20-30 years, 23.3% between 31 to 41 years, while 12.5% were over 51-60 years old.

The gender analysis shows 53% male farmers in Golinga as well as overall majority were between the age of 31-40 years (71.0%). Bontanga farmers were mainly between the age of 41-50 years (67%). Mature farmers were more involved in irrigated agricultural activities than young people on both projects, as expected. Also, the results are in agreement with (FAO & IFAD, 2019) findings that access to irrigation r in most developing countries is dominated by men. Moreover, gender and age variables play significant roles. However, gender distribution of farmers in both Golinga and Bontanga is close to parity (53% and 58%, respectively at Golinga and Bontanga), and far more favorable than presented in literature, because there was a growing cohort of young male and female farmers in these communities and a programme of promoting more gender-equitable approaches to agricultural production and marketing. Additionally, there were also on-going initiatives that provide training and support for women farmers and promotion of gender-sensitive technologies and practices that create the opportunities for women to participate in decision-making processes related to agriculture (FAO & IFAD, 2019).

The study found that education levels vary among farmers on Golinga and Bontanga. At Bontanga, 6% of farmers had a Post-Secondary or Tertiary education, 19% had a Junior High School education, 8% had a Senior High School education, 13% had a primary education, 10% had Arabic Makaranta education, and 44% had no formal education. In Golinga, a small percentage of farmers have attained higher education, while the majority have no formal education. This suggests that young people with a secondary education are either not interested in farming or are leaving rural areas to find other job opportunities. In comparison, respondents at Bontanga have a higher level of education than those at Golinga.

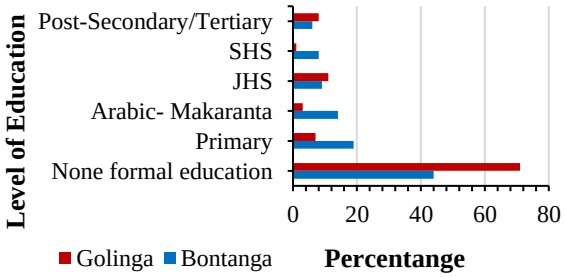


Figure 4: Education Levels of Respondents at Bontanga and Golinga Irrigation Schemes

Land Ownership at the Irrigation Schemes

The study found that at both Golinga and Bontanga, a larger proportion of male farmers own and farm their own land, compared to female farmers (Table 2). In those two irrigation schemes, women do not have equal land rights as men and face barriers in accessing credit and financial resources. Cultural expectations also limit women's ability to farm, as they are often expected to prioritize household responsibilities and child-rearing.

Table 2: Land Ownership at Bontanga and Golinga Irrigation Schemes

Bontanga		**Gender**				**Generation**			
		Frequency		Percentage		Frequency		Percentage	
		Male	Female	Male %	Female %	Elder	Youth	Elder %	Youth %
Land	Yes	60	23	88	44	66	17	70	68
Owner	No	8	29	12	56	29	8	30	32
Golinga		**Gender**				**Generation**			
		Frequency		Percentage		Frequency		Percentage	
		Male	Female	Male %	Female %	Elder	Youth	Elder %	Youth %
Land	Yes	40	20	62	36	41	19	53	45
Owner	No	25	35	38	64	37	23	47	55

Challenges Related to Irrigation Water Management

The challenges faced by farmers in Bontanga and Golinga irrigation schemes are presented in presented in Table 3. These challenges were assessed according to irrigation water management and farming practices. Table 3 and 4 present farmers' challenges related to irrigation water management with two main variables; knowledge of irrigation calender and irrigation water application.

Table 3: Challenges Related to Knowledge of Irrigation Calendar

Location	Challenges	Gender				Generation			
		Male	%	Female	%	Elder	%	Youth	%
Bontanga	Lack of materials	0	0	1	2	0	0	1	4
	Lack of labor	0	0	1	2	1	1	0	0
	Lack of skills	54	79	30	58	67	71	17	68
	Poor management	9	13	4	8	9	9	4	16
	Conflict	4	6	16	31	17	18	3	12
	Lack of labor & skills	1	1	0	0	1	1	0	0
Golinga	Lack of skills	77	100	40	93	77	99	40	95
	Poor management	0	0	2	5	1	1	1	2
	Lack of labor & skills	0	0	1	2	0	0	1	2

Challenges Related to Knowledge of Irrigation Calendar

The results in Table 3 indicated that irrigation water management faces different challenges in Bontanga and Golinga irrigation schemes. In Bontanga, the predominant challenge on knowledge of irrigation calendar was conflict and poor management. Poor management practices could also be contributing to the challenges faced with water management in Bontanga. Poor management, lack of labor, and lack of skills in Golinga were the challenges related to the management of water resources, such as inefficient use of water, inadequate maintenance of infrastructure, and lack of skilled personnel to manage the irrigation system. Lack of labor further exacerbated the situation, leading to reduced productivity and challenges in managing the irrigation system effectively.

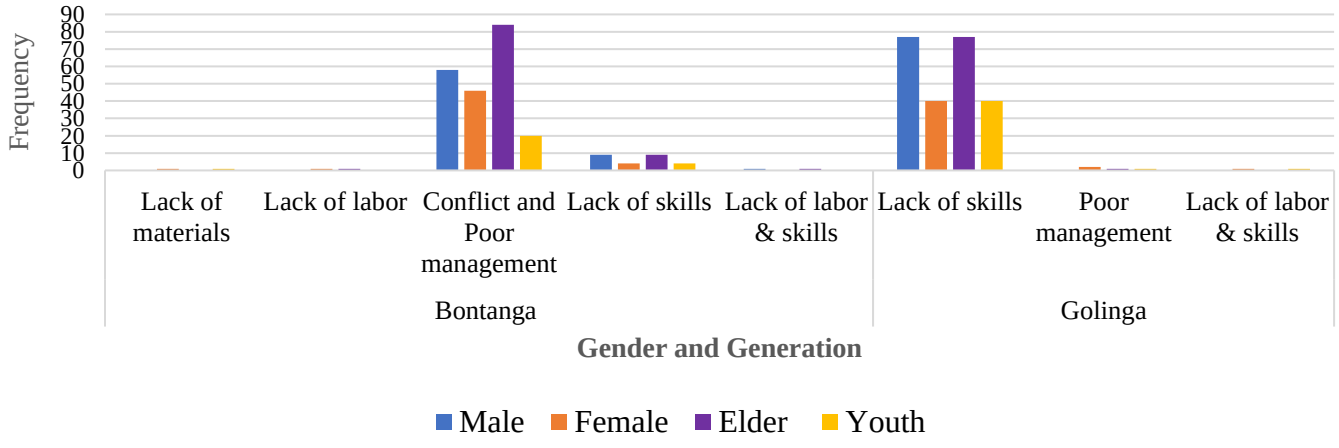


Figure 5: Challenges Related to Knowledge of Irrigation Calendar

Challenges Related to Water Application Methods

Table (4) provides information on the challenges faced by at Bontanga and Golinga, in relation to irrigation water management. The challenges were categorized based on different aspects of water management, including water application methods, water loss, distribution, water source problems, and

others (uncategorized). The main challenge faced by farmers in was the lack of knowledge and skills, according to 23 male and 7 female farmers, respectively. Additionally, 15 male and 9 female farmers reported difficulties with water distribution. Older farmers had more challenges with water application methods and distribution compared to younger farmers. However, the challenges related to water loss and others were reported more frequently by female and younger farmers.

Table 4: Challenges Related to Water Application Methods

Location	Challenges	Gender				Generation			
		Male	%	Female	%	Elder	%	Youth	%
Bontanga	Water application methods	23	34	7	13	24	25	6	24
	water application methods & water loss	5	7	22	42	23	24	4	16
	water distribution	15	22	9	17	19	20	5	20
	Others	25	37	38	73	14	15	10	40
Golinga	Water loss	25	32	20	47	31	40	14	33
	Water source problem	20	26	3	7	16	21	7	17
	Others	32	42	20	47	31	40	21	50

Thus, both Bontanga and Golinga face significant challenges related to water loss during irrigation. In Golinga, the predominant challenge was the availability of water. Both Bontanga and Golinga face challenges related to water distribution during irrigation. At Bontanga, there may be a need to address conflicts through effective water resource management policies, while at Golinga, there may be a need to focus on improving management practices, training personnel, and enhancing labor availability.

Farming Practices
Land Preparation

The most common challenge identified in both locations was a lack of materials, with 57 male and 33 female farmers in Bontanga and 28 male and 10 female farmers in Golinga reporting this issue. Thus, access to materials such as tools, seeds, and fertilizer may be a barrier to effective land preparation at both locations. At Bontanga, lack of materials was the most common challenge reported by farmers across all age groups, with elder farmers reporting the highest number (73). Lack of skills and labor were also identified, although to a lesser extent. At Golinga, weather conditions were identified as a significant challenge by both male and female farmers, alongside lack of labor and materials and skills.

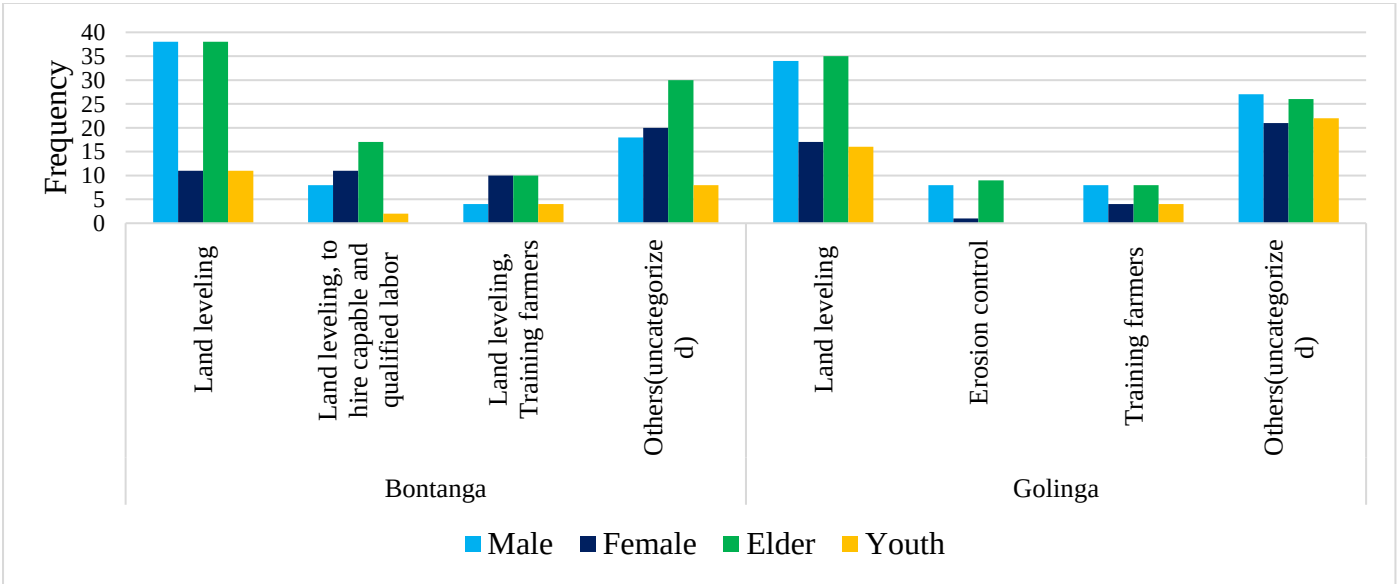


Figure 6: Land preparation problems at the Irrigation schemes

Direct Seeding and Transplanting

At Bontanga, the main challenge reported by both male and female farmers was a shortage of labor. Poor quality seeds and lack of labor were also mentioned, but not as frequently. At Golinga, the most common challenges were water problems and lack of knowledge, with male farmers reporting more issues with water and female farmers reporting more issues with knowledge.

Table 5: Direct Seeding and Transplanting

Location	Challenges	Gender				Generation			
		Male	%	Female	%	Elder	%	Youth	%
Bontanga	lack of labor	37	54	25	48	48	51	14	56
	Poor seeds, lack of labor	7	10	4	8	9	9	2	8
	others(uncategorized)	24	35	23	44	38	40	9	36
Golinga	water issues	24	35	9	21	23	29	10	24
	lack of knowledge	23	30	10	23	25	32	8	19
	water issues, & poor seeds	7	9	10	23	9	12	8	19
	Others (uncategorized)	23	30	13	30	20	26	19	45

Weed Control Issues

The most common challenge at both locations was the high cost of weed control (52 male and 24 female farmers at Bontanga, and 38 male and 12 female farmers at Golinga). Lack of skills was also identified as a challenge by some farmers at both locations (11 male and 13 female farmers at Bontanga and 10 male and 12 female farmers at Golinga).

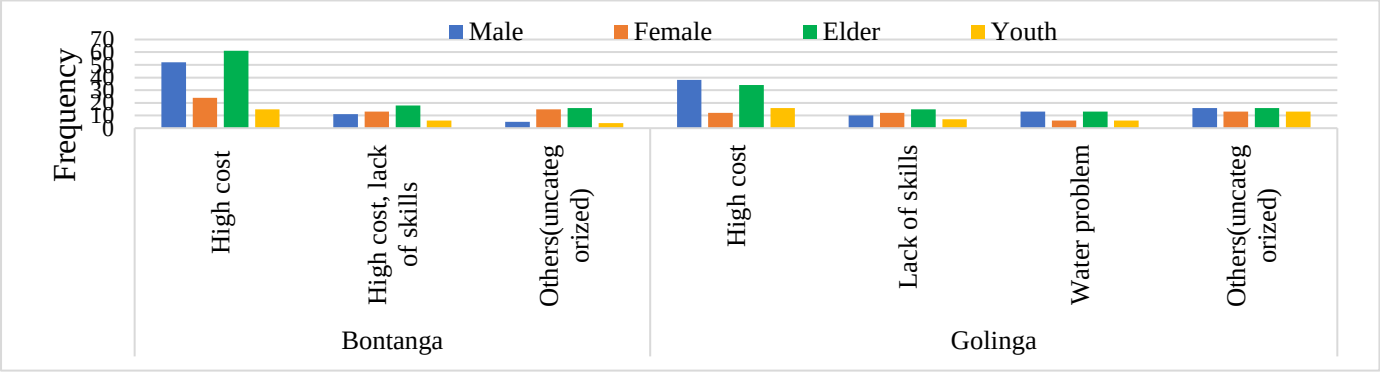


Figure 7: Weed Control issues at the Irrigation Schemes

Fertilizer Application

High cost of fertilizer was reported by 54 male and 30 female farmers in Bontanga and 20 male and 6 female farmers in Golinga. Some farmers also mention a lack of knowledge as a challenge, with 11 male and 5 female farmers in Golinga and 69 elder male and 15 elder female farmers in Bontanga. Challenges related to irrigation water management and farming practices can have significant implications for agricultural productivity, water resources, and sustainability.

Table 6: Fertilizer Application at the Irrigation Schemes

Location	Challenges	Gender				Generation			
		Male	%	Female	%	Elder	%	Youth	%
Bontanga	High cost	54	79	30	58	69	73	15	60
	High cost, lack of agro-dealers	5	7	7	13	9	9	3	12
	Others(uncategorized)	9	13	15	29	17	18	7	28
Golinga	High cost	20	26	6	14	16	21	10	24
	Lack of knowledge	11	14	5	12	10	13	6	14
	High cost, lack of knowledge	4	5	8	19	7	9	5	12
	Others(uncategorized)	42	55	24	56	45	58	21	50

CONCLUSION

In conclusion, addressing the challenges of irrigation water management and farming practices at the Bontanga and Golinga irrigation schemes requires a multifaceted approach that considers the specific needs and circumstances of different groups. Policy interventions should focus on gender-responsive approaches, financial support mechanisms, education and training programs, and mentorship opportunities tailored to the unique challenges faced by men, women, and youth. By addressing these challenges and promoting sustainable agricultural practices, the Bontanga and Golinga schemes can achieve improved water use efficiency, enhanced productivity, and better livelihoods for all stakeholders involved. Lessons learned at these irrigation projects can also be used at other locations across the country.In order to overcome the difficulties faced by farmers at Bontanga and Golinga, it will be helpful to collaborate with local organization or government agencies to enhance the availability of fertilizers and equipment. Additionally, exploring alternative and affordable methods of applying fertilizers could be beneficial at Bontanga, while providing education and training opportunities for farmers could improve their knowledge and skills related to irrigation water management and farming practices.

CONFLICT OF INTEREST

Authors have declared that no competing interests exist regarding the publication of this paper.

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REFERENCES

Abobi, S. M. (2019). *Fisheries Assessment and Trophic Modelling of Tono, Bontanga and Golinga Reservoirs, Ghana*. *2*(December). https://core.ac.uk/download/pdf/297283695.pdf

Adongo, T. A., Abagale, F. K., & Kranjac-Berisavljevic, G. (2015). Soil Quality of Irrigable Lands of Irrigation Schemes in Northern Ghana. *IJISET - International Journal of Innovative Science, Engineering & Technology*, *2*(8), 314–326.

Adongo, T., Abagale, F., & Kranjac-Berisavljevic, G. (2016). Performance Assessment of Irrigation Schemes in Northern Ghana Using Comparative Performance Indicators. *International Journal of Scientifi Engineering and Technology*, *5*, 217–224.

Baba, S. (2016). *Access to Irrigation and Gender : December*.

Bekoe, E. M. O., Amuah, E. E. Y., Abuntori, Z. N., Sintim, E., Kichana, E., & Quarcoo, G. (2021). Water Quality Impact from the Multipurpose Use of the Golinga Reservoir in Northern Ghana. *Water, Air, and Soil Pollution*, *232*(9). https://doi.org/10.1007/s11270-021-05331-9

Benson, O. V., Amaechi, N. M., Mbagwu, F. C., & Opara, G. C. (2017). *Redefining the Role of Women in Agricultural Development in Developing Countries*. 1–12.

Bonye, S. Z. (2022). Can i own land in my matrimonial home? A gender analysis of access to and ownership of agricultural land in Northern Ghana, Ghana. *GeoJournal*, *87*(4), 2685–2697. https://doi.org/10.1007/s10708-021-10396-4

Braimah, I., King, R. S., & Sulemana, D. M. (2014). Community-based participatory irrigation management at local government level in Ghana. *Commonwealth Journal of Local Governance*, *15*, 141–159. https://doi.org/10.5130/cjlg.v0i0.4067

Cobbina, S. J., Kumi, M., & Salifu, A. (2013). *Water Quality lity Assessment of the Bontanga a Reservoir . Reserv*. *3216*, 112–122.

Devkota, M., Gupta, R. K., Martius, C., Lamers, J. P. A., Devkota, K. P., Sayre, K. D., & Vlek, P. L. G. (2015). Soil salinity management on raised beds with different furrow irrigation modes in salt-affected lands. *Agricultural Water Management*, *152*, 243–250. https://doi.org/10.1016/j.agwat.2015.01.013

FAO, & IFAD. (2019). Gender dimensions of agricultural and rural employment : Differentiated pathways out of poverty Status , trends and gaps and rural employment : In *Food and Agricultural Organization of the United Nations, the International Fund for Agricultural Development and the International Labour Office*.

Kaini, M. (2020). Role of Agriculture in ensuring Food Security. *International Journal of*

Humanities and Applied Social Science, 1–5. https://doi.org/10.33642/ijhass.v5n1p1

Khatib, M., Obando, J., & Murimi, S. (2017). Effects of irrigation management practices on water allocation among farmers in Kiladeda sub-catchment, Tanzania. *Hydrology and Best Practices for Managing Water Resources in Arid and Semi-Arid Lands*, 70–85. https://doi.org/10.4018/978-1-5225-2719-0.ch004

Pérez, A. (2017). agriculture, environment and sustainable development in nigeria: some issues. *BMC Public Health*, *5*(1), 1–8. https://ejournal.poltektegal.ac.id/index.php/siklus/article/view/298%0Ahttp://repositorio.unan.edu.ni/2986/1/5624.pdf%0Ahttp://dx.doi.org/10.1016/j.jana.2015.10.005%0Ahttp://www.biomedcentral.com/1471-2458/12/58%0Ahttp://ovidsp.ovid.com/ovidweb.cgi?T=JS&P

Ritzema, H. P., Satyanarayana, T. V, Raman, S., & Boonstra, J. (2008). *Subsurface drainage to combat waterlogging and salinity in irrigated lands in India : Lessons learned in farmers ' fields*. *95*, 179–189. https://doi.org/10.1016/j.agwat.2007.09.012

Zwarteveen, M. (1997). Water: From basic need to commodity: A discussion on gender and water rights in the context of irrigation. *World Development*, *25*(8), 1335–1349. http://www.sciencedirect.com/science/article/pii/S0305750X97000326