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An Exploratory Study of the Impact of the One-Village-One-Dam Initiative in Northern Ghana

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Abstract: This study is an exploratory examination of the effect of the Ghana government's flagship program known as the One-Village-One-Dam (1V1D) initiative on the livelihoods of rural farmers in the five regions of Northern Ghana. A total of 15 constituencies proportionate to the number of constituencies in each of the five beneficiary regions were selected from the region. Data were collected from a total of 1585 respondents, comprising 785 from the control group and 800 from the treatment group. The survey focused on access to water, crop and livestock productivity, income generation, and overall well-being. Four main findings are reported. First, the results show differential effects of the 1V1D initiative. There was an increase in reliance on 1V1D dams for water, particularly in the Northern region, where challenges such as insufficient water storage and poor dam maintenance hindered their effectiveness for irrigation and livestock rearing. Second, the use of water from boreholes was more popular in the other parts of Northern Ghana. Third, the shallowness of most of the dams meant that they dried up during the dry season and, therefore, did not have a significant effect on crops and livestock productivity. Finally, the dams had a marginal effect on food security, income levels of the farmers, and consequently on their overall livelihoods. The findings of this exploratory study will provide insights to enrich further studies based on the second and third rounds of data collection.

Keywords: dam; food security; irrigation; farmlands; climate change; water security; well-being; Ghana

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Citation: Adams, S.; Martey, M.; Amoatey, C.; Taabazuing, J.; Otoo, R.; Abokyi, E. An Exploratory Study of the Impact of the One-Village-One-Dam Initiative in Northern Ghana. *Sustainability* **2024**, *16*, 8570. https://doi.org/10.3390/su16198570

Academic Editor: Wen-Hsien Tsai

Received: 23 July 2024
Revised: 15 September 2024
Accepted: 19 September 2024
Published: 2 October 2024

1. Introduction

Around the world, agricultural productivity is constrained by inadequate water resources. Many research studies show that sustainable water management promotes better production for consumption and commercial purposes and helps economic activities necessary for uplifting rural economies [1,2]. Ghana has been noted as one of the most vulnerable countries to the adverse effects of climate change due to over-dependence on rain-fed agricultural systems [3,4]. This suggests that water conservation is a critical issue for the livelihoods of millions of farmers [5]. Accordingly, the provision of water has been described as a game-changer in the livelihoods of farming communities in northern Ghana, as the agricultural sector is the largest water user (73% of total withdrawals) [6]. High rainfall shocks have resulted in marked levels of poverty and inequalities that raise concerns about Ghana's effort towards the realization of the Sustainable Development Goals (SDGs), and in particular SDG 6 [7–9]. This is why Acheampong et al. (2014) aver that small dams offer a lifeline to rural communities in northern Ghana during the dry season [10].

Gariba and Amikuzuno (2019) claim that because of the irregular rainfall patterns in the north, small dams are mostly considered to ensure a year-round growing season [11]. Dams are, therefore, seen as one of the most potent symbols of economic development for much of the 20th century. Of late, however, claims of the inherent environmental and social sustainability of small dams are widespread [12,13]. It is worth mentioning that while the construction of dams is reducing in many developed countries in the US and Europe, the reverse is the case for under–dammed regions, mostly in Asia and Africa [14]. Currently, irrigated agriculture makes up 20% of all cultivated land globally but produces 40% of the world's food supply. This type of agriculture is more productive per unit of land compared to rain-fed agriculture, enabling greater intensification of production and more variety in crops grown [15,16].

The implication is that dams could have beneficial effects through improvement in access to water and farmlands, consequently, agricultural productivity and progress in the livelihoods of citizens. The question then, is as follows: how are dams built under the government's 1V1D initiative impacting the beneficiary communities? This is the research gap driving the study. The specific objectives are to explore the effect of the IVD on access to water for domestic and commercial purposes, crop and livestock production, overall food security, income, and, consequently, the general well-being of beneficiary communities. In achieving the research objectives, the study will provide evidence concerning the value of small dams in the region, as there are not enough studies on the impact of small earth dams on the livelihoods of the beneficiary communities. It is worth mentioning that few studies have examined the effect of small dams on farm productivity and farmers' livelihood. Roan (2023), for example, examined the effect of the Nabdam dam in the Upper East region, while Jarawura (2014) focused on the Nanton/Savelugu district, and Acheampong et al. (2014) studied the case of 16 dams in the Upper West and East Regions [2,10,17]. This paper contributes to the small dam-development debate by employing more comprehensive data from northern Ghana's five regions (30 communities from 15 constituencies). The implementation of the government's flagship program, the One Village One Dam (IVID) initiative, provides an opportunity for this research based on the perspective of the beneficiaries. Additionally, the study provides evidence of the local context and other factors that could moderate the dam-livelihood dynamics. The findings will lead to evidence-based policy to ensure optimal developmental outcomes.

The study is organized as follows: in the next section, a brief review of the literature on dams and their impact on beneficiaries is presented. The data and methodology required to answer the research objectives are then described, the results presented, the conclusions given, and recommendations offered.

2. Review of Literature

The literature review provides a brief background of the 1V1D, after which theoretical and empirical studies related to dams are discussed.

2.1. The One Village One Dam Initiative

The One Village One Dam (1V1D) initiative is one of the Government of Ghana's six flagship programs to improve agricultural productivity. As the name suggests, the program aims to dig a dam in every village in the targeted regions to provide water for livelihood activities, especially during the dry season [18]. The purpose of 1V1D was to provide water to rural smallholder farmers to improve food and water security, crop yields, and socioeconomic well-being and reduce rural-to-urban migration [2,19]. It is therefore not surprising that Ahodo (2024) described the 1V1D as one of the best agriculture-related policies in Ghana. The 1V1D initiative led to the construction of over 500 small dams in the five northern regions of Ghana, designed to cover a land size ranging between two to three hectares, an earth embankment wall of height five meters, and a length ranging between 250 and 350 m each [20]. The Ghana government funded the construction of the dams, and communities were expected to form committees to oversee the effective operation of the dams under the supervision of the Ghana Irrigation Development Authority.

2.2. Theoretical and Empirical Discussion of Dams and Development Outcomes

The theoretical assumption of the study is based on Kirchherr and Charles' (2016) framework. This framework has been used by many other studies [12,21–23] to analyze the impact of dams (see Figure 1). The framework shows the impact of dams from a 'component' (infrastructure, livelihood, and community) and 'dimension' (space, time, and value) perspective. The dimensions of social impact are the variables' context. Any social impact component may occur alongside the different dimensions of social impact. The components of social impact are not mutually exclusive but rather sequential. Infrastructure changes may induce changes in livelihood which, in turn, may bring changes in the community. Accordingly, the framework provides a comprehensive analysis of the impacts of the 1V1D initiative as it relates to well-being, agricultural yields, and livestock production.

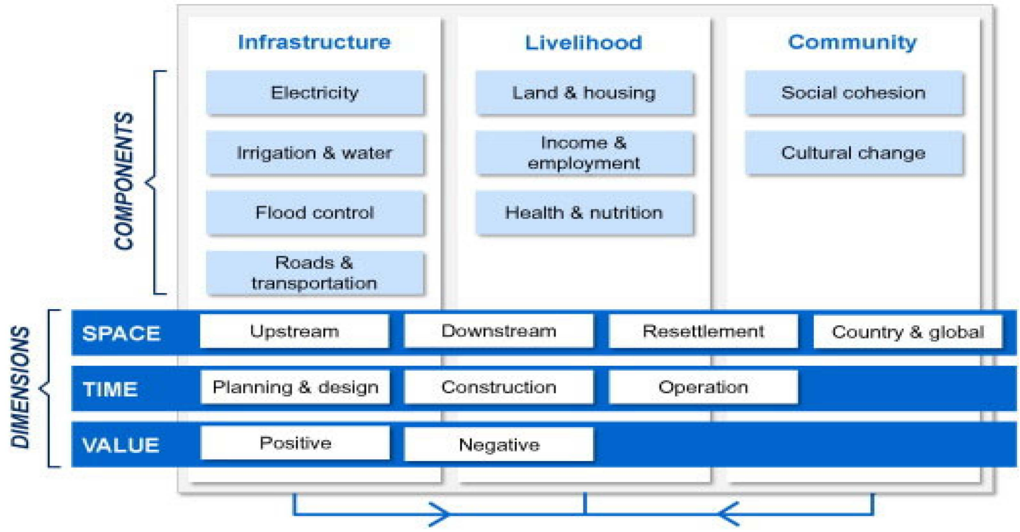


Figure 1. Impact of dams. Source: Kirchherr and Charles (2016).

Fundamentally, the presence of dams facilitates the intensification of production through the extension of the growing period of farm produce and climate change adaptation, which allows for multiple production and consequently generates higher output and income for the farmers [24–27]. The many benefits of dams have led to their description as transformational agents for development [2,28]. Generally, some studies suggest that small-scale irrigation broadens the range of crops that farmers may cultivate and improves food security, incomes, and women empowerment [29–31]. Empirically, a study conducted by Jarawura (2014) in the Nanton/Savelugu district in northern Ghana assessing drought and migration effects found that the two variables are related to over 50% of migration instigated by drought [17]. The findings support Carvajal et al.'s (2014) study which found that the presence of the dams led to an increase in the productivity and variety of crops produced, livestock production, and domestic water consumption [32]. Adebayo et al. (2018) employed a linear regression with endogenous treatment and Propensity Score Marching (PSM) technique to show a positive effect of irrigation on crop yield, income, and food security in Nigeria [33]. In an earlier study of the Northern Region, Kuwornu and Owusu (2012) found a positive effect of irrigation on per capita consumption expenditure. Specifically, the PSM results showed a gain between GHC 24.9 to GHC 28.3, and the Switching and OLS regression showed a gain of GHC 23.7 and GHC 5.4, respectively [34]. The exchange rate in 2012 was about 1.8–1.9 per dollar. In a related study of South Africa, Blanc and Strobl (2014) report that small dams might be more useful than large dams concerning the level of yield [16].

Contrary to the benefits identified above, dams may reduce nutrient transport, increase loss of biodiversity, disrupt traditional livelihood systems, increase pollution challenges, and reduce the transmission of vector- and water-borne pathogens [32]. Other studies show that dams affect malaria and child mortality and could worsen climate change impacts [35,36].

Similarly, a study by the International Food Policy Research Institute (IFPRI) (2015) showed that in developing countries, government expenditure on irrigation has a modest impact on economic growth and poverty reduction and that returns on investment in irrigation have been small [37,38]. Finally, the Northern Patriots in Advocacy and Research (NOPRA), for example, in the evaluation of Ghana's 1V1D reported that:

> The 1V1D initiative was widely received by the chiefs and residents of Upper East, Upper West, Savannah, North East, and Northern Regions when the government announced the desire to construct the dams and subsequently cut sod for the project in Ayopia in the Bongo District of the Upper East Region. But the projects have become an apology for their intended purpose with dams said to have been 100% completed drying up before March 2023.

Further, the report indicates that the 1V1D projects with 100% completion status in 10 beneficiary communities visited were drying up with six (6) out of the 10 dams completely dried up. Additionally, all 159 participants in the focus group discussions and community scorecard exercise in seven beneficiary communities disagreed that 1V1D has contributed to increased agricultural productivity, food security, and job creation. In a later report, the Executive Director of NORPRA pointed to the poor implementation of the 1V1D initiative, explaining that although the 1V1D project could have helped the country attain food sufficiency, government officials squandered the resources allocated for their implementation, resulting in poor execution of the projects [28]. The literature reviewed shows that many factors moderate the effect of dams, and therefore, to reduce the bias in our results, we employ the Kirchherr and Charles (2016) framework to provide a more comprehensive analysis of the impact of dams on livelihoods [21]. The data and methodology used to achieve the research objectives are described next.

3. Methodology and Study Design

The design involves the computation of changes in the average values of some outcome indicators in communities with dams over two years minus changes in values of similar indicators in communities without the dams (control) over the same period. To ensure that the treatment and control communities are similar we tried to select communities with similar characteristics like rural or peri-urban as well as population size.

3.1. Sampling Design and Sample Size

A multi-stage cluster sampling design was adopted in the selection of the treatment communities. In the first stage, the project coverage areas were stratified into five regions: Northern, Savana, North East, Upper West, and Upper West. A total of 15 constituencies proportionate to the number of constituencies in each of the five beneficiary regions were selected from the regions. In the second stage, two communities, each with a 1V1D dam, were then selected from each constituency, making a total of 30 treatment communities. In the third stage, at least 23 households were selected randomly from each selected treatment community. To account for attrition, a 15% margin was added to the sample in the treatment communities.

For the control group, two (2) communities without a dam were selected from each of the 15 constituencies. The selected control communities were at least 4km away from a dam (treatment) to deal with spillover effects. The similarity of the selected communities was arrived at based on pre-matching community variables. A random approach was employed as was performed for the treatment group. The breakdown list of the number of respondents from the various communities is attached as Appendix A and their geographical location as Appendix B.

3.2. Data Collection

The processes for data collection, from training and piloting of the instrument to collecting data, took three weeks. The enumerators had rich experience in conducting surveys and interviews in the study area. The data collection covered a total of sixty (60) communities, fifteen (15) constituencies, and five (5) regions. We employed the KoboCollect toolbox—an online survey tool that allows data collection with or without internet access—for the data collection. The toolbox on an Android tablet was used in a face-to-face interview to collect and transmit the household-level data. The toolbox significantly reduces the time spent on questionnaire administration if data are to be collected through the use of a pen-to-paper approach to data collection. It also helped eliminate the element of data coding, data template design, and entry. Additionally, data quality will be ensured since the necessary logic and controls will be incorporated. Further, the toolbox was useful, especially in communities where internet access is a major challenge. At the end of each day of work, during the field data collection, supervisors checked the forms filed by the enumerators before they were submitted to the server to ensure completeness and spot-check for errors.

4. Results and Discussion

The results are presented per the objectives identified. The key demographics of the respondents are presented to provide a contextual understanding of the data sources.

4.1. Key Characteristics of the Respondents

The sample included a total of 1585 respondents including 800 respondents from the control and treatment groups, respectively. As shown in Table 1 below, the highest number of respondents for the treatment (35.3%) and control (33.5%) groups came from the Northern region. As shown in Appendix A, the number of households surveyed in each community ranged between 23 and 33, except KunKwa in the Bolga East Constituency of the Upper East Region and Tambing in the Yunyoo Constituency in the North-East region, with 19 and 20 respondents, respectively. The data show that 60.0% and 61.3% of the respondents in the treatment and control communities, respectively, were males. The majority of the respondents, 61.9% and 62.3% from the treatment and control communities, respectively, do not have any formal education. Only 14.5% of the treatment and 10.4% of respondents in the control communities had secondary education, and even a smaller figure for tertiary education (1.9% and 2.3%, respectively, for treatment and control groups, respectively). The results show that there is no significant difference between the ages and household size of the two groups. This study is exploratory to help in the identification of baseline conditions. This means that the lack of significance difference at the initial stage helps in detecting impact, if any, at the end line. It is worth mentioning that two more rounds of data (mid-line and end-line) will be collected to identify the impact of the 1V1D initiative.

Table 1. Characteristics of respondents.

Variable	Treatment	Control	*p*-Value
Observations	785 (100%)	800 (100%)	
Sex of Respondent (Male)	471 (60.0%)	492 (61.5%)	
Age of Respondents: Mean (S.D.)	40.7 (16.2)	42.0 (16.1)	0.101
Ave Household Size: Mean (S.D.)	7.8 (5.0)	7.5 (4.2)	0.186
Highest Level of Education:			
No Formal Education	486 (61.9%)	498 (62.3)%	
Primary	67 (8.5%)	79 (9.9%)	
JHS	77 (9.8%)	86 (10.8%)	0.143
SHS	114 (14.5%)	83 (10.4)	
Diploma	26 (3.3%)	36 (4.5%)	
Degree	15 (1.91)	18 (2.25)	
Regions (%):			
Northern Region	277 (35.3%)	268 (33.5)	
Upper East Region	151 (19.2%)	152 (19%)	
Upper West Region	142 (18.1%)	173 (21.6)	0.486
Savanna Region	104 (13.3%)	105 (13%)	
North-East Region	111 (14.1%)	102 (12.8)	

4.2. Community Accessibility to Water for Domestic and Commercial Purposes

To assess the usefulness of the dams in providing water for domestic and commercial purposes, five (5) indicators were employed, including:

1. A major source of water for domestic and commercial use;
2. Time taken to walk to the major source of water;
3. Quantity of water used for domestic purposes in a week;
4. Quantity of water used for commercial purposes in a week;
5. Value of water used for commercial purposes.

The responses to a question as to the major source of water for households are presented in Table 2, which highlights the regional variation in the importance of the 1V1D as a major water source for households. Table 2 shows that in the Northern Region, communities with the 1V1D tend to rely on dam water as their major water source for domestic use (39.7%). This is in sharp contrast with other regions like the Upper East and Upper West where they rely mainly on boreholes as their main water source. The value of the 1V1D may be seen more as a source of water rather than irrigation in the Northern Region, where boreholes are not technically viable. An opinion leader in the Upper West Region reflected this thinking when he said the following:

Table 2. Major uses and sources of water by households.

Region	Source of Water	Domestic		Commercial	
		Control	Treatment	Control	Treatment
North East	1V1D	0.0%	6.3%	0.0%	10.0%
	Borehole	66.7%	67.6%	53.8%	65.0%
	Hand Dug Well	3.9%	14.4%	3.8%	5.0%
	Pipe Borne Water	2.0%	3.6%	0.0%	0.0%
	Pond or Dam not Under 1V1D	2.9%	0.9%	3.8%	5.0%
	River	2.9%	0.0%	38.5%	10.0%
	Other	21.6%	7.2%	0.0%	5.0%
	Total	**100%**	**100%**	**100%**	**100%**
Northern	1V1D	1.6%	39.7%	1.4%	32.5%
	Borehole	35.3%	30.6%	20.3%	26.5%
	Hand Dug Well	13.9%	4.0%	6.8%	2.4%
	Pipe Borne Water	0.4%	1.2%	0.0%	0.0%
	Pond or Dam not Under 1V1D	28.2%	19.0%	66.2%	37.3%
	River	2.0%	1.2%	0.0%	1.2%
	Other	18.7%	4.4%	5.4%	0.0%
	Total	**100%**	**100%**	**100%**	**100%**
Savannah	1V1D	0.0%	8.7%	0.0%	20.8%
	Borehole	95.2%	74.0%	94.1%	75.0%
	Hand Dug Well	0.0%	1.0%	0.0%	0.0%
	Pipe Borne Water	3.8%	14.4%	0.0%	0.0%
	Pond or Dam not Under 1V1D	1.0%	0.0%	0.0%	0.0%
	River	0.0%	1.9%	0.0%	0.0%
	Other	0.0%	0.0%	5.9%	4.2%
	Total	**100%**	**100%**	**100%**	**100%**

Table 2. *Cont.*

Region	Source of Water	Domestic		Commercial	
		Control	Treatment	Control	Treatment
Upper West	1V1D	0.0%	0.0%	0.0%	2.4%
	Borehole	97.7%	100.0%	97.6%	90.2%
	Pipe Borne Water	1.7%	0.0%	0.0%	0.0%
	Pond or Dam not Under 1V1D	0.6%	0.0%	0.0%	0.0%
	Hand Dag Well	0.0%	0.0%	2.4%	0.0%
	Other	0.0%	0.0%	0.0%	7.3%
	Total	**100%**	**100%**	**100%**	**100%**
Upper East	1V1D	0.0%	0.0%	0.0%	0.0%
	Borehole	87.5%	82.8%	96.2%	73.3%
	Hand Dug Well	8.6%	10.6%	3.8%	20.0%
	Pipe Borne Water	2.0%	3.3%	0.0%	3.3%
	Pond or Dam not Under 1V1D	2.0%	2.6%	0.0%	3.3%
	River	0.0%	0.7%	0.0%	0.0%
	Other	0.0%	0.0%	0.0%	0.0%
	Total	**100%**	**100%**	**100%**	**100%**

> "If the 1V1D cannot be used for irrigation, it is of little value to people in this area since water for domestic use can easily be obtained from boreholes and hand-dug wells".

About half of the respondents indicated that it takes them less than 10 min to walk from their house to the source of water. Also, 11% of the treatment and 9% of respondents from the control communities indicated that it takes them more than 30 min to walk from their houses to the source of water (see Figure 2).

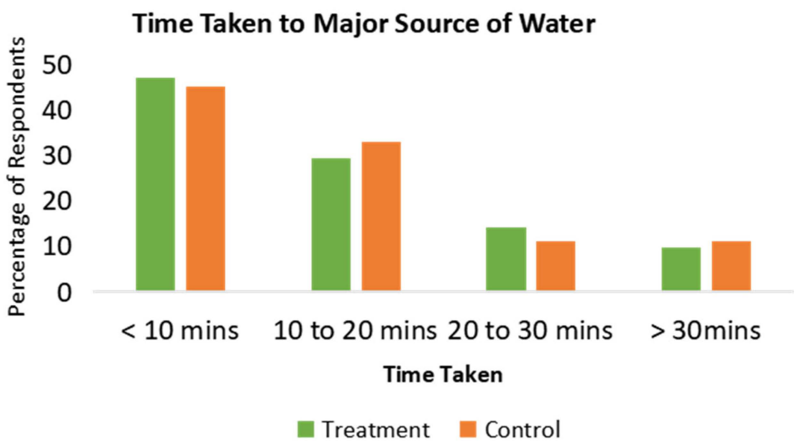


Figure 2. Average time taken to walk to the main source of water.

Table 3 captures the quantity of water used for domestic purposes, the quantity used for commercial purposes, and the cost of water for commercial purposes.

The usage of water in the treatment group (0.214 cubic meters) was higher than in the control group (0.192 cubic meters). On average, more water was used for commercial purposes in the control group (0.404 cubic meters) than in the treatment group (0.340 cubic meters). This, to some extent, explains why the expenditure on water is higher in the control group (GHC 13.7) compared to the treatment group (GHC 13). The exchange rate was about 8 Ghana cedis to 1 dollar when data were collected.

Table 3. Average quantity of water used in a week in cubic meters.

Indicator/Variable	Control (797)		Treatment (773)		Mean Diff.	*p*-Value
	Mean	Std. Err	Mean	Std. Err		
Quantity of water used for domestic purposes	0.192	4.4	0.214	10.7	0.022	0.053
Quantity of qater for commercial purposes	0. 404	121.1	0.340	37.2	0.064	0.614
Weekly value of water for commercial purposes	0.014	1.94	0.013	1.78	0.005	0.79

The findings of the study are consistent with Gezie et al. (2023) and Pradhan and Srinivasan (2022) who indicated that dams improve water accessibility to households [31,39]. In a related study, Gariba and Amikuzuno (2019) reported that dams have been instrumental in improving water access in the Sisili-Kulpawn Basin of the Northern Region of Ghana [11]. More recently, Ayertey et al. (2024) report that dams have been useful as a domestic source of water in the Guinea Savannah Agro-Ecological Zone of Ghana [15]. Overall, the results show that the dams are more popular in the north than in other parts of the Northern Region of Ghana. The differential effects of the dams suggest that the government must be strategic in addressing the water needs of the different communities. Kabore et al. (2024), however, have noted that the challenges associated with small dams in the West African region, including internal erosion, pore overpressures, settlement, and deformation, should be dealt with to improve their functionality and, consequently, beneficial effects [40].

4.3. V1D and Crop Production

The responses on how the 1V1D initiative impacts crop production are summarized in Table 4.

Table 4. Households who use water for crop production.

Irrigative Farming	Control		Treatment		Chi^2 *p*-Value
	Frequency	Percentage	Frequency	Percentage	
Yes	38	4.75	109	13.89	0.00
No	762	95.25	676	86.1	
Total	800		785		

Nearly 14% of households in the treatment communities and 5% (4.9%) of the control group used water for crop production, which might suggest that the 1V1D stimulated more households in the beneficiary communities to undertake dry-season farming. The generally low level of dry-season farming may be traced to inadequate water for irrigation purposes. An opinion leader had this to say:

> "When we are not getting water to drink in the dry season, why would someone want to use it to farm? No, I don't think the community will allow".

The respondents were then asked to indicate their source of water for dry-season farming, and the responses are presented in Table 5.

For the treatment communities, dams were the source of water (38.5%), while the control communities were mainly dependent on boreholes (31.6%) for their irrigation water for crops like bira, onions, tomatoes, pepper, and garden eggs.

Table 5. Main source of water for irrigation.

Main Source of Water for Irrigation	Communities with 1V1D	Communities without Dams
Borehole	18.4%	31.6%
Hand-dug well	6.4%	18.4%
River	0	0
1V1D	38.5%	0
Dam not under 1V1D	31.2%	21.1%
Other sources (buying water, rainwater)	5.5%	29%

4.4. Livestock Production

This section assesses the level of livestock rearing in the treatment and control communities, and the results are summarized in Table 6.

Table 6. Percentage of Households with Livestock.

Ownership of Livestock	Control		Treatment		Chi^2 *p*-Value
	Frequency	Percentage	Frequency	Percentage	
Yes	592	74.0	563	70.8	0.327
No	208	26.0	221	28.2	
Total	800		784		

More than 70% of households in both the treatment and control groups own livestock. While the control group has a slightly higher ownership rate (74%) compared to the treatment group (70.8%), this difference is not statistically significant. On average, households in the treatment communities own 3.12 animal units, whereas households in the control communities own 3.68 animal units. However, this difference is not statistically significant at the 95% confidence level. The treatment group exhibited relatively higher values for both the number of animal units sold (0.19) and animal units consumed (0.12), compared to 0.17 and 0.06, respectively, for the control group. Notably, only the difference in the number of animal units sold is statistically significant as reported in Table 7.

Table 7. Average quantity of livestock per household.

Indicator	Baseline		
	Control (800)	Treatment (785)	Mean Diff
	Mean (Std Err)	Mean (Std. Err)	(*p*-Value of *t*-Test)
Number of animal units owned by household	3.68(0.44)	3.12(0.3)	−0.57 (0.29)
Number of animal units sold	0.17(0.02)	0.19(0.24)	0.01 (0.65)
Number of animal units consumed	0.06(0.01)	0.12(0.05)	0.06 (0.24)

Note: 1 matured cow is equivalent to one animal unit, 2 young cows are equivalent to 1 animal unit, 2 matured donkeys are equivalent to 1 animal unit, 4 young donkeys are equivalent to 1 animal unit, 10 matured sheep/goat = 1 animal unit and 20 young sheep/goat = 1 animal unit.

4.5. Household Income Traced to Water Use (Irrigation/Livestock)

A graphical presentation of the average income during the dry season and livestock farming is presented in Figure 3 and Table 8. The average income from dry season farming and sale of livestock per household in the treatment group was Ghc 1900 and Ghc 885, respectively, while that of the control group was GHC 2130 and GHC 714, respectively. Households in the treatment group, on average, earned a little more from the sale of livestock compared to the control group, while the households in the control group, on average, earned a little more from the dry season farming compared to the treatment group. The *t*-tests, however, show no significant difference between the two communities. Some farmers also complained of losing significant numbers of their livestock due to disease outbreaks. This was attributed to limited access to veterinary services, which reduced the potential gains and profitability of the livestock.

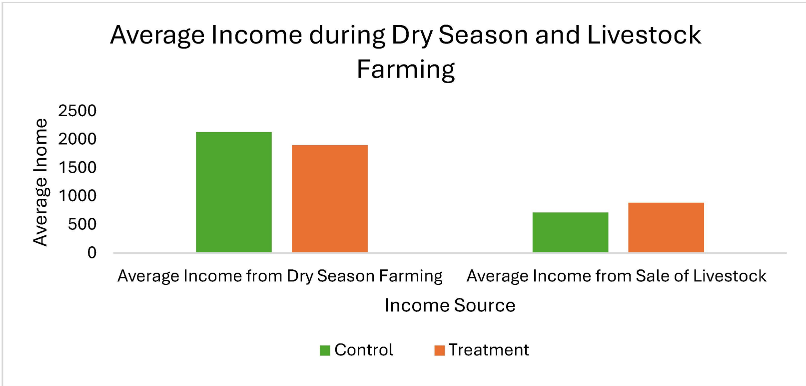


Figure 3. Income from Irrigation and Livestock in the Previous Year.

Table 8. Income from Irrigation and Livestock in the Previous Year.

Indicator/Variable	Control		Treatment		*p*-Value
	Mean	Std. Err	Mean	Std. Err	
The period in a year where there are food shortages in your household has improved this year compared to last year.	2.3	1	2.3	1.1	0.731
The general food security situation in your household has improved this year compared to last year.	2.3	1	2.3	1	0.696

4.6. Household Food Security

The perception of the communities on food security and household well-being is presented in Tables 9 and 10. The rating on a scale of 1 to 5 expresses the extent to which the respondent agrees or disagrees with the sets of statements outlined where 1—strongly disagree, 2—disagree, 3—cannot say, 4—agree, and 5—strongly agree. The higher the mean average rating, the more the household head perceives its well-being to be better this year than the previous year. The mean rating in both control and treatment groups for each question was 2.3, and therefore, no difference between them.

Table 9. Perception of Food Security.

Indicator/Variable	Control		Treatment		*p*-Value
	Mean	SD	Mean	SD	
The period in a year where there are food shortages in your household has improved this year compared to last year.	2.3	1	2.3	1.1	0.731
The food security situation in your household has improved this year compared to last year.	2.3	1	2.3	1	0.696

Table 10. Self-assessment of household well-being.

Indicator/Variable	Control		Treatment		Mean Diff.	p-Value
	Mean	SD	Mean	SD		
Considering health, I will say my well-being has improved.	2.9	0.04	2.9	0.04	0.06	0.789
Considering social support and solidarity, my well-being has improved.	2.7	0.04	2.5	0.04	0.13	0.019
Considering food security, my well-being has improved.	2.5	0.03	2.4	0.03	0.07	0.14
Considering peace of mind, my well-being has improved.	2.9	0.04	2.9	0.04	0.04	0.436
Considering income, I will say my well-being has improved.	3.3	0.04	3.3	0.04	0.028	0.617

4.7. General Well-Being of Household

Well-being is assessed from five dimensions, including health, social support, food security, peace of mind, and income. The statements compare the current year to the previous year in a positive statement. This then means that the higher the mean average rating is, the higher the perception is that well-being is better this year compared to the year before. As shown in Table 10, except for the income indicator, which recorded a mean rating of 3.3 for both treatment and control groups, all the other indicators recorded values below 3.0. More specifically, the health and peace of mind indicators recorded a mean value of 2.9 each. For social support, the control group recorded an average of 2.7, while the treatment group recorded 2.5. This means that both groups disagree with the statement, though the level of disagreement is higher in the treatment group. The difference is also significant at 5%. For food security, the mean rating by the household was 2.5 and 2.4 for the control and treatment groups, respectively, though not significant. It can be concluded that, except for the social support indicator, there is no significant difference between the two groups.

Many other studies have reported a positive effect of dams on crop and livestock production. This explains why Shaibu et al. (2019) argue that dams offer one of the best strategies for promoting food security, local employment, and as a result, improvements in income and poverty alleviation [27]. Similarly, Blanc and Strobl (2014) assert that dams positively affect cropland productivity [16]. The dams are expected to expand the variety of livestock and crops that the farmers can grow, which are critical in improving food security, women empowerment, and spending on health and education through the income effect [29]. Pradhan and Srinivasan's (2022) observation of the underperformance of dams is worth reiterating here and is indicative of the fact that dams could have both negative and positive effects [31]. It is worth mentioning that their study was based on a large dam. The literature was reviewed, and the findings of the study show that dams could have both positive and negative effects. This is well explained by Roan (2023), who intimates that the dams developed through the 1V1D initiative have been suboptimal and are mostly inadequate in supplying the water needs of the communities during the dry season farming [2]. This suggests that the policy is yet to reach the expected goal as a government flagship program to improve water access, crop and livestock productivity, income and the overall well-being of households. It is worth reiterating Ampadu et al.'s (2015) findings of the Vea dam in the Upper East region of Ghana, which show that though the dam had negative effects, it helped to improve the availability of water for domestic and commercial uses and agricultural activities [41,42]. The authors report that the positive effects far outweighed the negative effects and recommended that the government should work with stakeholders to identify constructive and innovative ways to maximize the benefits and minimize the negative effects of dams.

4.8. Other Findings and Unintended Effects of the Intervention

Some unintended effects emerging from the 1V1D program, as noted by the research team, are the following:

- Most of the dams have wild fish growing in them. Communities that depend heavily on the dam water for domestic use forbid the harvesting of such fish due to the fear of contaminating the water. In other communities like Kulinkpegu and Sando, controlled fishing is permitted whereby the community will invite fishermen to harvest the fish, take some, and the rest sold to community members, and the income put into a community development fund. For example, the Kulinkpegu community reported GHS 1,000 income from the sale of fish from their dam, which has been kept in their community development fund;
- In some communities with the 1V1D, Fulani herdsmen often send their cattle in large numbers to drink water from the dam and, in the process, trample on the dam embankment, thereby weakening it. This is associated with faster drying up of the dams and less water available for the community, which contributes to conflict between the herdsmen and the community members;
- Many of the dams were not functional and did dry up during the dry season. Due to a lack of good planning, including the selection of appropriate micro-dam sites and design, many of the dams suffered from shallowness, serious sedimentation, and water leakage problems, resulting in the drying up of dams, especially during the dry season.

5. Conclusions

This is an exploratory study of the initial effect of the 1V1D on the livelihoods of the communities in which they were implemented. The findings of the study reveal that almost 40% of households in communities with 1V1D rely on the dam as a major source of water for domestic and commercial purposes, while most households in the Upper East and West regions rely mostly on boreholes. An interesting observation in the treatment communities is that, in many cases, animals and human beings drink from the dam. Additionally, the findings show that dams have marginal use during the dry season, and even for those who farm, the land size is small. Moreover, the dammed communities seem to have more sheep and goats and sell more than the control communities, but the difference is not statistically significant. Finally, the 1V1D has not yet triggered the substantial impact on household food security as was intended. That is, the promise of the 1V1D as a practical solution to the pressing needs of the people is somewhat in doubt.

The findings of the study provide the following policy recommendations. First, the government should consider embarking on a complementary program to enhance the functionality and use of the dams, such as strengthening the embankments of some dams and creating a filtration section for drinking water for households such that animals could access drinking water at different outlets. Second, to enhance the usefulness and value for money related to the design and construction of dams, it is desirable to consider diverse local contexts rather than the one-size-fits-all-all strategy. For example, whereas small earth dams in many villages within the Northern Region may be useful within the context of heavy reliance on surface water in such communities, one big dam in each district where there is enough water for irrigation may be more suitable in areas like Upper East and Upper West. This is because underground water can easily be obtained from boreholes and hand-dug wells in the Upper East and West regions. Third, there is a need for policy direction on maintaining the dams to enhance their sustainability. There must be the engagement of key stakeholders to discuss openly the challenges and opportunities of dams in communities and, more importantly, be able to deal with the politics of damming. Finally, for the 1V1D to enhance livestock production, other complementary issues like access to veterinary services must be addressed. The findings of the study are limited because it employs a cross-sectional approach. It is worth mentioning that this is an exploratory study of the effect of the 1V1D initiative. There will be additional two rounds of data collection (Year two and Year three after the first data collection) from the same communities to provide longitudinal data to assess more robustly the impact of 1V1D. Future studies should provide more discussion of, for example, supplemental irrigation, the political economy dynamics of dam development, and design and implementation concerns to help minimize the challenges and optimize the benefits of dams.

Author Contributions: Conceptualization: S.A., M.M. and C.A.; Methodology: J.T., E.A., R.O. and M.M.; Formal analysis: M.M., E.A., S.A. and J.T.; Investigation: M.M., S.A. and R.O.; Data curation: M.M., R.O. and C.A.; Writing—original draft preparation: S.A.; Writing—review and editing: S.A. All authors have read and agreed to the published version of the manuscript.

Funding: Funder: USAID. Funding is by USAID through Feed the Future MRR Innovation Lab in collaboration with the International Centre for Evaluation and Development, under the Advancing Local Leadership Innovation and Networks project.

Institutional Review Board Statement: Not Applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available upon request from the corresponding author.

Acknowledgments: We recognize support from the International Centre for Evaluation and Development through the Development Impact West Africa project.

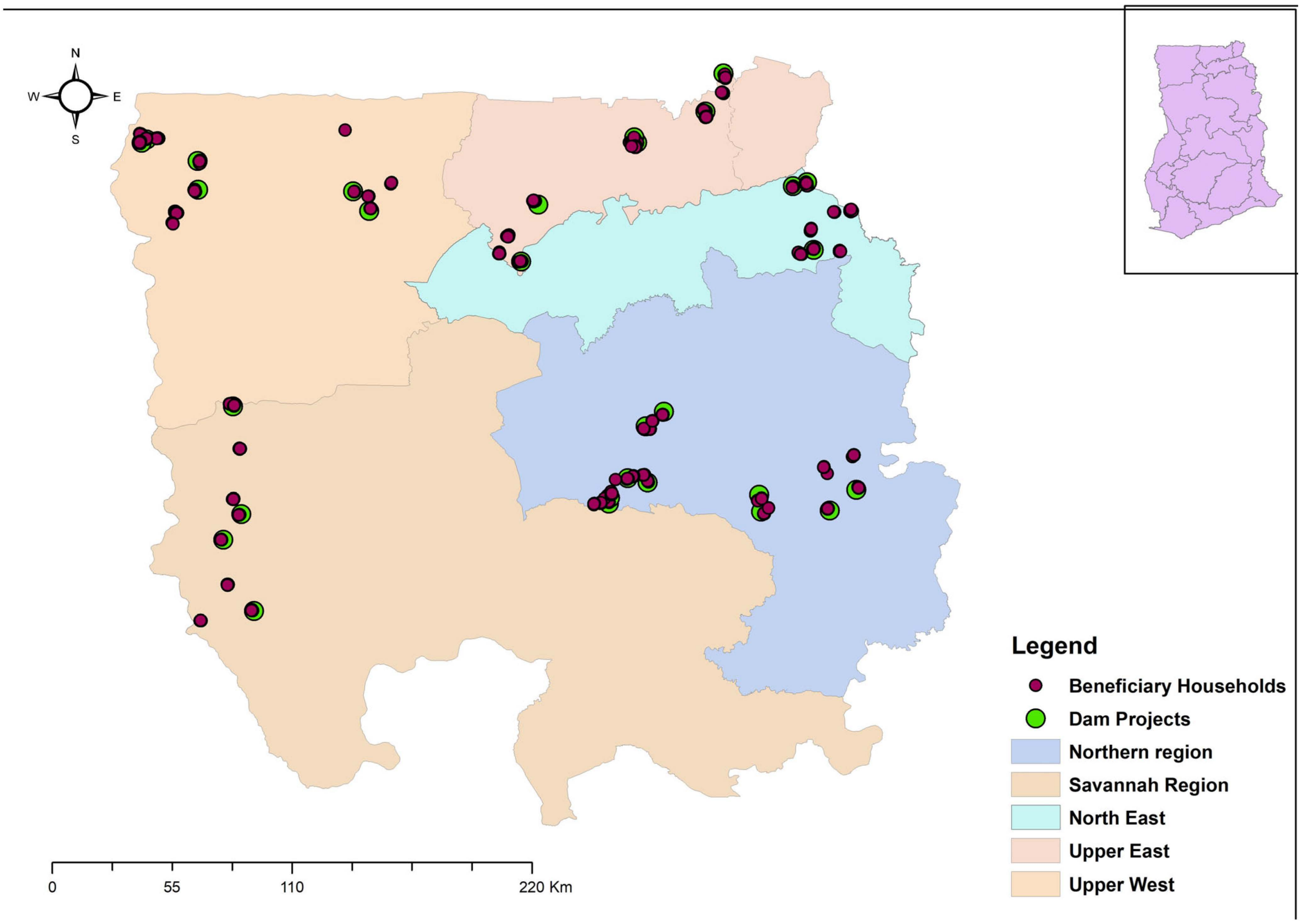
Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A. List of Study Regions and Constituencies and Communities

No.	Region	Constituency	Treatment (Dam) Communities	No. (%) of Observations (Treatment)	Control Communities	No. (%) of Observations (Control)
1.	NORTH EAST	BUNKPRUGU	Sanbiruk	26 (1.64)	Jilig	29 (1.83)
			Tuusk	32 (2.02)	Pagnatiik	27 (1.70)
		YUNYOO	Mantana	27 (1.70)	Tambing	20 (1.26)
			Gbeduri	26 (1.64)	Mozio	26 (1.64)
2.	SAVANNAH	BOLE BAMBOI	Mankuma	27 (1.70)	Abasama	26 (1.64)
			Sakpa	26 (1.64)	Kilampobile	27 (1.70)
		SAWLA-TUNA-KABA	Sawla	24 (1.51)	Gando	25 (1.48)
			Goyiri	27 (1.70)	Koli	27 (1.70)
3.	NORTHERN	Tamale North	Fou	26 (1.64)	Taha	28 (1.77)
			Kpuntaliga	23 (1.45)	Santungu	24 (1.51)
		Nanton	Nyeko	24 (1.51)	Jegun	26 (1.64)
			Sando (Rehab)	32 (2.02)	Bantanyili	26 (1.64)
		YENDI	Kpalgabeni (Rehab)	33 (2.08)	Gundogu	24 (1.51)
			Adibo	30 (1.89)	Nyankpani	30 (1.89)
		TAMALE SOUTH	Chanshegu	29 (1.83)	Adubiliyili	31 (1.96)
			Gbalahibila	25 (1.58)	Nyozee	26 (1.64)
		MION	Kulikpegu	28 (1.77)	Nagbali	24 (1.51)
			Gbimsi	27 (1.70)	Atayili	29 (1.83)

No.	Region	Constituency	Treatment (Dam) Communities	No. (%) of Observations (Treatment)	Control Communities	No. (%) of Observations (Control)
4.	UPPER WEST	SISSALA East	Kulfuo	33 (2.08	Kurobio	27 (1.70)
			Bichembo	27 (1.70)	Yigantu Jaana	23 (1.45)
		JIRAPA	Vinving	25 (1.58)	Nyeni	24 (1.51)
			Kogri	30 (1.89)	Baazu	26 (1.64)
		NANDOM	Kusale	26 (1.64)	Brutu	24 (1.51)
			Tubogru	26 (1.64)	Taayaga	24 (1.51)
5.	UPPER EAST	BAWKU West	Zebella	24 (1.51)	Teogo	24 (1.51)
			Sapeliga	31 (1.96)	Googo	27 (1.70)
		BUILSA SOUTH	Gbedembilsi	23 (1.45)	Baasa	25 (1.58)
			Chansa	30 (1.89)	Wiesi	24 (1.58)
		BOLGA EAST	Dachio	24 (1.51)	Katanga	23 (1.45)
			Kunkwa	19 (1.20)	Cangoo	29 (1.83)

Appendix B. Geographical Location of Dams and Households



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