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Development of small dams and their impact on livelihoods: Cases from northern Ghana

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Small dams offer a lifeline to rural communities in northern Ghana during the dry season. The paper discusses issues related to water use, socio-economic significance, and sustainability of small dams following substantial State interventions and donor agency investments in the development and management of small dams in Ghana. Through the lenses of political economy narrative, the paper explores the political, economic and social realities that shape the development, operation, and management of small dams. Evidence from sixteen small dams examined, using multiple indicator approach revealed overall satisfactory to highly satisfactory performance indices for small dams. Economic returns from irrigation offer incentives to improve performance but give limited account of performance dynamics of small dams. A holistic view of values and priority attached to multiple uses account for satisfactory performance. Whilst operational limitations of small dams prevail, the paper argues that moving beyond 'technical or engineering fix' and focusing on limitations in national and local institutional arrangements, politics, interests, and rights are crucial for effective planning, management, and enhanced performance of small dams.

Key words: Small dams, development, management, performance, multiple uses, indicators.

INTRODUCTION

Small dams' development has been part of Ghana's rural economy since the post colonial period (late 1950s to mid 1960s). The period saw the construction of approximately 240 earth dams and dug-outs in northern Ghana with the prime objective to provide water for livestock and domestic uses, mitigate recurrent drought impacts, and as well serve as soil and water conservation measure. At the time, the government's policy was geared towards a rapid economic development through massive investment in agricultural production, making the development of large-scale irrigation dams a priority. Such an approach was presumed to be both technically and politically attractive given its massive capability to accelerate social and economic development through the provision of adequate water supply for domestic applications, irrigation, and hydropower generation (Biswas and Tortojada, 2001). However, expectations were hardly met following multi-decades of large scale dam

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Implementation, poor management by government agencies, and challenges associated with operation and maintenance.

The soaring cost of developing large-scale dams coupled with underperformance prompted the government to rethink the idea of dam development in Ghana. This led to a gradual shift towards the development of small dams, informed by the idea that 'small is beautiful' which became a guiding philosophy of many donor intervention policies on dam's development (Swatuk, 2008). Notable among the small dam development projects in Ghana over the past 30 years are the World Bank's Community-Based Rural Development Project (CBRDP), Village Infrastructural Project (VIP), the three IFAD sponsored projects-Land Conservation and Smallholder Rehabilitation Projects (LACOSREP I and II), the German Development Cooperation (GIZ) in the Upper East Region, the Upper West Agricultural Development Project (UWADEP), and the Northern Region Poverty Reduction Programme (NORPREP) for the Northern Region among many others. Currently, there are approximately 1,100 small dams and around 2,500 small- dug-outs with an irrigation potential of between 5,000 and 10,000 ha distributed across the country.

Moving towards the concept of small dams' development came with management and institutional reforms which promoted active participation of local beneficiaries in small dam development. To this end, the Government of Ghana and its development partners invested in the establishment of Water Users' Associations (WUAs) to operate and manage these small dams. The underlying hypothesis was that local communities tend to have greater incentives than external actors to maintain their natural resource base. Organizing local water users in WUAs around small dams has the potential to increase their sense of ownership, leading to improved performance of the system. However, evidence of WUAs performance in operating and managing small dams have had mixed results. While small dams offer significant performance advantages over large-scale dams within irrigation investment projects (Inocencio et al., 2007), debates continue about their performance (Faulkner et al., 2008; Mdemu et al., 2009), impact on the environment and health (Boelee et al., 2009) as well as their long-term sustainability (Andreini et al., 2009). Recent donor-driven investments in northern Ghana have focused on rehabilitating and upgrading existing small dams for mainly irrigation purposes. However, outputs from the small dams irrigated agriculture in terms of yields and farm income have not adequately met expectations. Whilst there is renewed interest to invest more resources into small dam development, there is need to take stock of the performance of these dams vis-à-vis their objectives. For rural areas in northern Ghana, the provision of small dams may be lifeline to socio-economic development by providing great relief during water-scarce periods for multiple uses (domestic water use, livestock use, brick making, and dry season irrigation), fueling socio-economic livelihoods in rural communities (Liebe, 2007).

In evaluating the performance impact of small dams, several researchers have proposed various indicators focusing on internal processes of irrigation system that relate performance to operational objectives such as the area irrigated, crop patterns, and distribution and delivery of water to assess the quality of operational performance (Molden and Gates, 1990). Other indicators emphasize on yield output and economic measures (Behailu et al., 2004; Olubode-Awosola et al., 2006; Faulkner et al., 2008). These indicators have been based on the assumption that a combination of "efficient" technology, markets, and "capable" agencies would result in the best performance (Uysal and Atıs, 2010) often the complex social fabric that influence management and performance of small dams. However, despite the prevalence of technology, market, and agency systems, evidence suggest that in most cases this combination has not resulted in effective irrigation services (Meinzen-Dick et al., 1997). The paper contends that social indicators are also essential and highly linked to the sustainability and performance of irrigation systems.

The paper adopts a holistic approach for the assessment of small dams' performance and their impact in contributing to the socio-economic livelihood of beneficiaries. Using information collected from sixteen small dams in the Upper East and West regions of northern Ghana, we employed eight indicators to characterize the performance of these small dams from the standpoint of efficient use of water, socio-economic output, and sustainability of small dams. In this paper there will be a brief description of the study region and the characteristics of irrigation schemes. This will be followed by an outline of the methodological approach for assessing the performance of irrigation schemes, presentation, discussion of results and conclusion.

MATERIALS AND METHODS

Case study site and characterisation of small dams

The Upper East and West regions are part of the three northern regions of Ghana. Considered as the two most deprived regions in Ghana, majority of the people live in rural areas and their main source of economic livelihood is rainfed agriculture (Ghana Statistical Service (GSS), 2010). Seasonal rainfall pattern in these regions is uni-modal with averages ranging between 800 and 1200 mm. The rainfall season starts in April and ends in October reaching its peak in August, followed by a long dry season from October to April. Seasonal rainfall is highly erratic with high intensity which barely infiltrates the soil (Liebe et al., 2005). Mean temperature ranges from 28 to 30°C. The vegetation is mainly savanna grassland dotted with two important economic trees most commonly shea butter, *Butyrospermum paradoxum*, and *Parkia clappertonian.* Soils in the regions are vulnerable to erosion, have low water retention capacity and low fertility. Millet, sorghum, maize, and groundnuts are the principal crops grown during the wet season. Small dams offer a relief during the dry season as it serves

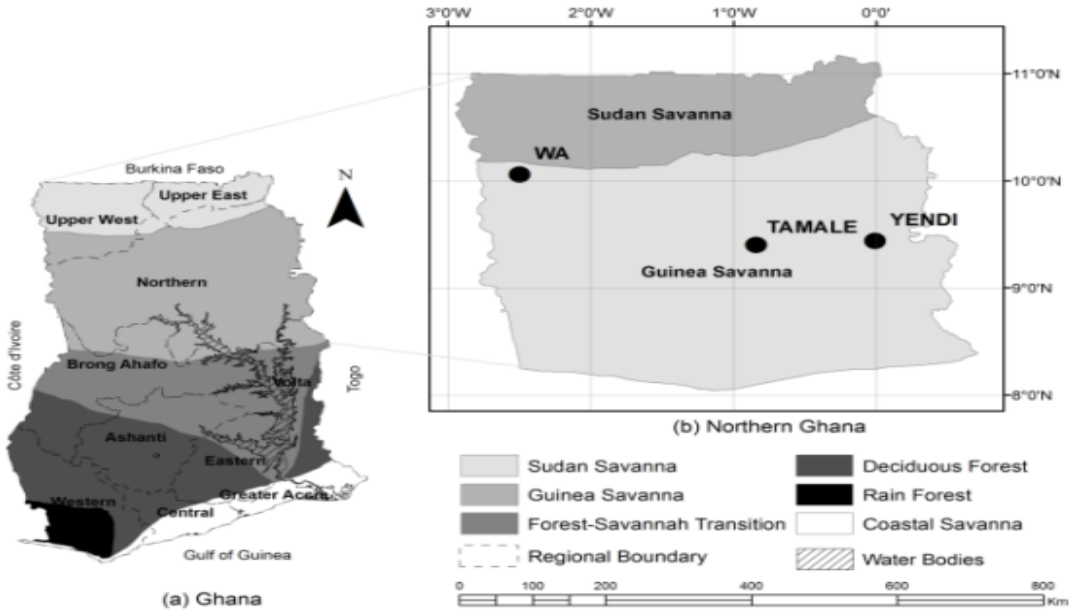

Figure 1. Map of Ghana showing the two regions in northern Ghana and the vegetation type (Source: Dosu, 2011).

Table 1. Principal characteristics of selected small dams in the Upper East (UER) and West (UWR) regions.

Dams	Year	No. of users	Designed irrigable area ha)	Irrigated area (ha)	System type	Water supply	Dam type	Spillway type	Crops grown
Boya Kpal	1945	400	-	-	-	-	Earth	Concrete	-
Zanlerigu	2000	500	9	4	Pipe/wells	Pump	Earth	Concrete	Mixed vegetables
Datuku	2001	1050	10.5	2	Lined canal	Gravity	Earth	Concrete	Mixed vegetables
Nayoko	2000	1200	8	3	Lined canal	Gravity	Earth	Concrete	Mixed vegetables
Kunkwak	2002	620	10.5	1	Lined canal	Gravity	Earth	Concrete	Mixed vegetables
Gumyoko	1960	3000	15	8	Lined canal	Gravity	Earth	Concrete	Mixed vegetables
Dorongo	1963	1000	12	12	Lined canal	Gravity	Earth	Concrete	Tomato
Kamega	1965	3500	10	7.6	Lined canal	Gravity	Earth	Concrete	Onion
Nyimati	2006	1196	10	10	Wells	Motorised pump	Earth	Concrete	Mixed vegetables
Demangye	1998	1600	5	2.7	Wells	Motorised	Earth	Concrete	Tomato
Kaleo	1963	2500	12	3	Pump	Motorised pump	Earth	Concrete	Mixed vegetables
Goli	1998	1500	15	5	Lined canal	Gravity	Earth	Concrete	Mixed vegetables
Babile	1990	7500	8	5.2	Lined canal	Gravity	Earth	Concrete	Mixed vegetables
Tarsaw	2003	2000	20	2	Pump	Motorised pump	Earth	Concrete	Mixed vegetables
Tumu	1963	2000	25	1.5	Pump	Motorised pump	Earth	Concrete	Mixed vegetables
Karni	1944	2245	9	9	Lined canal	Gravity	Earth	Concrete	Mixed vegetables

multiple purpose including domestic, livestock watering, irrigation and many others. Irrigated crops during the dry season around the small dams include tomatoes, leafy vegetables, onions, pepper, shallots and carrots. Most irrigated areas are characterised by mixed vegetable cropping.

Small dams play a crucial role in the production of market vegetables such as onions, pepper, tomatoes, and other leafy vegetables during the dry season. Approximately 482 small dams (with estimated irrigable area of 2210 ha) are concentrated in northern Ghana. The estimated flood area at Full Supply Level (FSL) for small dams ranges from 3 to 14 ha with a storage capacity of up to 1 million cubic meters (MCM). All the dams have earthen embankment with length ranging from 200 to 400 m. As a measure to check erosion, vetiver grasses are grown on the side of the dam walls. Water may be available throughout the season in most of the dams. Majority of the dams are equipped with either lined or earth canal with very few having motorized pumps. Irrigable areas are estimated from 5 to 25 ha. Table 1, presents detailed characteristics of the selected small dams from the Upper East and West regions of northern Ghana.

Data collection and analysis

In understanding the social, economic, political and technical perspectives that influence the development of small dams in the country, the paper adopts a multi-tier approach to data collection. First, databases of small dams from the Ghana Irrigation Development Authority (GIDA) and Ministry of Food and Agriculture (MoFA) were collated and inventoried. Second, the inventory of small dams was validated through field visit to all dam sites and a Rapid Participatory Opportunity/Constraint Appraisal approach (RPOCA). Under the RPOCA approach, Agricultural Extension Agents (AEAs) who oversee the dams in their operational areas were engaged in a participatory working session to verify the dams' condition. At the national level and district, we conducted key informant interviews with policymakers (Ministries of Water Resources, Agriculture, Irrigation and Environment), donors, technical development partners (IFAD, World Bank, GIZ, etc.), and Non-Governmental Organizations who are key stakeholders in the development and implementation of small dams' projects in the regions.

Third, sixteen small dams were selected at random from various districts in Upper East (UER) and West (UWR) regions. Detailed studies of the 16 dams were conducted using field observations and Focus Group Discussions (FGDs) to gain both qualitative and quantitative understanding of small dams' performance and impact on the livelihood of water users. The Upper East and West regions provided suitable study areas to explore in depth and understand the incentives, local or national interests, and institutional arrangements that hinder or encourage the development of small dams. The FGDs comprised the Chief and elders of the community, randomly selected groups from the various water users including; irrigator groups, livestock farmers both in and outside the community, women, fishermen groups, and brick makers. Semi-structured interviews were also conducted targeting individual small dams' users (livestock farmers, irrigators, fishermen, women, etc.). Finally, key informants in the community namely local elected representatives, head of organizations, customary authorities and leaders of WUAs were also interviewed to gain insight into how the various institutional arrangements contribute to small dam's management in improving performance and impact.

Performance index analysis

The paper considers several indicators comprising of physical, social and economic variables in order to capture an overall assessment of small dams' performance. These include: the status of the physical conditions of the dams and their infrastructure such as valves, canals, outlets, pumps, etc.; whether they have broken down before; leakages or in good shape to maintain water flow; the level of operation and maintenance (O&M) of dams which entails proper functioning of the small dams as well as the maintenance culture of water users; equitable access to water and water availability which entail the ability of small dams to provided water for all water users throughout the dry season; the dams' importance to the community showing the extent to which the community or water users value the small dam; the extent to which the WUAs are organized and active to efficiently manage the smooth operation of small dams; the rate of water fee collection; and the level of management of small dams by the WUAs or community. The selection of indicators was done through a literature survey on assessment of performance of small-scale irrigation dams (Vermillion et al., 1999; Turner, 1994), and deliberation on these indicators at the focus group discussion to determine the importance of indicators in defining performance of small dams.

The study adapts the indicator approach which has been employed in the field of climate change to assess the vulnerability of communities or individuals to the impact of climate change and variability (Gbetibouo et al., 2010). The indicator approach employs specific set or combination of indicators (proxy indicators) and measures performance by computing indices, averages or weighted averages for selected indicators. This approach is applicable at any scale (e.g., household, county/district, or national level). Although the indicator approach is subjective in terms of selection of variables and application of indices, we find this approach very suitable as it is able to capture the multi-dimensionality of small dams' performance in a comprehensible form.

Performance indicators are ranked from 1 (Lowest) to 5 (Highest) by water user groups and extension agents from the various irrigation dams. In calculating the overall performance index for each dam, we standardised the values by using a ranking and scoring system to calculate the coefficient of the indicators. The highest performance indicator value is assigned the highest co-efficient value of 1.0 (on a scale from 0.0 to 1.0). The coefficients for the remaining indicators are calculated by dividing each indicator values by the highest indicator value.

The next step is to assign relative importance – weight (0.0-1.0) to the indicators. Three methods of assigning weights to indicators were identified from literature and used namely: (1) statistical methods such as principal component analysis (PCA) or factor analysis (Cutter et al., 2003); (2) arbitrary choice of equal weight (O'Brien et al., 2004); and (3) Expert judgment (Brooks et al., 2005). Statistical method such as the PCA was deemed as the most optimal approach; however, it minimized the contribution of individual indicators which did not move with other individual indicators. The development of weights via expert judgment has proven to be effective but it is often constrained by difficulties in reaching a consensus on the weights among expert panel members (Lowry et al., 1995). Local knowledge and traditional relevance of indicators, mostly unaccounted for in statistical method such as PCA were important towards the determination of vulnerability in the local context. Here, we go beyond just expert judgement by including local knowledge and traditional importance or value in attaching weight to indicators through consultations with the various small dam user groups including irrigators, livestock farmers, fishermen groups, women and WUAs. The performance index of an indicator is calculated by multiplying its weight factors by its coefficient (on a scale of 0.0 to 1.0).

Yield and economic output analysis

Yield data for irrigated crops in the small dam during the 2010/2011 dry season cropping were collected from irrigated farmers. With irrigated area of most small dams being mixed cropped, yield values per ha were standardised by converting yield (kg) to monetary value (in US$) taking into account the exchange rate at that time. The average irrigated plot per farmer ranges from as little as 0.05 to 1.5 depending on the number of farmers and the size of the irrigated area. The net revenue per farmer is estimated by dividing the estimate net revenue per ha by the number of farmers operating in the irrigated area. Economic benefit is considered as one of the prime objectives of small dams' development to provide supplementary income to farmers.

Following the outcome of the various indicators, the paper discusses the results through the lenses of political economy narrative using the actor-oriented approach to explore the political, economic and social realities that shape the development, management and performance of small dams. This actor-oriented approach has firm theoretical foundations based on critiques of prevailing structuralist development ideologies and practices (Apthorpe and Gasper, 1996; Clay and Schaffer, 1984; Long and Long, 1992) and acknowledges the complexity of interactions that occur between actors in the implementation of programmes at both field level (Biggs, 1997; Jackson, 1997) and institutional level

Table 2. Performance indicator indices for small dams in Upper East region.

Indicators	Indicator coefficient								Weight	Indicator performance index							
	Boya Kpal	Zanle-rigu	Dat-uku	Nay-oko	Kunk-wak	Gum-yoko	Doro-ngo	Kam-ega		Boya Kpal	Zanl-erigu	Datu-ku	Nay-oko	Kun-kwak	Gum-yoko	Dor-ongo	Kam-ega
Physical condition	0.40	0.60	1.00	0.40	0.60	0.40	1.00	0.80	0.05	0.02	0.03	0.05	0.02	0.03	0.02	0.05	0.04
O&M	0.40	0.60	0.60	0.40	0.60	0.80	0.80	1.00	0.10	0.04	0.06	0.06	0.04	0.06	0.08	0.08	0.10
Water availability	1.00	1.00	1.00	0.75	0.75	1.00	1.00	1.00	0.20	0.20	0.20	0.20	0.15	0.15	0.20	0.20	0.20
Equitable access	0.80	0.80	0.80	0.80	0.80	0.80	0.80	1.00	0.15	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.15
Importance	0.60	0.80	0.60	0.80	0.80	1.00	1.00	1.00	0.10	0.06	0.08	0.06	0.08	0.08	0.10	0.10	0.10
WUAs	0.20	0.60	0.60	0.20	0.80	0.80	0.80	1.00	0.20	0.04	0.12	0.12	0.04	0.16	0.16	0.16	0.20
Water levy	0.25	0.25	0.25	0.25	0.50	0.25	1.00	1.00	0.05	0.01	0.01	0.01	0.01	0.03	0.01	0.05	0.05
Management	0.20	0.60	0.60	0.40	0.60	0.60	0.80	1.00	0.15	0.03	0.09	0.09	0.06	0.09	0.09	0.12	0.15
Overall performance index										0.52	0.71	0.71	0.52	0.72	0.78	0.88	0.99

(Grindle, 1997). The actor-oriented approach acknowledges human action and consciousness as the central role in shaping situations. The actor-oriented approach "calls for a detailed ethnographic understanding of everyday life and of the processes by which images, identities and social practices are shared, contested, and negotiated by the various actors involved (Long and Cruz, 2003)". This has strong implications on how we look at the implementation of small dams' development and management.

RESULTS

Performance indicators

Data in Table 2 show that in the Upper East region, majority of small dams were in poor to average physical infrastructural conditions. On how small dams are operated and maintained, most of the small dams were poorly to averagely maintained to facilitate operation, with the exception of three dams that were adequately maintained. On availability of water, equitable access to water and the importance of dams to communities, majority of small dams received favorable scores as reliable source of water needs. In half of the small dams, Water Users' Associations (WUAs) were poorly organised to manage the operations of small dams. On the collection of water levy for small dams' minor maintenance, most of the dams performed poorly in mobilizing financial resources from the water users. Poor to average management practices characterize majority of small dams in this region.

In the Upper West region, data in Table 3 show that two small dams were regarded to be in excellent physical infrastructural conditions while majority of the small dams were in poor to average conditions. On the operation and maintenance, most of the small dams received satisfactory level of maintenance, with the exception of one small dam which was poorly maintained. Majority of the small dams received satisfactory scoring on the availability of water, equitable access and the importance of dams to communities. In more than half of the small dams, WUAs were poorly organized and inactive to manage the operations of small dams and this reflected in the poor water levy collection rate. Majority of the small dams were not adequately managed.

In Tables 2 and 3 we present the indicator performance indices and the overall performance index for each dam. In the Upper East region, six dams recorded highly satisfactory performance indices with Kamega dam emerging as the dam with the highest performance index (0.99) whilst Boya Kpal and Nayoko had the least performance indices.

In the Upper West region, three dams performed very satisfactorily with only two dams recording the highest overall performance indices of 0.97 and 0.94 respectively. The overall performance indices for the remaining dams ranged from average (0.5) to a little about average (0.6).

Economic output from selected small dams

Table 4 provides a summary of economic value of irrigated crops from the selected small dams. The net revenue of crop yield per hectare per season from irrigated agriculture ranged from US$300 to US$1400 for the Upper East and US$550 to US$1700 for the Upper West region. These wide ranging economic values per hectare appeared to be considerably decent for irrigated agriculture given that the daily minimum wage for the country

Table 3. Performance indicator indices for small dams in Upper West region.

Indicators	Indicator coefficient								Weight	Indicator performance index							
	Nyi-mati	Dem-angye	Kal-eo	Goli	Bab-ile	Tar-saw	Tumu	Karni		Nyi-mati	Dem-angye	Kaleo	Goli	Bab-ile	Tar-saw	Tumu	Karni
Physical condition	1.00	0.40	0.60	0.80	0.80	0.60	0.60	1.00	0.10	0.10	0.04	0.06	0.08	0.08	0.06	0.06	0.10
O&M	1.00	0.60	0.60	0.60	0.80	0.60	0.80	0.80	0.15	0.15	0.09	0.09	0.09	0.12	0.09	0.12	0.12
Water availability	1.00	0.80	0.80	0.60	0.80	0.80	0.80	0.80	0.15	0.15	0.12	0.12	0.09	0.12	0.12	0.12	0.12
Equitable access	1.00	0.60	0.60	0.80	0.80	0.60	0.40	1.00	0.10	0.10	0.06	0.06	0.08	0.08	0.06	0.04	0.10
Importance	1.00	0.60	0.60	0.60	1.00	0.80	0.80	1.00	0.20	0.20	0.12	0.12	0.12	0.20	0.16	0.16	0.20
WUAs	0.80	0.20	0.20	0.20	0.80	0.60	0.40	1.00	0.15	0.12	0.03	0.03	0.03	0.12	0.09	0.06	0.15
Water levy	1.00	0.25	0.25	0.25	0.75	0.25	0.25	1.00	0.05	0.05	0.01	0.01	0.01	0.04	0.01	0.01	0.05
Management	1.00	0.40	0.40	0.60	0.80	0.60	0.60	1.00	0.10	0.10	0.04	0.04	0.06	0.08	0.06	0.06	0.10
Overall performance index										0.97	0.51	0.53	0.56	0.84	0.65	0.63	0.94

in 2010 was $2 according to the Ministry of Finance and Economic Planning. However, the net revenue of irrigated crop yield per farmer ranged from US$15 and US$90 in the Upper East and US$50 to US$750 in the Upper West region. These revenues for irrigated crop yield excluded labor cost because labor was usually provided by family members.

DISCUSSION

Impact of physical condition on small dams' performance

In all the dams surveyed, it was a common observation that the physical condition of dams and their infrastructure to a greater extent reflect their level of maintenance and management. The physical condition of low performing dams are often charaterised by eroded and seeping dam walls, faulty and broken valves and canals, and spillway failure which in many cases could be attributed to poor maintenance culture of beneficiary communities. These problems on several occasions contributed to the drying up of small dams. In some cases, poor infrastructural conditions, by default, emerged from poor planning and implementation of small dams' project by contractors with political clouts but limited technical knowhow related to small dams' development.

The development approach of these small dams mimicked the top-down approach of large-scale dams' projects which in part accounted for their underperformance (Nkhoma, 2011). Adams (1992) argued that small dams "have been a little more scaled down version of large projects with similar high technology irrigation systems developed through top-down planning processes dominated by government bureaucracy" (For details on the politics of small dams' development, see Venot et al., 2011). In the course of the paper, we will see how this bureaucratic approach has negatively impacted on the performance of small dams. The need to factor in local and historical context in the process of developing and implementing small dams cannot be over-emphasized if satisfactory performance of small dams is anticipated.

Whilst physical constraints may hinder efficient functioning of small dams particularly for irrigation, they do not necessarily influence yield outputs and water provision for multiple uses. In certain cases, small dams have the capacity to store water throughout the dry season irrespective of physical conditions, making water available for various uses. For example, livestock users would describe small dams as performing satisfactorily provided they are able to supply water for livestock through the dry season. Again, in some small dams where irrigation facilities were uncompleted or even absent, farmers cultivated crops under irrigation by digging wells and constructing earth canals to channel irrigated water to their farm plots.

Social and institutional realities of small dams development and performance

Equitable access to water is shaped by a preconceived notion that water is a free commodity" or "gift" and each member of the communities has the right of access. This is not to

Table 4. Economic outputs of small dams in the Upper East and West region.

Small Dams	Irrigated area	Irrigated area per farmer	Number of farmers/ha	Net revenue US$/ha	Net revenue /farmer US$
Upper East					
Boya Kpalsiako	-	-	-	-	-
Zanlerigu	1.5	0.1	17.0	838.7	49.3
Datuku	2.0	0.1	10.0	603.3	60.3
Nayoko	8.0	0.1	17.0	358.7	21.5
Kunkwak	3.0	0.1	17.0	682.0	40.9
Gumyoko	11.0	0.1	20.0	370.0	18.5
Dorongo	12.0	0.1	10.0	898.7	89.9
Kamega	7.6	0.1	20.0	1376.0	68.8
Upper West					
Nyimati	10.0	0.1	11.0	562.0	50.6
Demangye-Ko	2.7	0.1	10.0	-	-
Kaleo	1.5	0.1	10.0	826.7	82.7
Goli	5.0	0.3	4.0	1669.3	417.3
Babile/Tanchara	5.2	0.1	10.0	570.0	57.0
Tarsaw	2.0	0.5	2.0	1462.7	731.3
Tumu	1.5	0.3	4.0	938.7	234.7
Karni	9.0	0.3	4.0	1252.7	313.2

say that water is not contested resources in small dams. Keen water contestation may arise based on the different priorities of the multiple actors involved, for example between irrigators and livestock farmers over access to water in some dams. For example, in one of the dams, extension of irrigated area with the aid of motor pumps culminated in high water contestation which threatened to disrupt the planned irrigation scheduling in the dam. Access is not only a function of availability of water infrastructure but also a function of local institutions and processes that ensure access to those assets (Cotula, 2006).

Conflicts rarely occur concerning the water uses in small dams but conflicts may occur between implementing agencies and beneficiary communities. Whilst the model for small dams' development has been lauded a participatory approach, local communities have questioned such participatory tenets by criticizing development agencies of prioritizing irrigation at the expense of other important uses such as livestock watering, fishing, molding blocks, and construction. The implication is that, local beneficiaries tend to be delusional about small dams ownership and management.

In rural part of northern Ghana, state policies and legislations on water resources tend to have very little impact, rather local norms or traditional rules tend to shape decision making in communities around resources including the right of access, use, and management of small dams (Laube, 2007). For instance, in most communities, it is morally unacceptable to deny people access to drinking water, and denial might cause severe conflicts (Laube, 2007). This is not to say that practical exclusion from access does not occur. The right of access to water in small dams may be based on bodies of norm such as traditional rules and customary laws. Exclusion may occur not on legal arrangement basis, but on local power hegemonies viewed by the population as uneven or even illicit (Eguavoen and Spalthoff, 2008). However, these rules or norms may evolve over time as a result of diverse factors like cultural interactions, social-economic changes, migration, and political changes.

Characterizing low and average performing small dams at the local level was the low level of organization and activeness of WUAs in their operation and management of small dams. While WUAs are regarded as managers and decision makers around small dams, principally to undertake minor maintenance and daily management activities, there exist several local institutions that are connected to each other and to other levels of decision making, contributing to different and complementary roles in the governance of small dams (Eguavoen, 2007). The traditional authority led by the chiefs still plays an important role over small dams perceived as a common property, often held in trusteeship by chiefs or spiritual leaders. Although, chiefs and elders play a limited role in the day to day decision making on small dams, they function to activate and enforce social norms of behavior through established patterns of authority and leadership in events that require major decisions concerning the small dams (Gyasi et al., 2006). They are known to settle disputes, resolve conflicts and maintain social cohesion.

They also enforce local rules governing water resources by threatening perpetrators with spiritual or social sanctions, sometimes in co-operation with local administrative or political bodies (Laube, 2008). They hold the prerogative to allocate land for irrigation, sanction communal labor for small dams' maintenance and empower WUAs by enforcing rules and regulations on the use of small dams. However, WUAs are viewed as an "external package" that do not account for pre-existing socio-environmental conditions and cultural norms that influence decision making, limiting their scope to contribute to sustainable management.

Another indicator linked to WUAs is the degree to which water use levies are mobilized by WUAs. Majority of small dams are charaterised by very poor rate of water use levy mobilization which likely reflected in the level of activeness and organisation of WUAs. Funding for small dam development has always come from international development donors or government coffers without the financial input from WUAs or beneficiary communities. With very limited financial capacity or no financial stake in small dams' development, WUAs are expected to mobilize funds through the collection of water use levies ranging from US$0.5 to US$2 per person per season. Water levies serve as seed money for minor maintenance and to access credit and loans for inputs.

Although, monies collected may be insignificant for even minor repairs, payment tends to incentivize water users commitment, stimulating a sense of participation in operation and management of small dams. Considering that uses such as livestock water, domestic uses, etc. are non-commercial, water use levies are charged to mainly irrigators which in part account for the unwillingness to pay. Whilst some level of success could be credited to the effective organization of WUAs in some small dams, majority of WUAs according to water users have performed below expectation as a result of weak financial position of WUAs. The paper argues that whilst the presence of social engineered approaches such as the WUAs are relevant for sustainable management of common resources, they do not necessarily translate into high performance, in this case, of small dams.

To be recognized as effective WUAs requires functional structure that organizes themselves through regular activities in small dams and also has the ability to mobilize internal funds through water levies. The ability of WUAs to organize for effective water management may sometimes rest on socio-cultural incentives and on their ability to link effectively with other pre-existing traditional institutional arrangements. This is backed by the fact that social capital generated conditions such as norms, religion and culture seem to have a stronger organization for natural resources management than the social capital created by "institution fix" such as the WUA (Meizen-Dick, 2008). In contrast, Khanal (2003) argues that by recognizing that WUAs are partisan, political and heterogeneous bodies, it will be possible to understand their dynamics and avoid dysfunction.

Economic impact of small dams

Economic productivity provides a diagnostic tool for identifying the monetary value of water use for irrigation in small dams. Among the multiple uses of small dams, irrigation is singled out as the most economically viable strategy which stimulated the construction or rehabilitation of several small dams. With massive demand for vegetables during the dry season, farmers have the opportunity to maximize income from irrigated agriculture, which has the potential to positively impact livelihoods (Faulkner et al., 2008). High economic output from irrigation provides mixed interpretations with regards to their influence on the performance of small dams. In some cases, substantial economic output may reflect positively on the overall performance of small dams. Economic output driven by readily accessible markets for irrigated crops offers incentive for proper management and sustainability of small dams. In other instances, low to average performing small dams are able to produce high economic output irrespective of the constraints. In as much as net revenue per hectare may be significant, crucial to farmers is the individual income. Whilst economic returns from irrigation may partially influence the performance of small dams, it remains an essential component for small dams' sustainability and rural economic livelihood.

Focusing on the so-called "economically viable irrigation" as the principal yardstick for small dams' performance might be counterproductive where reproductive concerns –illustrated by livestock activities, fisheries, breweries, domestic water needs- may predominate. Small dams have social meanings and local populations value them for the multiple uses, which tend to translate into their perception about small dams performance (Venot et al., 2012). In most cases, local people were highly satisfied suggesting that small dam's performance depends on the interest and priority use of beneficiaries. For instance, multiple users of small dams for livestock, fishing, breweries, domestic uses, and brick making gave high ranking performance of small dams. Performance is centered on small dams' capacity to make water available for multiple uses throughout the dry season irrespective of their physical conditions. Priorities of water use for different activities exist in the different regions. For instance, in Upper West region, the initial purpose for small dams' establishment was for livestock watering. In cases of water scarcity, livestock are given the priority over domestic use and irrigation indicating the high premium placed on livestock. Livestock is considered as guaranteed or secured capital and social assets or investment which can readily be turned into fiscal note to cater for household needs during emergencies (e.g. hospital bills, school fees, etc.).

Political realities of small dams' development

The rationale for small dams' development like many development projects originates from a combination of technical, social-economic and political reasons as pointed out by Floch and Molle (2009) for irrigation development. It is widely viewed as a development project sanctioned by international development partners and donors and guided by imported policies or norms whose underlying assumptions contrast with the realities of the areas they are meant to stimulate development (Landell-Mills et al., 2007). Such underlying interplay of politics, power and interest has had serious ramifications on the outcome of such development projects (Tidemand, 2010; Nkhoma, 2011). Small dams are, however, perceived as viable intervention for addressing multiple needs such as recurrent drought, livestock watering, block manufacturing and irrigation with the ultimate aim of increasing food security (Ghana Poverty Reduction Strategy, 2003).

The development of these small dams in Ghana has been undertaken by different implementing agencies through a series of projects at different periods with little or no coordination (Andreini et al., 2005). The lack of proper coordination of different actors in the provision of small dams has resulted in duplication of several rehabilitated small dams. Once these small dams are developed, management is entrusted to WUAs which are established by the small dams' development projects with very little input and knowledge from beneficiary communities. This approach is government's way of shedding operational and maintenance responsibilities to local beneficiaries. With the transfer of responsibilities seldom included in the devolution of power, WUAs were seen as operating in an apolitical institutional vacuum and hardly acknowledged the multiple claims that small dam projects induced.

In principle, WUAs are deemed as bottom-up, user-centered, and participatory, yet they still exhibit the characteristics of a top-down approach to designing and implementing policy and institutional reforms, which Kloezen (2002) refers to as "institutional engineering". Donors and governments entered rural communities, constructed or rehabilitated small dams and imposed specific configuration (e.g.) WUAs) deemed at triggering collective action for effective and sustainable management of small dams. WUAs exemplified collective institutional arrangements served as conduits for reform (Khanal, 2003; Meinzen-Dick et al., 2002; Meizen-Dick, 2008). But, as highlighted by Skjølsvold (2008), water users are seldom involved in the process or are they explained what the objectives are. For some water users, WUAs have been perceived as a platform instigated by politicians at high places to canvas for political vote to secure seat district, regional or even national assembly.

The paper argues that the relatively mixed performance of WUAs can be attributed to the implementation approach that was adopted for their establishment during past development projects, specifically, the lack of attention given to the local social fabric and the multiple actors and livelihood strategies that are organized around small dams. We further argue that the approach is flawed with several deficiencies notably in the way institutional arrangements are shaped and "imposed" by implementing agencies, regardless of the local dynamics of management of natural resources.

One important aspect that remained subtle in the result is the low patronage to irrigated agriculture in many small dams. Although, irrigated agriculture offers economic incentives for rural livelihoods, the increasing pace of many rural households' engagement in broader economy, in particular the impact of urban migration tends to undermine the objective of establishing small dams to improved economic livelihood through irrigation. Rural people especially the productive age group between 15 to 30 years find it more lucrative to migrate to the urban centers to engage in menial jobs as a means of generating income. Upon returning the villages, migrants are able to influence other members of the community about the positive prospects of migration by showing assets acquired from the journey. This to a large extent has reduced labor for both irrigated and rainfed agriculture as well as other socio-economic activities in several small dam beneficiary communities. However, the detailed discussion on migration which account for a substantial part of rural household income is beyond the scope of this paper.

Conclusion

Small dams offer a reliable source of water in an unreliable semi-arid region of Ghana. The paper examines some physical, social and economic indicators that account for small dams' performance. The paper reveals rather intricate results in the performance of small dams when we consider diverse views on uses and values attached to small dams. Performance with regards to each indicator varied considerably in most dams. However, very consistent among high ranking indicators were the availability of water, equitable access, and the importance of small dams in the community. Economic returns from small dams' irrigation reinforce the notion of irrigation as most viable source of rural economic livelihood among other uses. However, in spite of its economic incentives, perceived patronage of irrigation in most dams is unfavorably low possibly due to small dam irrigation as a 'new venture', and a shift by many rural households into broader economy. Although economic returns from irrigation may partially influence the performance of small dams, it remains an important driving tool for small dams' sustainability and rural economic livelihood. It is worth noting that, a skewed focus on a more "productive" irrigation as the principal

measure of small dams' performance might be counterproductive where reproductive concerns – illustrated by livestock activities, fisheries, breweries, domestic water needs – may predominate.

Overall, performance of small dams can be said to be a subject of holistically viewing values and priorities in multiple uses offered by small dams to beneficiaries. Small dams are historically and socially constructed through interests of different actors in the local settings. In ensuring sustainability and meeting the demand of contributing food security, economic development, and income diversification, there is need to move beyond small dams as 'technical or engineering fix' by focusing on both national and local institutional and organizational processes that account for the planning, implementation, and management of small dam's development and use.

The development and management of small dams can also be viewed as a political process which engages multiple stakeholders that have conflicting and competing interests and incentives. The use of small dams is rarely contested and their management are shaped by interests, interactions, and priorities of different stakeholders. Given the important contribution of small dams to the development of rural economy and organization of rural society, the paper conclude that taking a holistic approach toward understanding the interaction among stakeholders and local dynamics within broader context of political economy is essential for the successful performance of small dams.

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Conflict of Interest

The findings and conclusions contained within are those of the authors, and do not reflect positions or policies of the Bill and Melinda Gates Foundation.

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