POLICY BRIEF

UNLOCKING NORTHERN GHANA'S AGRICULTURAL POTENTIAL THROUGH TARGETED INVESTMENTS IN SMALL RESERVOIRS

RESEARCH ON THE GOVERNMENT OF GHANA ONE VILLAGE ONE DAM PROJECT UNDERTAKEN FOR, AND BY THE PEASANT FARMERS ASSOCIATION OF GHANA (PFAG)

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In partnership with

SMALL RESERVOIRS POLICY BRIEF

Rightly executed small community dams:
The appropriate policy solutions in Northern Ghana's Agriculture

Summary

Water storage has a vital role to play in improving food security and reducing poverty, particularly in the geographical context of northern Ghana that is characterized by short unimodal rainfall pattern. A wide range of storage structures are available with the commonest being dams. While the positive effects of large dams have not been thoroughly utilized, the special appeal of small water infrastructure makes them more preferred. Despite the construction of more small-scale dams all over northern Ghana, not all of them remain functional. While some are defective and silted, others were not well engineered (particularly those constructed under the one village one dam(1V1D project), hence not able to serve their intended purposes. This policy brief examines the shortcoming of the approaches used in the execution of community dams and recommends options for better results. It is also recommends that the reservoir planners in Ghana need to give careful considerations to re-engineering and correcting defects in already constructed reservoirs except for critical areas where newer ones needs to be constructed.

Recommendations

- ***Appropriate water storage*** for agriculture can contribute to poverty alleviation, arrest the seasonal migration among the youth, and increase food security.
- ***A cut off wall should be constructed along the heel of the dam wall*** at the upstream end to reduce seepage
- Government should ***resource existing institutions mandated*** to champion dam construction instead of establishing ***parallel institutions*** to do the same work.

- The construction and rehabilitation of water structures should always involve ***relevant stakeholders for accountability and value for money.***
- Strict ***buffer laws*** must be enforced to prevent sedimentation.
- The L***abour Intensive Public Works approach*** where community members' labour is used in dam rehabilitation while they earn a living should be regularized.
- Strong local leadership at the community and district levels, coupled with good oversight and supervision of water infrastructure and projects is essential to fully utilize the benefits of the dams and prolong their life span.

Context

Agriculture is the largest consumer of water. Natural variability in rainfall in most places makes access to fresh water unpredictable. For smallholder farmers, the difference between plenty and famine is hinged on reliable access to water. The definite response is to construct reservoirs to capture flash floods in the rainy season for irrigation purposes in the dry season. Today many dams are constructed across various parts of the world to trap water for later use, but the extent of their usefulness and sustainability is the subject of considerable study.

Water storage

More than 45, 00 large dams (dam walls more than 15m high) have been built throughout the world and the majority of these are in North America, China, and Europe out of which 40% are used for irrigation. Large irrigation reservoirs have also received huge public investments in the developing world. While these investments have yielded significant impacts in improving food security and poverty reduction in most parts of Asia, the same cannot be said of sub-Saharan Africa[1]. This is the case because, the potentials of large reservoirs are underexploited.

The controversy surrounding large dams

Although large dams contribute significantly to economic development, the controversy surrounding the effectiveness of large reservoirs for irrigation in Africa led to a reduction in investment and a shift to small scale dams. There are concerns of (i) Negative environmental impacts where river ecosystems and wetlands downstream are affected; (ii) Social impacts of more residents being displaced due to the large area they cover eg. the Vea scheme; (iii) management lapses where irrigation scheme managers prioritize their own needs and those of influential strangers with lands in the project's site over those of indigenous farmers (iv) underutilization and associated low revenues which have, neither fully recouped the high investment costs nor the operations and maintenance costs of large irrigation infrastructure[2]. These bottlenecks put a big question mark behind the economic viability, generating debates on whether investing in large-scale irrigation infrastructure is worthwhile for irrigation development in sub-Saharan Africa.

The convenience of small reservoirs

Amidst the ineffectiveness of large dams, water infrastructure is still needed to safeguard people's livelihoods and the environment, hence a gradual shift towards the development of small reservoir infrastructure. The special appeal of small reservoirs is that; (i) their construction requires comparably little expenditure (ii) they represent an adequate tool to manage freshwater storage (iii) they spread throughout an area and reach a wide population (iv) they are better managed and gives indigenous farmers full control over the water[3]. Hence, small dams can make a major contribution to rural livelihoods.

It is obvious from the cost-benefit analysis perspective that the construction of small reservoirs for irrigation holds a great deal of rewards for communities vis-à-vis large-scale projects, hence is preferred. On this basis, the Government of Ghana in 2018 set out to construct more small earth dams under the one village one dam (lV1D) project, to make water available to a wider rural population of Northern Ghana for all-year-round irrigation. However, without proper consultation and sound engineering such interventions are often a nine-day wonder, and at best white elephant projects.

Impact of small storage structures on rural livelihood

Small multipurpose reservoirs are an age-old adaptation to living in dry areas with highly variable rainfall. Ghana and Burkina Faso are notably good examples of rural communities maximizing economic returns from small community reservoirs. In the Upper East and West Regions of Ghana, the net revenue of crop yield per hectare per season from irrigated agriculture is US$550 to US$1,700 depending on the type of crop[4]. These values are considered decent for irrigation farmers given the fact that the daily minimum wage is pegged at $3 by the Ministry of Finance and Economic Planning.

Generally, small functional community dams in Northern Ghana are said to have contributed significantly to the reduction of seasonal migration and poverty as well as aiding in the production of relatively cheap food for everyone during the long dry season. Unfortunately, some of these dams are defective, silted, or not well-engineered, limiting their potential. These limitations are estimated to cost the economy of the area, a quarter of its growth potential. The Upper East Region case is a good illustration of the urgent need for appropriate intervention in the rehabilitation of reservoirs to increase agriculture productivity.

Importance of the problem **(problem, causes, and effects)**

Malfunctioning in small reservoirs

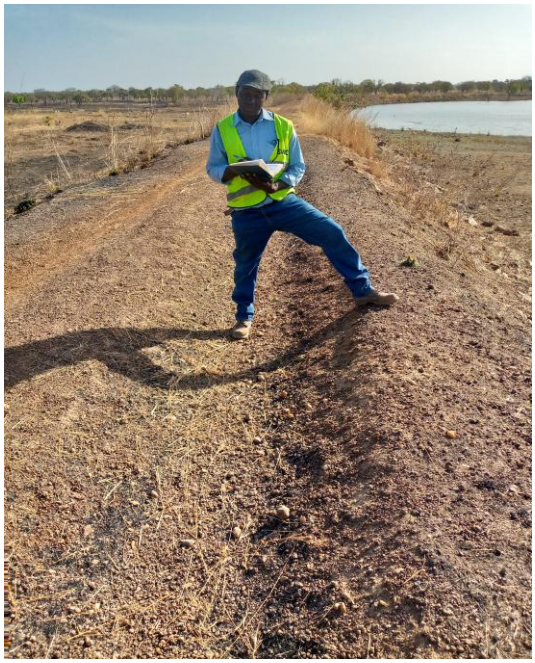
Currently, there are about 300 community dams in the Upper East Region that helps to reduce over-reliance on rain-fed subsistence agriculture. Meanwhile, not all of them are functional. Some have deteriorated due to the wearing off of the dam wall materials, the activity of reptiles boring holes, technical failures, and siltation. A holistic research evaluation of two newer projects constructed in 2019 **(**the Vunania dam funded by the World Bank, and the Gia dam under the One Village One Dam [1V1D] policy) provides empirical evidence to inform policy direction.

For instance, shortly after the construction of the Vunania community dam, the facility is bedeviled with; (i) Massive water loss at about 6m behind the embankment which actors are not certain if it is seepage from the reservoir. (ii) High spillway approach which require water to rise a bit higher before spilling and then the spillway apron is scaring at the back side (iii) The shallow reservoir, which is further endangered by gardening operations that take place very near to it. Iv) Possible faulty valves at the offtake and lateral chambers, v) undulating embankment where locals reported a tipper truck tie sank, likely indicating pore spaces in the embankment material These lapses shortly after the construction may limit the potential of the facility.

Water oozing out of the ground a distance away from behind the Vunania dam

Water scaring the spill way apron

Seemingly high spill way approach.



Undulating embankment surface

leakages in the irrigable area along the main pipeline

Faulty Valve at the Offtake Chamber (left) and Lateral Chamber (right)

Regrettably, the major cause of concern for all stakeholders is the water loss behind the dam wall and the possible causes include;

Seepage from the toe of the dam wall; this is likely a result of poor key trench (inadequate compaction of foundation layers, poor material (not enough clay), or key trench not deep enough).

Fissures in the rocks underneath the impounded area; if the rocks underneath the impounded area have fissures (cracks), the porous nature of such rocks allows water to percolate along the joints of the cracks, and then by virtue of the pressure of the impoundment, water is forced out from the ground at the back of the embankment through the pore spaces**.**

Repositioning of the Valve; During construction, the valve was wrongly positioned and so, the removal and repositioning of the valve again may have broken the seal of the toe which the contractor probably overlooked.

Modifications on site by the contractor and community members; The modification done by the contractor and community members besides the data given could have resulted in this defect. For instance, pressure from community members led to the extension of the dam wall after the main dam wall was almost completed.

Although all stakeholders expressed different views regarding the cause of the problem, they all agree that the source of the defect needs to be identified and corrected if not the intervention may not yield the needed results sustainably.

In another case, the Gia dam constructed under the 1V1D project within the same period is too small, its embankment is not engineered, and the reservoir is too shallow leading to the water drying up even before the onset of the dry season. Although this dam was constructed to store water for small-scale dry season irrigation, the inadequate storage subsequently after construction has reduced it to livestock watering only. Thus, the intended objectives and the actual construction are far apart.

These lapses in the Gia dam are attributable to the fact that collaborative efforts required by all stakeholders in the conceptualization, design, and construction suffered a setback. The sitting was inappropriate, the embankment was not engineered, and the deepest portion is too steep exposing livestock to the danger of being entrapped. Generally, the project execution lacked that touch of professionalism because of the non involvement of key stakeholders.

The Gia reservoir was constructed in 2019 under the 1V1D showing a flat valley with a pocket of water in the deepest part in January.

The evidence emerging from the Gia and Vunania reservoirs indicates that the potential benefits from community dams may not be fully harnessed due to construction defects. Implying that public sector funds cannot be justified in rolling out similar infrastructure projects in the local communities of the semi-arid regions, except if certain policy measures are put in place.

Critique of policy approach and recommendation

Despite the teething problems identified, it cannot be ignored that interventions such as small-scale dams are the way to go for northern Ghana. Therefore, attending to the initial hurdles in these early days could save substantial public resources from going down the drain. At the same time, Ghana should take several steps to ensure community dams are constructed devoid of these bottlenecks and managed sustainably. To this end, the following steps are needful;

Re-engineering of the dams under IVID

The current state of the Gia dam reflects the state of most of the dams constructed under the 1V1D. The reservoir cannot even store enough water for livestock watering all year round, talk less of meeting small-scale irrigation. A uniform excavation of the Gia reservoir to the deepest depth is highly recommended to create room for more water to be stored. This can potentially increase its usefulness to farmers in the community. The excavation should have a gentle slope in order to make it friendly for livestock watering. Engaging the local people and roping in relevant stakeholders including the GIDA, MoFA and MDA's would ensure standard execution and judicious use of public funds.

With limited funds, it is possible to adopt the Labour Intensive Public Works (LIPW) Approach to reengineer the structure. This approach employs community labour with some form of financial motivation to rehabilitate reservoirs with supervision from sector institutions including GIDA. The Ghana Safety net project successfully used this approach to rehabilitate some community dams in Northern Ghana, which is worth emulating.

Correction of defects in community dams after construction

Dam defects when detected early and corrected will preserve the dam structure from deteriorating further. Hence, correcting the defects left by the initial construction of the Vunania community dam is highly recommended. The main defect that needs to be corrected is the perceived seepage. Ascertaining the source of the defect is the first step to solving the problem. This can easily be established by beginning with a thorough examination of the dam wall followed by manually excavating a trench of about $4m^2$ and 2m deep to see the direction of flow in. If the position of the phreatic surface is not found by these two processes, there is the need to proceed to conduct an in-situ geotechnical diagnosis of the dam wall which will determine if the foundation layers of the super-structure is well compacted or not. Since the first two processes do not require heavy machines or high expertise, it is less expensive to establish. Hence, it is recommended that these processes be carried out as soon as possible to find a solution to the problem.

In the interim, possible seepage can be minimized through the introduction of a cut off wall bellow the dam wall. The cut off wall is a deep trench dug along the upstream end of the embankment (heel) and filled with impermeable material such as clay. This is the most recommended remedy because it reduces seepage through horizontal cracks,

fissures and pervious seams in the foundation and it is also a long term solution.

Additionally, it is recommended that the height of gravel heaped towards the spillway from the impounded portion be leveled while excavating the high points within the impounded area to increase its storage capacity.

Creation of a national coordinating mechanism for community dam construction and management.

Most of the dams constructed under the 1V1D are shredded with similar lapses uncovered in the Gia dam project attributable to the approach employed in project implementation. The approach adopted for the implementation of the 1V1D was the "Government directly engaging a private consultant without involving key stakeholders in the field who have the technical know-how and experience. GIDA is mandated to oversee the development of irrigation infrastructure in Ghana and its human resource have built experience and skills over the years. Hence, government should resource and motivate the institution instead of establishing parallel institutions to do the same work.

Moreover, any project within the jurisdiction of community dams should involve all relevant stakeholders at the National and local levels of Government such as MoFA and MDAs. The beneficiaries' community leaders and members are also critical if investments in small community dams will yield significant and sustainable impacts in improving food security and poverty reduction.

Furthermore, Ghana could benefit from creating a high-level, interagency mechanism with representatives from the primary departments concerned with different aspects of water storage systems. The primary function of this mechanism should be to coordinate policy efforts toward strong adherence to the requirements for the construction of community dams so that Government does not bypass working institutions to work with individuals on community dam projects. The mechanism should also identify national strategic priorities to guide local officials and provide guidance to reservoir managers. It should also ensure persistent checks and balances on community dam projects to ensure proper construction and maintenance of the reservoirs. This mechanism could take several forms; committee, council, *ad hock* working group, or a joint conference platform.

Incorporating community engagement in community dam construction

Several factors determined the design and positioning of a dam that community members may not be preview to. For effective collaboration from community members, there is a need for proper community engagement and sensitization before and during construction.

For example based on earlier surveys in the 1960s and pillars planted from those surveys the community members claim that the siting of the dam wall was wrongly done. On the other hand, the engineers indicate that they consulted hydrological details from their archives but there was the need to redesign the dam to suit the available funding, and the design volumes eventually informed the citing of the dam wall. In reality, the pillars were planted to indicate the catchment area within

which the reservoir should be constructed but not to indicate the geographical location of the embankment as the community members agitated for. In the future, incorporating proper community engagement and sensitization in community dam construction will prevent misconceptions such as the one encountered in the execution of the Vunania community dam project.

Establish and implement water management by-laws; in some countries, bylaws serve as the foundation for water governance. The challenges of sitting farms very close to reservoirs tend to threaten their potential from siltation. The buffer by-laws should be clearly defined, and the institutional mechanism for enforcement strengthened. There is a need to provide a legal foundation including a more effective role for community leadership. It is also important to clarify the allocation of powers and responsibilities in the implementation of small reservoir development and management. This can include who is to construct the reservoirs and who is responsible for grassing the reservoir buffers and for enforcing the laws to prohibit farming within the buffer boundary to curtail sedimentation.

Dry season gardens sited too close to the reservoir at the Vunania dam site

Post-construction analysis and evaluation; just as the pre-construction and design of small community dams are crucial, post-constructional analysis is critical. This will provide a lens for assessing the sustainability of the projects against the intended aims, justifying public expenditure on the infrastructure or otherwise. Hence, authorities should endeavor to conduct the post-construction evaluation following the completion of community dam projects.

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