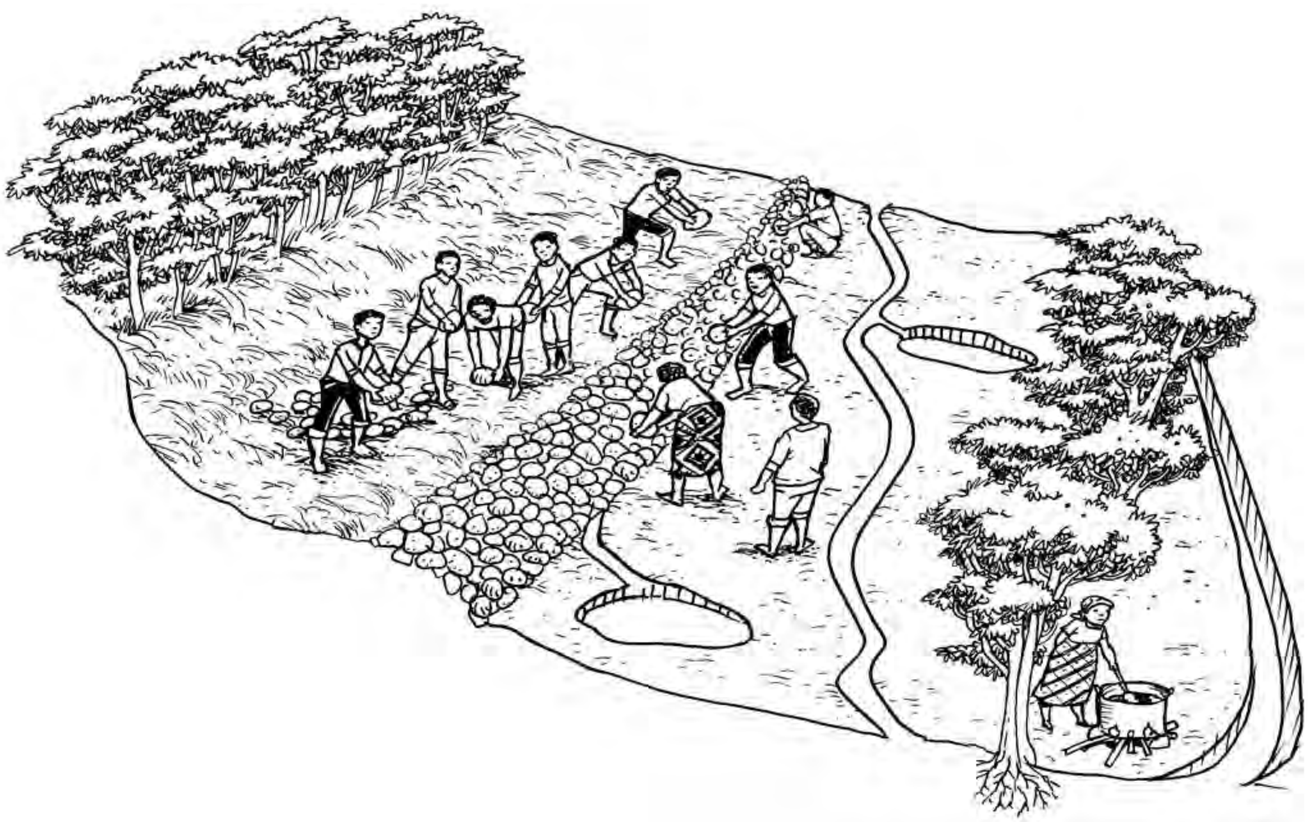
Integrated Soil and Water Conservation through the Use of Stone Bunds, Percolation Pits, and Trenches in Rwambu Wetland Catchment Area



Rwambu wetland borders the Kamwenge and Ibanda districts in the Rwenzori Subregion, western Uganda. It lies between latitudes 0°01'0" N and 0°02'0" N and longitudes 30°24'0" E and 30°25'30" E. Covering a population of 2,714 (Kamwenge District- Portal, 2014), Rwambu wetland is drained by Rwambu River, which meanders through Nyabbani Subcountry in Kamwenge District, and Ishongororo Subcounty in Ibanda District.

The Rwambu wetland forms part of the feeders for the Mpanga River, a permanent river system that drains into Lake George. From a conservation viewpoint, the Mpanga ecosystem is home to the threatened and endemic cycad trees (*Encephalartos whitelokii*) (UWA, 2003). This puts the Rwambu wetland at the center of conservation focus in the entire Mpanga River catchment area. The wetland and its neighborhood support local livelihood by providing land for agriculture, fish, water, and raw materials for crafts, among others. It also provides other ecosystem services such as flood control and micro-climate modification. The main economic activity in the area is agriculture where the major food crops include maize, beans, and potato and cash crops include banana and coffee. A small percentage of the population is engaged in pastoralism.

The problem

Rwambu wetland is surrounded by steep sloping hills with V-shaped valleys. According to the Kamwenge District Development Plan (2004), more than 90% of the population in Rwambu is engaged in subsistence rainfed agriculture as their main source of livelihood. With the increasing population, decreasing land for agriculture, soil erosion reducing soil fertility, and climate variability, farmers around Rwambu wetland continue to register increasing incidents of crop failure that threaten their food security. More so, the eroded soils from the hill slopes finally settle in the wetland, thereby causing water contamination and silting of wetland water reservoirs (NEMA 2012). The situation in Rwambu requires adoption of strategies and measures that can address the above challenges, in an integrated approach, in order to improve the hydrological status of the catchment through intercepting and trapping of runoff water, while allowing it to slowly percolate through the soil and reduce erosion. Consequently, this would in turn improve soil moisture content and sustain agricultural production for household food security and income needs.

Getting started

Stakeholder mapping

Project design and implementation took a participatory approach to ensure full involvement of the primary project targets. Stakeholder mapping was the initial project activity that brought on board different stakeholders critical to project success. Key stakeholders that were identified at this stage were the district water officers, district natural resource officers, district agricultural officers, subcounty authorities, Rwambu catchment management organizations, the community, technical support units, and the private sector. These stakeholders were specifically selected so their experiences, technical skills, and support can be tapped in drawing the project implementation plan. It is at this stage that the project objectives, rationale, and expected outcomes were identified and agreed on.

The role of Joint Effort to Save the Environment (JESE) was to enable stakeholders to identify strategies and measures to adopt and use in their land to address the challenges of erosion, declining soil fertility, and reduced agricultural production and to achieve overall conservation of Rwambu catchments. Discussions on the control measures focused mainly on physical soil and water conservation (SWC) technologies. Selection and prioritization of the technologies were based on criteria such as slope gradient, ease of construction, cost implication, availability of materials for construction or their substitutes, complementarity, and perceived effectiveness. The final selection of the technologies was done through show of hands by the farmers; those with more support were selected. From this process, three technologies were selected: stone bunds, percolation pits, and trenches. These were further integrated with agroforestry along the hill slopes to enhance soil structure stability and modify the micro climate.

The rationale for the integration was that, if the three technologies were applied in an integrated manner, they would complement one another and ensure effective trapping of runoff that would eventually percolate slowly into the soil. The reduction in erosive power of the runoff would also improve soil moisture content and increase agricultural production in the long run.

Establishing the Implementation Committee

A committee comprising seven people was selected with two representatives from the community, one representative from the district technical personnel, an engineer and a social worker from JESE, and two representatives from the Rwambu catchment management organizations.

The responsibilities of the committee included offering technical support and making key decisions on project implementation and management. Specifically, it was required to mobilize the community, to develop the criteria for tracking and evaluating progress, and to make reports. This committee further took center stage in reviewing final construction designs and work timeframes, selecting host farmers, and handling materials and logistics.

Implementation

This phase started with a survey and confirmation of actual sites of interest and host farmers. The survey further showed the slope gradients, valley shapes, soil types, and assessment of soil vulnerability to erosion.

Further discussions with farmers focused on land ownership. This process was followed by the drafting of a memorandum of understanding (MOU) between the Implementation Committee and the host farmers. The MOU clarifies that the technologies to be implemented on their land would benefit the entire community and affirms that the participating community would have free access to these technologies for learning, progress monitoring, and reporting purposes.

Technology design and construction

A total of 265 community members (142 females and 123 males) were directly involved in the actual construction of the soil structures and integrating them with agroforestry activities.

Design and layout

Stone bunds and trenches were designed in uniform dimensions of 30 x 3 x 4 ft along the identified hill slopes with the capacity to retain about 10,200 liters of runoff water. The width and depth were customized based on the slope gradient, type of crop in the garden, and available labor for excavation of trenches and placing of stones along the slope. The percolation pits, on the other hand, were designed in the dimensions of 10 x 10 x 7 ft with the capacity to intercept about 19,800 liters of runoff water and allow it to percolate into the soil.

The three technologies (practices) were placed across the slope, one after another, depending on the intensity of perceived erosion. For instance, the upper hill slopes with high perceived water velocity had all the three technologies with stone bunds appearing at the top, followed by percolation pits and trenches at 15-m intervals, while the medium and lower slopes had two practices being integrated at 20-m intervals. The integration was further determined by the availability of construction materials and labor.

Importantly, trenches and percolation pits were preferred because they were easy to excavate compared with stone bunds that required lots of stones for alignment along the slope. Later, the stone bunds were planted with local grass to strengthen them against erosion. However, outside this study, the three technologies can be randomly placed across a slope as an alternative integration, with or without any further integration besides using each singly.

Most materials, equipment, and labor for the construction and planting of Grevillea trees were locally mobilized, which was a milestone for the project. On average, each participant contributed 3 man-hours a day. The community further provided food and water during the project working days.

This was important as the implementation team was not constrained by logistical issues and they just concentrated on giving technical support in terms of planning, review, and overall implementation.

Grevillea trees spaced in lines at intervals of 17 ft were planted at the middle and lower parts of the hill slopes. This species was selected by the community because of its fast growth rate, strong rooting system, high biomass accumulation, and multiple uses for wood fuel, timber, and poles. To quicken this process, JESE procured seeds of Grevillea, potting materials, wheel barrows, spades, and watering cans, which were given to the farmers who established three community nursery beds. These nursery beds were maintained by the farmers themselves, contributing labor, meals, and other logistics, while JESE offered technical support on nursery bed management and other technical backstopping. The community took it upon themselves to supervise seedling distribution and actual planting.

Monitoring and progress tracking

Participatory monitoring and review meetings were organized at community, subcounty, and district levels to track progress and ensure accurate reporting of successes, challenges, opportunities, and insights emanating from the project.

Table 1. *Cost involved in constructing the different structures.*

Technology	Average cost (UGX)	Dimension	Remarks
Stone bunds	22,442 per meter	3.3x3x4 feet	Cost of stones and labor
Trenches	5,050 per meter	3.3x3x4 feet	Excavation cost
Percolation pits	89,100 per pit	10x10x7 feet	Excavation cost

The Implementation Committee played a key role in the technical assessment of the progress by offering advice with regard to performance of established technologies. It is important to note the pivotal role played by the host and participating farmers in assessing progress and suggesting means for improvement, especially in overcoming the labor intensiveness involved in the establishment of the three technologies.

Key results

A total of 4,000 m of linear length of stone bunds were constructed. The stone bunds matured and stabilized land uphill for agricultural productivity. This has resulted in reduced soil erosion, thus minimum loss of fertile soil downhill and less water runoff, an indication of increased water infiltration. Also, 3,000 m of “Fanya chini” trenches were constructed. The trenches intercept surface water runoff, thus allowing it to seep through the soil and retain the eroded soil. This contributed to ground and surface water recharge, slowed runoff velocity, and increased agricultural production. Percolation pits collected water runoff and allowed it to infiltrate slowly into the ground. These further intercept water and make it available for agricultural re-use.

Approximately 60,000 Grevillea tree seedlings from the community nursery were planted. The trees have matured and stabilized the soil on the hill slopes, improved the aesthetics, and enhanced the micro-climate in the area. Other observed results include reduced siltation of the wetland and contamination of water points and reduced pressure and encroachment on wetland and downhill resources.

Key challenges and limitations

The major challenge faced was the slow decision of all stakeholders to get involved in project activities, which affected the implementation time frame.

Several limitations were encountered:

- The practices were labor-intensive, which made it hard to complete assignments on time. This also affected the adoption of technologies at the household level. Looking at all three technologies, a great deal of energy is required to construct them. If labor is to be hired, it would be too costly for a poor household to do. Adoption therefore is limited.

- It was difficult to assess the short-term hydrological outcomes.

Addressing limitations

- The community was encouraged to engage in collective action through pooling of labor. They agreed on work dates, although sometimes adherence to this was low. However, those who regularly reported for work were committed and did a commendable job.

- Qualitative hydrological indicators to ascertain effectiveness of the structures were used.

Lessons

- An integrated approach to SWC requires effective stakeholder involvement to ensure success and sustainability of the results. Strategies to achieve this should be carefully planned before the project is begun.

- The community takes a long time to adopt new technologies. However, when comprehensively sensitized and their capacities built, their adoption rates can increase.

Conclusion

The three technologies, when well-planned and integrated with agroforestry practices, can effectively retain water on hilly landscapes. This has been observed in the Rwambu catchments where runoff water was retained. This has reduced soil erosion, improved soil moisture conditions, stabilized soil physical conditions, and minimized the siltation of wetland water resources. It has contributed to improved agricultural productivity and water resource management as well.

Strategies for scaling

- The technologies must be shared in different fora for awareness creation, replication, and modeling.

- More community members must be mobilized to ensure adoption of the technologies on their farms.

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