Holding the Rain

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In Lesotho, agriculture consists of subsistence farming and involves extensive mono-cropping with very few external inputs. Livestock graze freely over communal pastures and barren or harvested fields. As a result, much of Lesotho suffers from chronic land degradation and soil collapse. This has led to the loss of biodiversity, declining agricultural productivity, depletion of nutrient balances, falling water tables, flash flooding and an increasingly dependent and poor rural population. Despite the innovations and considerable personal efforts of individual farmers, Lesotho still imports 85 percent of its food, and large parts of the country are turning into desert.

BBCDC

Bethel Business and Community Development Centre (BBCDC) is a rural development and education institution located in the Senqu Valley in the Mohales Hoek district of Lesotho. BBCDC aims to help build up the capacity of young Lesotho men and women so they can contribute to rural and urban development in their region.

View of the Phamong Valley from Mt Moorosi, Lesotho, 2000. Photo: BBCDC.

The Centre is situated on degraded pasture land typical for this area of Lesotho. It was established in 1993 and was immediately confronted with severe weather challenges. The annual average rainfall of 500-600 mm tends to fall very irregularly and in the early years there were frequent droughts. When the rains finally came, the streams filled up quickly despite the parched earth, highlighting the low capacity of the soil to absorb water. Famine was only averted through the intervention of the World Food Programme (WFP).

When BBCDC, in partnership with WFP, began a road construction programme in 1995, it came to understand the importance of drainage and run-off mitigation. Small dams and swales (see Box) were constructed at several locations along the roadway to control water flow, but because no one assumed ownership of these structures, they quickly silted up and lost much of their impact. However, the experiences of this programme made BBCDC aware of the importance of water.

Restoring the land

Inspired by theories drawn from permaculture, BBCDC decided to use ecology to restore the environment and started a programme to systematically develop the BBCDC campus. Soils on the campus were extremely compacted and despite some grass cover, were largely sealed, cemented and anaerobic. This was obvious to anyone digging swales or involved in excavating the building foundations.

New swale construction. Photo: BBCDC.

In order to halt the flow of storm water into the campus and to collect run-off from compacted areas like roads and paths, BBCDC students and staff constructed an extensive system of swales and diversion drains. Almost all the swales were dug by hand using picks and shovels, and simple A-frames or line levels were used to survey them. In the beginning the going was tough. Each swing of the pick dislodged a lump of clay-like rock. Once the rain came, things speeded up and deepening and extension of the swales required less effort.

Restoration required very careful landscape design. Rain falls at intensities of up to 100 mm per hour during summer in Southern Africa, whereas infiltration rates are perhaps 1 to 4 mm per hour on unimproved land. In the uppermost reaches of a watershed or micro-shed, the "stacking" of water and subsequent run-off lasts only a few minutes during high intensity rainfall.

The swales worked magnificently and a dynamic process of restoration and accelerated biological activity was set in motion. Storm water not only carries away soil, but also organic debris such as leaves, grass and manure. When storm water is diverted from the roads and tracks used by animals, swales act as a nutrient pump and trap. Vigorous pioneer plants growing more than two metres high do not always impress visitors, but their root systems do a great deal of beneficial work. Besides breaking through plough pans (the layer of compacted soil below the reach of the plough blade) and opening up the soil, they also provide essential organic matter for mulching and composting.

An evolving farming system

At the same time as more fruit trees were planted and became established, the swale system grew, matured and became more resilient. As conditions improved, BBCDC started to develop the farming system into a more sophisticated system characterised

Swales

Swales (or earth bunds) are the cheapest and simplest earthworks for water harvesting and storage. Swales are dug along contour lines or in flat areas and are designed to store water in soil and sediment by intercepting overland flow and enhancing groundwater recharge. Soil can hold thousands of times more water than tanks or dams, and water which infiltrates the soil in a swale is stored three to five metres deep, where it is available to trees. A good swale system can handle 200 percent of a village's runoff. A well-designed succession of five to seven swales can actually create a spring from stored groundwater. Swales become increasing efficient as they age and tree roots develop and humus accumulates. To encourage vegetation to re-establish itself quickly and to derive the maximum benefit from tree roots and humus, it is important that swales are smooth and have the right shape.

A system of small closely spaced swales keeps water flows small, their velocity near zero and minimises their destructive force. This is one reason why swales need to be surveyed accurately. The most important principal is that they should slow, spread and sink water.

by intercropping, mixed orchards and forage production. Over the years, intercropping between the fruit trees in the orchard has altered the structure of the soil and increased its infiltration capacity.

The large fields along the west side of the campus have been subdivided into smaller fields marked out along contour lines; and various market gardens have been developed all over the campus in the corridors between the swales and tree plantings. Many of these sheltered gardens enjoy a noticeably better microclimate. They are more productive and are also more responsive to irrigation and intensive management. All the fields on campus are now being converted along these lines.

Multiple water sources

To get through stretches of drought, BBCDC steadily invested in multiple water sources and in pumping, storage and delivery systems. At present, sources of additional water supply include rainwater tanks, a hand dug well, a spring, a groundwater dam, and a small pond constructed at the highest point of the campus. In 1998, BBCDC constructed a sand dam on a stream on the eastern side of the campus. It is working as planned and has helped raise the water table and made more water available for irrigation. Plans are being made to scale-up this initiative and build three more sand dams along a 5 km stretch of the stream. These dams will be located at points that make gravity flow irrigation possible.

At the moment water is lifted by a diesel pump installed near the groundwater dam, a solar pump installed in the well, and a gravity-driven hydram at the spring. Water is stored in stone masonry tanks for gravity flow irrigation of fields and gardens. Rainwater is also collected from the roofs of six buildings. The total water storage capacity on the BBCDC campus is now about 110 000 litres, of which 45 000 litres is rainwater collection from roofs. Water can be delivered to fields through a combination of flood, sprinkler and drip irrigation systems. During dry weather, swales can be flooded to water forage and fruit trees. The diesel pump can either fill storage tanks or operate up to 20 sprinklers. Drip irrigation sets are used on small market gardens and fed by gravity from the storage tanks. Grey (domestic waste water) and black (sewage) water from the school is also used to support the growth of ornamental plants and trees on the campus.

Restoration ecology and the community

As the capacity of BBCDC has grown, it has been able to increase its outreach activities in the surrounding community. In June 1996, BBCDC began a two-year "landscape design" extension programme with drought mitigation funds from the European Union. In the first year, BBCDC formed a partnership programme in the village of Ha Teboho with a number of families that volunteered to take part. Individual homesteads were swaled and gardens were terraced. The programme provided for the transportation of stones for constructing terraces, surveying, fruit trees and hand tools. Money was also provided to run workshops on surveying, land degradation, composting, and horticulture. These workshops were learner-centred and participatory and included discussions, presentations, fieldwork, skill building, group work, planning exercises and site visits. The local community responded enthusiastically.

This approach was proactive, beneficial and direct. The 1997, the programme went on to build on these successes and began to promote the fencing of home gardens and orchards. More co-operators from the village of Ha Teboho joined the programme and two years later the programme was extended to another three villages. By 2002, BBCDC was working with six villages in the Phamong Valley.

The resources available for this programme are modest and average less than US$5,000 per annum. A next step is the extension of this effort to the broader landscape, fields and pastures.

Conclusions

Energy and water balances on the BBCDC campus have certainly improved over the last decade. The water collected by the swales has triggered vegetation growth, proving how effective landscaping (such as constructing swales) and bioengineering (the engineering work done by plants) can be. Although we cannot influence the timing or distribution of rainfall, we can prepare carefully for the day when it does rain and try to ensure that as much rainwater as possible stays where it falls. This water must be stored and guided carefully through the landscape. If this is not done, all the pumps and tanks in the world will be of little use.

A groundwater dam is one of the multiple water sources available to the BBCDC campus. Photo: BBCDC.

Creating water storage to halt or slow down overland water flows is essential, because good moisture infiltration takes time. In regions of chronic degradation, water is a destructive force because the natural collection system provided by living plants has been destroyed. An aggressive strategy of water collection is, therefore, an important first step in the rehabilitation of degraded land.

BBCDC's work with local communities has been successful because the local communities recognise the risks and consequences of existing practices and have actively participated in the process of rehabilitation. While development agencies, extension services and participatory learning and action (PLA) methods help, they are no substitute for communities that are eager to learn, innovative and open to change. BBCDC made progress because its interventions were based on a commitment to create a culture of learning and innovation in which local communities felt a sense of ownership in the improved systems they were working to develop and maintain. ■

We wish to thank the local community for its enthusiastic support along with Helvetas, the Swiss Association for International Cooperation, and Ireland Aid in Lesotho for supporting programs and capacity building at BBCDC.

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