Land-Water Linkages in Rural Watersheds Electronic Workshop

18 September – 27 October 2000

Case Study 25

Micro-dams for rainfall water retention in Central-West Brazil

Pilot project on water and soil conservation in the micro-basin of the Paiol stream

Luciano Cordoval de Barros
Agr. Eng., EMBRAPA
Sete Lagoas, MG, Brazil
email: cordoval@cnpms.embrapa.br

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS
Rome, Italy

ABSTRACT

The accelerated and disorganized deforestation in Central Brazil and the transformation of these natural ecosystems into crop land or pastures, without adequate technologies, resulted in irrecoverable damages to the environment, especially with respect to water and soil conservation, with particular mention to compactation. As a consequence, the soil intake rate decreased and surface runoff increased, thus causing laminar erosion, low soil quality, silting up of rivers, floods and decreased sustainability of family properties.

With the objective of reverting this scenario, a demonstrative unit was implemented in Sete Lagoas MG, (1,350mm rainfall per year), in 1995, in a property of 70 ha, where 30 micro-dams ("barraginhas") were built to contain surface runoff damages.These micro-dams also retain pollution sources carried by the waters and favor the recharge of good quality water tables, by means of improving soil intake rate, recovering water sources and alleviating droughts.

Due to the success of this demonstration unit, by means of field visits by farmers, NGO´s and publication of articles in journals and national/international congresses, a decision was taken to extend the experience and build 960 low-cost micro-dams, in 1998, in 60 small properties covering all the micro-basin of the Paiol stream, comprising a total area of approximately 40 km2, in the village/community of Estiva, Sete Lagoas county. That was only possible because of the active participation of small farmers in the indication of existing degraded sites and the support provided in terms of food and lodging for the working teams

As a result, it is now possible to hear the farmers testimonials on the effects observed in elevation of water tables observed in their domestic reservoirs ("cisternas"), better utilization of the water and drought alleviation, that have increased their yields.

INTRODUCTION

Aiming at the future of water quantity and quality, a project is being developed in Sete Lagoas, Minas Gerais State of Brazil, named “Tanks and dams for contention of surface rainfall waters” making use of a simple system that, although not being new in its principle, has been aparently forgotten in the last decades.

This pilot project is intended for areas with porous deep soils. It consists of providing each rural property, or a group of properties in the same micro-basin system, with mini-dams placed at sites susceptive to erosion, as, for instance, degraded stream beds. By doing so the runoff is stopped and its disastrous effects are minimized and the slurry material is retained together with pollutants, like dirt, fertilizer, agro-chemicals, manure that may contain antibiotics etc, which would otherwise flow to streams and other water bodies, causing contamination, temporary floods and other damages.

The system is already under testing at four rural properties and have presented very positive results. It is now going to be tested in a larger scale: to be implemented in the total area of a micro-basin, allowing for all farmers within the area of influence to benefit from the mini-dams and to permit the observation of their collective effect in the basin, in terms of the influence of each property on its neighbors. Other aspect to be observed will be the follow-up of the implementation of the system, especially the resulting consequences to the community behavior of farmers, like their observation skills and creativity in detecting opportunities to profit from conditions arising from new developments in their area, due to the new moisture regime, such as portions of land suitable for non-irrigated crops or reforestation, or for digging domestic wells, a condition that did not exist in the previous environment. The efficiency of the system towards soil and water conservation measures may be improved with the adoption of other conservationist practices like contours and minimum tillage.

SYSTEM OPERATION

When precipitation reaches the soil surface, part of it infiltrates and another runs off. This runoff, depending on soil characteristics and rainfall intensity, may concentrate to a point to cause damages (mainly erosion) do the surface. If no barrier exists to stop or to slow down this flow, most of the rain may be lost downstream thus contributing to floods. As this runoff is contained by sequential mini-dams, all materials diluted or in suspension in the water will also be stored in the reservoirs. As the first dam, located in the upper part of the area, is filled up, any excess runoff will flow through its spillway and will reach the second mini-dam below in the sequence and so on, down to the lower part of the property If a system is well designed and implemented, during the occurrence of most rains the last dam will hardly ever fill up, and no water will get to the lower lands.

In the central- west part of Brazil, there is a predominance of "cerrado" (savanna-like) areas, with porous deep soils. When mini-dams are built, the porous media underneath them will function as storage for infiltrated water. The objective of the system with sequential dams is to recharge (figure1) and to drain (figure 2) the water bodies ("lakes") formed by them thus making it possible to the water to infiltrate in a short period between rains. The micro dams have a capacity of 80m3 with an average diameter of 20m, with a heigth of 2.0 to 2.5m.The material used is the natural local soil (dirt). The water is temporarily stored for further slow seepage for about one or two weeks thus recharging the water table and being used downstream as water source (sub-irrigation). In our experience, it is common to have 12 to 15 complete recharges of the lake and the porous media underneath within a normal rainy season, that is 1,200 to 1,600 mm in aproximately six months.That will function as a natural water reservoir.

The system will cause an elevation of the water level in the soil profile which may be noticeable by observation of the level of shallow wells, the moisture increase in the soil of lower lands, or the development of small springs. Besides, the system will permit filtration of the retained water in the soil and its subsequent slow discharge along the year, thus contributing to stabilize streams and water sources. That is an important contribution towards the need to secure water supplies to farms and towns and, in a broader view, to the generation of power which will depend on the stabilization of big lakes.

INNOVATIVE SYSTEM BUILDING PROCEDURE

When building dams in their properties, many farmes make use of bulldozers which are heavy and slow machines, with low efficiency, and usually depend on transportation from one property to another. Also, they normally build the dams during the dry season, when the soil is difficult to excavate and to compact.

In this system, wheel loaders are used to do the work. They can displace from one property to another independtly of other vehicle, present flexibility to operate and are more efficient. The system is implemented during the rainy season, after the first rains ocurred, taking advantage of residual moisture in the soil for excavating and compacting. In this manner, they can be at work for six to eigth months, instead of being restricted to four to six months of dry season. As a result of this procedure, a mini-dam with a capacity of 80to 100m3 will require an average of 1 (one) machine-hour each, which represents a value of about US20.

THE PILOT PROJECT

The pilot project was implemented during March to August of 1998, in the micro-basin of "Córrego do Paiol", a rivulet in the county of Sete Lagoas, Minas Gerais State, to function as a demonstration and training unit for farmers and extensionists from other regions in the State. The Paiol micro basin has a total area of approximately 40 km2. Micro dams were built in about half of the area, compresing 60 small (family) properties. The system consists of 960 sequential mini-dams and is being funded by the National Secretariat of Water Resources and IICA, its implementation being the result of a partnership among EMBRAPA, the rural community and the Extension Service.