Lost and reclaimed: A case study of gully rehabilitation in central Kenya highlands using low-cost measures

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Abstract

Gully control and reclamation activities using low-cost measures were carried out in early March 2001 at Gatanga division, Kenya. The study area was selected on the basis of previous work carried out in farmers fields by the Legume Research Network Project (LRNP). The project's main objective is to introduce green manure legume species that perform well in different agro ecological zones of Kenya mainly for the purpose of soil fertility improvement and erosion control in smallhold farms. Area studied is characterized by a mean annual rainfall of about 1100 mm with a bimodal distribution, deep red soils, steep slopes and intensive landuse.

Field activities were carried out in one of the farms which had literally been abandoned due to gully erosion. The length of the gully was 130 m with an average width and depth of 1.62 and 1.4 m, respectively. Work involved planting of grasses (mainly *Brachira humidocola*) and mucuna (*Mucuna pruriens*) on the floor and sides of the gully. In addition 'macro-contour lines' were constructed in the farm which involved planting lines of mucuna, sesbania (*Sesbania sesban*) and napier grass (*Pennisetum purpureum*) along the terrace embankments. Through photographs taken over a 3 year period, evidence is given to show that the gully has completely healed and that the farm has been brought back to productivity.

Media Summary

Successful reclamation of the gully using low cost methods enabled the farmer to return his land back to productivity.

Key words

Soil conservation, *fanya juu* terraces, mucuna seeds, *Grevillea robusta* seedlings

Introduction

The problem of soil erosion in Kenya was identified as a major environmental problem in 1935 (Winston and Lipsomb, 1973). One of the most important contributory factor to the decline in soil productivity in Kenya is the substantial loss of fertile soil through erosion which has already affected 80% of the country's arable land. Studies conducted in central highlands of Kenya indicated that changes in soil pH, % organic carbon and % total nitrogen following erosion were significantly correlated with cumulative soil loss (Gachene et al, 1997, 1998). Work by the Ministry of Water Development (MoWD, 1992) showed that excessive quantities of fertile soil have been washed from cultivated steep slopes (often ranging from 6 to 55%) of central Kenya highlands (Table 1). Current agricultural practices in most of the smallholder farms leave the soil bare during the onset of the rains resulting in severe interrill, rill and gully erosion (Khisa et al 2002). The latter form of soil erosion, not only poses a serious threat to loss of cropland but also affect accessibility and mechanization in such farms.

Table 1. Suspended sediment loads from major rivers of central Kenya highlands

River name	Catchment area (km^{-2})	Suspended sediment load ($t\ yr^{-1}$)
Athi	41,199	2,942,313
Tana	2,365	999,721
Mathioya	500	20,107
Maragua	414	70,797
Chania	518	22,132
Thika	316	53,056

Source: MoWD, 1992

Control measures for gully-erosion must be site-specific, and a proper understanding of the processes of formation and development is a precondition for effective control. Gully control structures can be classified as temporary or permanent. Temporary structures are intended to function until vegetation becomes well established. They include, planting of vegetative materials on the floor and sides of the gully, brushwood check-dams, loose stone check-dams, earth-filled gunny bags and check-dams. The objective of the check-dams is to slow down the water and cause deposition of silt, which may allow vegetation growth.

It can be extremely difficult and costly to rehabilitate a gully once it has developed. Thus, much more attention needs to be given to developing effective procedures and low-cost measures for gully control and reclamation. In particular, attention needs to be paid on the use of vegetation wherever possible. Our experience in the same area has shown the potential of *Mucuna pruriens* in controlling soil erosion especially during the critical period when the ground is bare and prone to erosion (Khisa et al, 2002). Among other several factors, the common cause of gully formation are lack of cover in the catchment as a result of clearing for cultivation; runoff discharged from a road through culverts, grazing pressure and development activities. This study addressed the use of locally available vegetative materials, namely green manure and shrubby legumes, grasses and trees, for gully control and rehabilitation.

Method

This study was carried out in Kiama village, Gatanga division, Thika district, Kenya and is located at latitude 0? 56.4’ to 0?59.4’ S and longitude 36?54.5' to 37? 0’ E. The farm belongs to Mr. Daniel Ndung’u who had participated in earlier trials involving the use of green manure cover crops (GMCC) for soil fertility improvement and erosion control. The average altitude of the area is about 1500 masl. The terrain is hilly and susceptible to erosion. The area receives an average annual rainfall of 1100 mm in a bimodal pattern, March to May and October to December. The soils are nitisols which are acidic and of low plant nutrients (Mureithi *et al* 2004). Farm sizes range from 0.1 to 2ha and the predominant crops are maize, beans, sweet potatoes and bananas.

During one of the field visits, it was noted that the GMCC, mainly mucuna (*Mucuna pruriens*) could not alone control erosion effectively due to the steepness of the slopes (56%) and the poorly maintained soil physical measures in the farm. Furthermore, the farm was prone to gully erosion as there was runoff discharge from the nearby earth road which had led to gully formation in the middle of the road and in Mr. Ndung’u’s farm.

In 1999 long rain season (March to May), a gully had started to form along the boundary which separates Ndung'u's farm and one of the neighbour's farms while another had started forming in the middle of Ndung'u's farm. A visit was made by the LRNP team to assess the damage with the ultimate goal of reclaiming the gully. The team had to identify the safest way of discharging the runoff, examine the appropriate conservation measures to be applied and assess the necessary inputs required for healing the gully. It was agreed that the owner of the farm provide some labour and napier grass (*Pennisetum purpureum*) for stabilizing the embankments while the project was to meet part of the costs for the labour, provide mucuna seeds and grevillea (*Grevillea robusta*) tree seedlings, wooden pegs and gunny bags.

Gully rehabilitation activities

Field activities were carried out in early March, 2001. The length of the gully was 130 m with an average width and depth of 1.62 and 1.40 m, respectively. The work involved planting of grasses (mainly creeping signal grass, *Brachira humidicola*) on the floor and sides of the gully, construction of check dams using gunny bags which were filled with the soil and reinforced with wooden pegs, and brushwoods which were constructed immediately below the check dams. A total of 130 gunny bags were used, of which 110 were provided by the nearby Kiama Coffee Factory whose land also neighbours the gullied road.

Other soil conservation activities in the farm

This involved the construction of a cutoff drain and *fanya juu* (form of a bench terrace where the soil is thrown upslope during construction) terraces in Ndung'u's farm. Creeping signal grass (*Brachira humidicola*) was planted along the embankments of the cutoff drain. Along the terrace embankments, lines of *Mucuna pruriens Sesbania sesban* and *Pennisetum purpureum* were planted next to each other along the embankment while grevillea trees were planted in the ditches. In total, 40 sesbania and 30 grevillea seedlings were planted. Once the gully showed signs of healing (the healing processes starts when water flow is slowed down by the check dams thus causing deposition of silt, which on the other hand allows vegetation growth), mucuna was planted along the floor and on the sides of the gully. Nine to twelve months after commencement of the work, most of the vegetative materials especially mucuna, napier and signal grasses had established well.

Impact of the technology

After seeing the efforts made by the project team and the farmer, Kiama Coffee Factory staff offered 110 gunny bags, which were used for the rehabilitation of the gully. Having visited the site to see the team's activities, the Soil and Water Conservation extension officer from the Ministry of Agriculture expressed the willingness to collaborate with the project team. In an area already experiencing serious soil erosion problems and where extension services are not reaching most of the farmers, this work has already generated a lot of interest to the surrounding farmers. In addition the method used by the project offers several advantages to the farmer, namely, erosion control, soil fertility improvement, source of fodder for livestock and, building material and firewood. The gully is strategically placed along the road and many farmers have requested for technical assistance. Observation after 3 years show that the gully has already healed. Indeed the farmer is already making use of his farm which is currently under sweet potatoes, maize and bananas.

Conclusion

The authors recommend that priority be given to those measures which simultaneously control the gully and restore the affected land, if not to its former state, at least to some kind of productive use for fodder, fuelwood or growing crops such as bananas. In particular, more attention need to be paid to the use of vegetation wherever possible as this is a more cheaper method of controlling gully than the construction of gabions which are expensive and labour intensive. Although Kenya has accomplished a great deal of gully control and rehabilitation through the work of various agencies, much can be achieved by creating more awareness to the local farmers and by training extension staff on low cost, but effective methods of gully control. The authors noted that failure of gully control in the area was attributed to lack of enough technical skilled personnel and poor maintenance of gully control structures. It is the responsibility of the

individual farmer to carry out erosion control measures in his or her farm while the government has the major role of providing technical guidance on proper and effective methods of erosion control. The latter is currently being addressed by the Soil and Water Conservation Branch in the Ministry of Agriculture. The gully in the study area had been caused by runoff discharge from a nearby earth road and it is therefore essential that road construction should be accompanied by effective soil conservation measures.

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References

Gachene CKK, Jarvis NJ, Linner H and Mbuvi JP, 1997. Soil erosion effects on soil properties in a highland area of central Kenya. Soil Sci. Soc. Am. J., 61: 559 – 564.

Gachene CKK, Mbuvi JP, Jarvis NJ and Linner H, 1998. Maize yield reduction due to erosion in a high potential area of central Kenya highlands. African Crop Sci. Journal, Vol. 6, No. 1, pp 29-37.

Khisa P, Gachene CKK, Karanja N.K. and Mureithi JG, 2002. The effect of post harvest crop cover on soil erosion in a maize-legume based cropping system in Gatanga, Kenya. Journal of Agriculture in the Tropics and Subtropics, Vol 103, pp 17-28.

MoWD, 1992. The study of the National Water Master Plan. Sectoral Report (B): Hydrology, Nairobi, Kenya

Mureithi JG, Gachene CKK, and Wamuongo J, 2004. Participatory evaluation of the effects of residue management practices of green manure legumes on maize yield in central Kenya highlands. Accepted for publication in the Journal of Sustainable Agriculture.

Winston LC and Lipsomb JF, 1973. The history of Kenya agriculture. University Press of Africa, Nairobi, Kenya, 74 pp.