VETIVER GRASS: AN OPTION FOR EROSION CONTROL IN THE HILLY REGION OF BANGLADESH – PROSPECTS AND LIMITATIONS

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Abstract

The hill areas of Bangladesh experience intensive downpour during the monsoon, from June to August. Rainfall intensity may exceed 100 mm/hr for 15 min at a time. Total annual rainfall is about 2 800 mm (as recorded at Soil Conservation and Watershed Management Centre). Soils are shallow, with an erosivity factor ranging from 0.36 to 0.54. The terrain is exposed to raindrop splashing during the early monsoon. Shifting cultivation, massive deforestation, fuel wood collection, infrastructure development and other land uses without appropriate conservation measures accelerate erosion. The whole scenario at present leads to severe land degradation in the hilly region. It is estimated that soil loss from steep slopes (where K = 0.37) is about 42 t/ha/yr under shifting cultivation, and the total loss per year over some 32 500 ha is 1.5 million t. This loss is reduced to 6-11 t/ha/yr by using hedgerows in shifting cultivation along contours. It was observed that the performance of vetiver as a hedge crop is the best with respect to soil retention as well as management.

Hedgerow Rationale

The World Bank (1992) reviewed the impact of soil degradation and found that 1 200 million ha (almost 11% of the vegetative cover of the world) has undergone moderate to serious degradation due to human activity over the last 45 years. Taylor and Young (1985) identified a double penalty from soil erosion: loss of crop productivity and loss in the value of the future crop-enhancing technology. However, technological intervention tries to protect the land for sustainable crop production and the environment. Traditionally mechanical measures such as construction of terraces, embankments or contour bunds are taken to shorten the slope length for conserving soil and water. Nowadays vegetative or bioengineering measures such as strip cropping, contour cropping, mulching, hedgerows along contours, or use of trees and plants are being emphasized and popularized, as present conservation is more eco-minded. Conceptually both types of measures are adopted to reduce runoff flow and volume. Mechanical measures are costly, requiring high skill and budget. These systems fail to attract small stakeholders (Woodhead and Chaudhaly 1991). As an alternative, vegetal barriers in the form of grass, shrub and tree hedges have become popular because they are easy to establish, require little skill and do not cost much. Over and above the beauty of the hedgerow system is its contribution to soil fertility from its biomass and its off-farm usable products. It is also environment-friendly. However, in most cases, a combination of mechanical and vegetal means shows the best results.

Choice of Species

Generally local or indigenous species are favoured for hedgerows and the choice depends on a species perennial and coppicing habit, drought tolerance and resistance to pruning or trimming (preferably leguminous), on whether it can grow in a wide range of soil characteristics, tolerates soil submergence, is resistant to disease, invites no pests or insects, has multipurpose use and is easy to manage and to propagate.

Retrospect and Prospect of Hedgerow Use in Bangladesh

Bangladesh spreads over hills (12%), a terrace (8%) and a flood plain (80%). Soil erosion is spectacular all over the country. Very little work has been done to quantify the extent. As normal practice, farmers allow grasses like *Cynodon dactylon* on field bunds or dykes to protect them from erosion. In low-lying areas, generally close to water, vetiver grasses are used to control drainage channels, field dykes and roadsides. The off-farm use of the vetiver is as roofing material for poor huts and occasionally as fodder.

In hilly areas, use of hedgerows as barriers is rare. Unfortunately soil erosion is severe in that part of Bangladesh. Shoaib et al. *(*1998) estimate that about 5 500 ha of land is used for shifting and/or root-crop cultivation each year without any conservation measures. Total loss of soil is about 2.5 million t/year. However, the valleys of the hills are broad-based tabletop terraced, and field bunds (dykes) are working as raisers. The batters of these raisers are usually 1:1 of height 0.5 to 1.0 m and covered by *Cynodon dactylon*.

An ICOMD project initiated hedgerow planting in hills through the SALT program of the Chittagong Hill Tracts Development Board (CHTDB). The job was started by using leguminous shrub crops. The results are shown in Table 1.

Table 1. Runoff, soil loss and deposition for various treatments on experimental plots. CHTDB Alutila, Khagrachari

Cultivation practice	Runoff (m^3/ha) Mean of 3 replications	Soil loss (t/ha) Mean of 3 by multi-slot divisor measurement	Soil loss/deposition (t/ha) Mean of 3 by erosion pin measurement
Jhum, no hedgerow	9 670	27.68	-1.7 (226.1)
Jhum, with *Leucaena leucocephala* hedgerow	4 971	17.49	+3.9
Jhum, with *Flemingia macrophylla* hedgerow	3 733	9.02	+4.1
Jhum, with *Desmodium rensonii* hedgerow	2 657	6.83	+3.9
Vegetables and cash crop with *Indigofera tysmanii* hedgerow	4 098	15.32	+6.1

Biomass yield from different species as found at the SALT station at Alutila, with pruning three times at 20 cm height, is shown in Table 2 (Khisha 1999).

Table 2. Biomass yields from various hedgerow species at SALT station, Alutila, Khagrachari

Hedgerow species	Green weight (t/ha/yr)	Dry weight (t/ha/yr)
Flemingia macrophylla	12.8	4.5
Indigofera tysmanii	7.9	3.6
Acacia mangium	10.5	4.5
Desmodium rensonii	9.0	2.6
Leucaena diversifolia	10.5	6.0
Grass species		
Vetiveria zizanioides	12.8	4.5
Thysanoleana maxima	20.0	8.3

Since 1996 the Soil Conservation and Watershed Management Centre (SCWMC) has conducted experiments on controlling erosion in shifting cultivation by using hedgerows on steep slopes. This includes vetiver as one of the hedge species as of 1997. Soil loss and runoff were estimated from 100 m^2

plots by multi-slot divisors and adoptability of hedge species at different parts of the slope. The species are *Tephrosia candida, Indigofera tysmanii,* Napier, and vetiver.

Results are given in Table 3. The *Tephrosia candida* hedge is three years old; it shows less soil loss in relation to others. Two-year average results are presented here as reference.

Table 3. Soil loss under various hedgerows with shifting cultivation

Mos.	Vetiver +SC	Napier + SC	*Tephrosia + SC	Indigofera + SC	Shifting cultivation (SC)	Under natural shrubs and creepers	Rainfall in mm
Jan							33
Feb							50
Mar							60
Apr	0.1	0.2	0.2	0.2	1.7	0	189
May	1.1	1.1	0.7	1.8	3.4	0.2	456
Jun	4.1	4.3	3.7	5.4	19.3	0.7	867
Jul	4.2	3.9	2.1	4.5	11.9	0.5	525
Aug	2.9	3.4	1	2.5	3.7	0.3	462
Sep	0.1	0.1	0.1	1	2.4	0.1	244
Oct	0	0	0	0	0	0	108
Nov	0	0	0	0	0	0	51
Dec	0	0	0	0	0	0	0
Total	12.5	13.0	7.8	15.4	42.1	1.8	

*SC = shifting cultivation (paddy) * Three-year-old hedge*

The shrubs were pruned three times per year at a height of 50 cm, when the grasses are at 25 cm. The calculation was done for steep slopes where the hedgerows are at 1-m vertical intervals and expected total length of the row is approximately 3 000 m. Table 4 depicts the results. Management costs were also calculated. Performance of the species was observed in terms of growth rate, survival and propagation and maintenance. Among them *Tephrosia* is the best at the initial stage but the survival rate is least after three years, whereas vetiver performed best from the second year of its establishment. It needs least maintenance and is easy to propagate although the initial growth rate is very slow.

Table 4. Biomass yields from various hedgerow species at SCWMC, Bandarban

Hedgerow species	Green weight (t/ha/yr)	Dry weight (t/ha/yr)	Management cost (US$)
Tephrosia candida	26	8.7	40
Indigofera tysmanii	22	4.8	35
Desmodium rensonii	30	10.3	35
Gliricidia sepium	27	7.9	37
Grass species			
Vetiveria zizanioides	25.8	10.9	20
Thysanoleana maxima	25.1	9.4	30
Saccharum spontanum	18.9	8.2	32

The soils are shallow, pH 4.9 to 5.7, OM 3.9 to 4.4%, total N is around 0.2%, P 2.6 to 6.6 meq/100g soil and K is 0.3 to 0.8 micro g/g soil.

Limitations of Use of Vetiver Hedgerows in Bangladesh

During the period of the experiment (1996-99), several GO/NGO field staff and officers, farmers as well as policymakers visited the centre and appraised the results and the low-cost technology to control erosion. Still, the approach requires more motivation and partnership with the end users. The following constraints were identified:

- Non-availability of the hedgerow materials to propagate
- Lack of awareness (both policymakers and users)
- Land ownership and/or tenure
- Lack of appropriate training to identify contours (field staff and users)
- Ignorance of the many uses of hedgerows

To overcome the limitations, intensive advocacy workshops and training and participatory demonstration models may be initiated. Publicity in the media and audiovisual programs could generate substantial interest and motivation.

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