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Effects of vegetative barriers for channelization of Shiwalik torrent at Sabhawala in Doon Valley (India)

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Abstract

A study under highly fragile ecosystem was conducted at Sabhawala watershed area in Doon Shiwalik hills of Uttarakhand. The Uttarakhand state is particularly sensitive to forest land disturbing activities. Steep slopes, high rainfall and weak geology of the Uttarakhand state accentuate the land degradation and soil erosion process at much faster rate than in the plains. In the head water reaches the sediment is flushed with the high velocity currents. But when it reaches the relatively terrain foothills. Its debris carrying capacity diminishes and the debris starts accumulating on the river bed causing change of river course and flooding its bank. To assess survival percentage of different species for effective vegetative barriers for channelization of Shiwalik torrents, controlling and management of torrent flow, runoff, erosion control, various vegetative barriers species as *Vitex negundo*, *Arundo donax*, *Ipomea carnea*, *Dendrocalamus Strictus etc* were established during the study period. The protective vegetative barrier plant species used as *Ipomoea carnea* recorded the height survival percentage as *Ipomea carnea* (90%) having the growth 150 cms followed by *Vitex negundo* (86%) along with 111.0 cms growth *Pennisetum purpureum* (Hybrid Napier) (84 %) with 113.5 growth height , *Jatropha curcas* (83 %) with 110.5 growth height, *Arundo donax* (70%) with 100.0 cms height growth, The protective vegetative barrier measures were provided a base root technology for conservation and management of relative torrential watershed in Doon Shiwalik Himalayan region of India.

Keywords: *Torrent*, *vegetative barriers*, *Bio-engineering methods*, *Shiwalik region*, *runoff*

Introduction

The Uttarakhand state is particularly sensitive to forest land disturbing activities. Steep slopes, high rainfall and weak geology of the Uttarakhand state accentuate the land degradation and soil erosion process at much faster rate than in the plains. In the head water reaches the sediment is flushed with the high velocity currents. But when it reaches the relatively terrain foothills. Its debris carrying capacity diminishes and the debris starts accumulating on the river bed causing change of river course and flooding its bank. These rivers with flash flows and high sediment loads are known as torrents. Thus, the real problem of torrent formation lies in lesser Himalayan in fact, due to misuse and mismanagement of upstream catchments. The problem of torrent menace has been rising in Uttarakhand with the rise, in population pressure and related mismanagement of upstream watersheds.

Torrents or torrential streams have been defined variously,According to FAD; torrential stream /torrent has been defined as small mountain stream which flows with high velocity and flashy, usually carrying large size bedload particles. In defining other subtypes, the source also describes a torrential stream as one which transports heavy load of sediments derived from slides and other unstable areas as a sediment laden torrent or gully washer. Again another type is a small torrent supplied with sediments by a slide area has been described as a flashy slide-fed torrent (FAO, 1981). In an another conservation guide of FAO, torrent has been described as a natural channel or waterway with (a) A small catchments or watershed; (b) Steep and

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irregular section of extreme oscillation of the runoff with high flood peak with rain and storm; and (c) High bedload transport, due to intensive erosion and mass movement and sedimentation (Hettinger, 1976).

In the present study, the protective vegetative cover was established in the torrent of Sabhawala watershed area for the identification of effective protective vegetative cover with the help of mechanical measures and appropriate soil and water conservation techniques. Trees and Grasses used for the establishment of the initial vegetative cover by the species as *Dalbergia sissoo*, *Bauhinia purpenea*, *Dendrocalamus Strictus* , *E. hybrid*, *Ipomea carnea*,*Vitex negundo*, *Arundo donax*, *Eulaliopsis binata (Bhabhar)*, *Pennisetum purpureum (Hybrid Napier)*, *Jatropha curcas*, *Crysopogon fulvus*, *Saccharum munja*, *Pueraria hirsute(kudzu)* , *p.antidotale and V.zizanioides etc.* The plants used as *Leucaena leucocehapla (Subabool)*, *Salix tetrasperma*, *Acacia catechu* (Khair) *Cedrela toona*, *Baunhinia* spp. *Erythrina suberosa*, *Lannea grandis*, *Pithecelobium dulce* (Jungle Jalebi) *etc* has been observed as a effective protective vegetative cover and helping in recharging ground water, channelization of torrent water flow and controlling flood.

Materials and Method

Study area

The study was conducted at Sabhawala watershed in the Doon Shiwalik range of the Uttarakhand (India). The experimented site located at the longitude 77º 48' E and latitude 30º 20' N. Uttarakhand is characterized by two types of climate, sharply differentiated in the plains and the mountainous regions. Rainfall is quite favorable in this area and is more than 1100 mm per annum. However its main concentration is in monsoon season (about 80% of the total precipitation), which is the major cause of erosion in the rainy season. Frost conditions also occur in the winter months. The soils have poor structure and their water retention capacity is quite low. As a result of poor water holding capacity, it supports less biological activities and that is why drought conditions prevail in the summer months. Due to constant erosion over a period of time, soils have been washed and left with very poor nutrients status.

Methodology

The selected experimental torrent at Sabhawala watershed area originating from Doon Shiwalik foothill regions of Himalaya have been identified and delineated for the experiment. The experimental program was planned taking into account the objectives of the study and the parameters were selected to centralize the aim of sampling to achieve the representativeness and validity of the samples. The study was conducted for two years (April, 2007-March, 2009) and the frequency of sampling was set as per existing conditions during the rainy seasons or flood periods.

Results and Discussion

The primary concern of watershed management is to continuously increase the productive capacity of land, water, vegetation and other resources by selecting and developing the best way of managing the renewable and non-renewable resources in watershed to meet the present and future needs of the community. It requires the collection and analysis of a great deal of information of the physical relationship of vegetation-soil water to land management which would ensure economic and social progress of a region.

In the present study, various plant species effectively served as vegetative barrier and had better soil binding capacity in the layer, which helped in soil aggregation, increased infiltration rates, improve soil moisture level and conserved maximum runoff.

In the present study for the vegetative barrier, live hedges and vegetative spurs, various trees and grasses were planted on bank of the upstream side in the Sabhawala watershed area to identified the best performance of Survival and growth behavior of species like *Dalbergia sissoo*, *Bauhinia purpenea*, *Dendrocalamus strictus*, *E. hybrid*, *Ipomea carnea*, *Vitex negundo*, *Arundo donax*,

Eulaliopsis binata, *Pennisetum purpureum*, *Jatropha curcas etc*.

The best survival and growth was shown species as *Ipomea carnea*,(90%) having the growth 150 cms , *Vitex negund* (86%) along with 111.0 cms growth Pennisetum purpureum (Hybrid Napier) (84 %) with 113.5 growth height , *Jatropha curcas* (83 %) with 110.5 growth height, *Arundo donax* (70%) with 100.0 cms height growth, *Dendrocalamus strictus* (76%) with 103.7 cms height, *Eulaliopsis binata* (65%) with 105.0 cms height growth, *Bauhinia purpenea* (70%) with 50.0 cms height growth, *Dalbergia sissoo* (64%) with 54.0 cms height growth. Plantation of these vegetative barriers plants species was done in July – August during rainy days. However the best survival and growth was shown by *Ipomea carnea,(90%)* followed by *Vitex negund* and Pennisetum purpureum species might be a better choice over fodder species on these freely accessible areas because browsing restricts the establishment of fodder species.

Table. 1: Survival and growth behavior of different vegetative barriers plants species on torrent bed and banks

Vegetative barrier Plant species	Species Survival (%)	Species Growth (cms)		Current species Height	Annual increment Basel dia	Type of vegetation
		Height	Basel dia			
Dalbergia sissoo	64	54.0*	2.5	-	-	Shrub
Bauhinia purpenea	70	50.0	2.0	23.0	0.6	to
Dendrocalamus strictus	76	103.7*	2.2	50.5	0.6	tree
Ipomea carnea	90	150.0	2.5	113.0	0.8	Shrubs
Vitex negund	86	111.0	2.4	77.0	0.7	Shrubs
Arundo donax	70	100.0	2.5	63.0	0.6	Shrubs
Eulaliopsis binata	65	105.0	10.3+	70.0	5.8	Grass
Pennisetum purpureum	84	113.5	3.1	78.5	0.3	Grass
Jatropha curcas	83	110-5	2-6	111.0	0.6	Shrubs

***= Browsed by cattle**
+= Clump diameter

Napier (*P.purpureum*) could be suitable vegetative barrier, where fodder production is a priority while *S. munja* as a barrier is suitable where conservation and crop production is the main objective. Burdak (1982): reported that *S .munja* is recent advances in desert afforestation. Various research works in the rooting behavior of some grasses in the Shiwalik were carried out by Saha *et a1*. (1994) on *Saccharum munja*, *Eulaliuopsis binata* and *Vetivaria zizanionides* and described at the roots of *S. munja* (Munj) reached the maximum depth. Highest root densities were confined to the plough layer in all the three species, the trend being *E.binata* (89%) > *Vetivaria* (77%) > *S.munja* (48%).

Samra and Sharma (1995) made experiment the soil binding factor for three perennial grasses (*S.munja, S.spontaneum, Arundo donax*) in sandy choes at Rei Majra and observed that the *S.spontaneum* had the highest above ground biomass (398 kg) followed by *S. munja* (28.3 kg) and least *A. donax* (3.7 kg). Soil binding capacity in 0-10 cm layer was recorded highest for *S.spontaneum* (1590) followed by *S.munja* (788) and *A.donax* (31).

The selected vegetative barrier plant species effectively served as vegetative barrier and had better soil binding capacity in the torrential soil, which helped in underground water recharges because that increased infiltration rates, improve soil moisture level and conserved maximum runoff and played a significantly contributed to controlled and channelization the degraded torrent channels and protected the agricultural land for the better survival and increase the economy of inhabitants in and around the watershed catchment basin. The vegetative grasses, shrubs and tree plantation on

the earthen embankment of torrent provided the fodder to livestock and fuel of the villagers of Sabhawala

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