BIO-DIVERSITY CONSERVATION AND NATURAL RESOURCE REGENERATION THROUGH WATERSHED DEVELOPMENT AT JHANSI

C.R.Hazra

All India Coordinated Project for Research on Forage Crops, Indian Grassland and Fodder Research Institute, Jhansi (U.P.) -284 003 (INDIA)

ABSTRACT

Seven microwatersheds with an area of 5395 ha located at Kharaiya Nala Watershed (Jhansi) were fully treated with appropriate soil and water conservation measures. Barren village common lands consisting of 665 ha on ridges were fully rehabilitated through silvipasture. Treatment on watershed basis had a great impact in containing soil and run off water losses and improving agriculture and animal production. Development of common lands through soil and water conservation helped with faster ecological succession of grasses and regeneration of rootstocks resulted in bio-diversity conservation. Increased land and biomass productivity reflected on the socio-economic gains of the farmers including landless poor.

INTRODUCTION

Destruction of forests by the village poor is the major cause of land degradation due to accelerated soil and water erosion. It is a major challenge to counter ill effects of land degradation and rehabilitate these lands for bio-diversity conservation and plant production. The role of afforestation, silvipasture and grassland development has been highlighted by many workers for restoring soil productivity and reducing soil and water losses as caused by erosion (Patil, 1979; Hazra, 1989). Its effect is quite substantial when the treatment is made on watershed basis (Hazra and Singh, 19992a; Hazra and Singh, 1992b and Hazra et al, 1996). The present work was thus undertaken to revegetate the highly degraded village common lands through appropriate mechanical and vegetational measures on watershed basis.

METHODS

Jhansi district is located south of Uttar Pradesh state(24^{o} 11' N latitude and 78^{o} 17' E longitude) in India. A cluster of seven micro-watersheds (5395 ha) located in a major watershed of Kharaiya Nala, east of Jhansi was fully treated on watershed basis. Various soil conservation measures like contour bunding, field bunding, gully plugging, field to field drainage and checking and storing of rain water on ani-cuts were practised for arable lands. On village community lands consisting mostly of hills and hillock ridges at a length of 8 km with an area of 665 ha were also treated with various mechanical measures viz. contour stone ridging (spaced at 3 m having slopes 20% and more and wider spacing 6 m having slopes 8-20%), small trenches (3 x 0.45 x 0.45 m ^{3}) on contours, gully plugs, continuous bunds with boulders and soil across the slopes, cutting the slope length by pebbles and stones along with vegetational measures and creation of diversion channels on foot hills which at times used cattle proof trenches. The entire ridge was planted with suitable tree species like *Azadirachta indica, Albizia lebbeck, Acacia nitotica, Dalbergia sisoo, Leucaena leucocephala, Acacia catechu, Pongamia pinnata* and several of the grass and legume species were also introduced viz., *Cenchrus ciliasis, C. setigerus, Pennisatum pedicellatum, Panicum maximum, Stylosanthes hamata, S. scabra* etc.

RESULTS AND DISCUSSION

Run-off, Soil Loss and Sedimentation Control : Sedimentation varied from 28 -45 cm prior to the treatment of watershed which was decreased to 0.5 cm after six years of treatment. Greening of hills and hillocks and also the arable lands had a real impact in containing run-off water and soil loss (Table 1). The run off water loss was reduced from 30-70 per cent to 15-19 per cent and soil loss from 5.9-41.0 t/ha to 0.63-1.10 t/ha. Consequently, water table depth was raised 5-6 metres.

Silvipasture and Forage Production : Soil and water conservation measures not only helped in regeneration of rootstocks of trees and shrubs but also regeneration of many natural grass and legume species which otherwise would have been lost due to continuous removal of top soil. The survival of different planted trees and shrubs were to the extent of 40, 80 and 90 per cent on hill tops, hill slopes and foothills, respectively. This corroborates the observations noted on the canopy coverage and radiation infiltration. Lowest forage yield was also observed at hill tops (2.45 t/ha) against the yields of 6.82 t/ha on hill slopes and 8.08 t/ha on foothills.

Regeneration of Range Grasses : The effect of protection together with soil and water conservation measures has a great impact on ecological succession of many useful and valuable grass and legume species. The study was made on one year enclosures in some of the sites prior to watershed initiation of work and the changed rangeland vegetation after four years indicated a great shift in vegetation from poor quality grass of *Aristida* sp. and other annual grasses to most desired grassland vegetation of the tract like *Dicanthium annulaltum, Sehima nervosum* and *Chrysopogon fulvus* in the sites (Table 2). This has also resulted in increased herbage productivity from 0.42 to 5.3 t/ ha. The herbage productivity further improved to 6.8 t/ha due to reseeding with *C. ciliaris, P. pedicellatum* and *S. hamata* .

Regeneration of Trees and Shrubs : Regeneration of rootstocks of trees and shrubs was also made for a period of three years. The regeneration was dependent on root-stocks availablity and these in turn depended on the extent of degradation taken place. Once the mechanical and vegetational conservation measures were adopted, the root-stocks regenerated because of improved soil moisture status. Natural regeneration of trees and shrubs varied from 900 to 3000 per hectare after one year. This has also a practical implication that the number of tree/shrub saplings to be planted would depend on number of regenerating root-stocks. Number of saplings thus planted varied between 200 - 850 per hectare in the different micro-watersheds depending on number of regenerated root-stocks. It was observed that *L. leucocephala* and *A. lebbeck* were fast growing tree species. On steep slopes A. indica was found to be the best surviving plant species and *A. lebbeck* on foothills.

Arable Crop Production : The vegetational development and regeneration of degraded hills not only helped in providing useful green biomass for animals but also helped in conserving soil and water. This has further resulted in improving the crop productivity from 0.6 to 5.2 t/ha annually primarily due to increased water availability for irrigation. The irrigated area increased from 10 to 83 per cent of cropped area and the cropping intensity from 81 to 192 per cent. The farm income rose by 800 per cent.

Soil Fertility Build Up : Greening of degraded lands resulted in soil fertility buildup over the years. The soil organic matter content was increased by more than 300 per cent. The available N, P,K and S content was greatly appreciated. About 210 ha area around foothills which was earlier affected by scree deposits was fully brought under arable cropping.

Socio-Economic Gains : The cooperation of villagers is found to be very good because of increased income from their arable lands which are almost 8 - 9 times greater than in the pre-treated period. The cooperation and participation of landless people is also good because of alternate employment opportunities and round the year engagement for agricultural operations. Most of the landless families are also engaged in basket making from unwanted shrubs, like *Lantena camera* which is primarily used for vegetable packing which has developed in a big way in the watershed. Annual income of the village poor rose by 600 per cent. The availability of forages was greatly improved, from 51 per cent deficit to 10 per cent surplus after four years. This has resulted in doubling the milk yield. Similarly, the initial fuelwood availability was only 10 per cent which was improved to 85 per cent of the requirement.

The project suggests that the entire cost for greening the degraded lands is more or less recovered within three years. The cost-benefit ratio of the programme is 1:2.94 on entire watershed basis and 1:1.10 for the revegetated hills. Village resource management committees were also formed for protection and sharing the usufruct benefits of the regenerated resources in a rational manner.

Regeneration of village common lands through afforestation is found to be cost-effective and give tangible benefit to the people if it is treated on watershed basis. Simple forest regeneration on village common lands may not be acceptable to the community and may not be viable if the community's need is not considered. The participation of the villagers is a must from the initial micro-planning stage to implementation of the programme and to its protection including decision making authority for usufruct sharing. The project has developed a cost effective model for greening barren hills and hillocks constituting common lands through village resource regeneration. The project has also clearly demonstrated the existence of upland - lowland interaction in the Vindhyan ecosystem and that development of one in isolation of the other will not succeed.

REFERENCE

Hazra, C.R. 1989. Forage and soil productivity under agroforestry and silvipasture system in Bundelkhand region. In promotion Fuelwood Trees (Eds. N.G. Hegde, L.L. Relwani and V.D. Kelkar), BAIF Publications, Pune, pp 83-88.

Hazra, C.R. and D.P. Singh. 1992a. Soil and water conservation and silvipasture for wasteland and barren hill improvement at Gaharawa watershed - An Indian Experience. In Proc. Second International Symposium on Integrated Land Use and Management, Deptt. Primary Industries, Queensland, Australia, Key Note Paper No. 28, pp 1-8.

Hazra, C.R. and D.P. Singh. 1992b. Watershed management for sustainable rainfed agriculture development - An experience at Tejpura Watershed. In Proc. Second International Symposium on Integrated Land Use and Management, Deptt. of Primary Industries, Queensland, Australia, Key Note Paper No. 39, pp 1-8.

Hazra, C.R., D.P. Singh and R.N. Kaul. 1996. Greening of common lands in Jhansi through village resource development : A case study. Society for Promotion of Wastelands Development, New Delhi, pp 1-50.

Patil, B.D. 1979. Agroforestry with accent on forage -fuel production. Bull. IGFRI Research Area Series 1, Jhansi, pp 1-48.

Table 1
Effect of soil and water conservation measures and afforestation of barren hillocks on the sedimentation, soil loss, run off and water table depth.

Character	Prior to watershed treatment	After six years of watershed treatment
	(1989-90)	(1995-96)
Sedimentation (metre)	0.36	0.005
Soil loss (tonnes/hectare)		
Hillocks (30% slope)	41.00	0.90
Wastelands (8% slope)	20.50	0.63
Arable land (3% slope)	5.90	1.10
Run off water loss (Per cent annual rainfall)		
Hillocks (30% slope)	70.00	19.00
Wastelands (8% slope)	48.00	15.00
Arable land (3% slope)	30.00	18.00
Water table depth (metre)	12.00	7.00

Table 2
Effect of protection and soil and water conservation measures on ecological succession

Grass and legume sp. before the protection and any treatment	Protection of species (%)	Grass and legume sp. after four years of protection and soil and water	Protection of species (%)	Dry forage (t/ha)	
				Initial product-	Productivity after four years
(1989 - 90)		(1993 - 94)			
Aristida sp.	35	*Dicanthium annulatum*	22	0.42	5.3
(*Aristida mutabilis* *A. adscensionis* *A. funiculata*)		*Bothrichloa pertusa*	18		
		Themada sp.	12		
Ermopogon foveolatus	18	*Digitaria* sp.	10		
Heteropogon contortus	15	*Cenchrus* sp.	8		
Indigofera cordifolia	5	*Sehima nervosum*	8		
Annual grasses	27	Others	22		

(*Heteropogon contortus, Apluda mutica, Indigofera cordifolia, Atylosia searaboides* etc.)