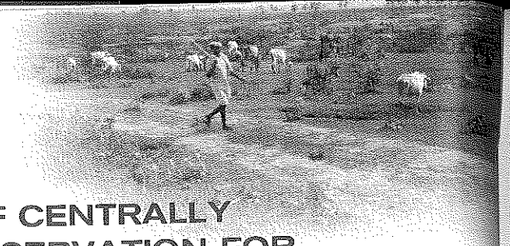

STRATEGIES AND ACHIEVEMENTS OF CENTRALLY SPONSORED SCHEMES OF SOIL CONSERVATION FOR ENHANCING THE PRODUCTIVITY OF DEGRADED LANDS

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INTRODUCTION

Agriculture occupies a key position in India. It meets the requirements of food grains and also supplies raw materials for our industries. It is a source of livelihood for the teeming millions of our country. In fact, India's ability to improve and sustain productivity of land and water will be the acid test for the success of our efforts aimed at accelerating the pace of economic development in India. The non-expandable soil and water resources have to accommodate the competing demands for production of food, fodder, fibre, fuel, minerals, urbanisation, other non-agricultural land resources, etc., for meeting the needs of the ever-increasing human and animal population.

Soil erosion and land degradation pose severe challenges to the productivity of land and life of reservoirs of multipurpose irrigation projects threatened by a high rate of siltation. Also there are frequent flood hazards in selected rivers of the country due to large scale deforestation and land degradation in the river basin. In view of these problems, soil and water conservation measures have been adopted on watershed basis in an integrated manner in the country to minimise soil erosion, sediment deposit into the reservoirs, reduce flood peaks and volume and ultimately increase the productivity.

The catchment of a river system or a reservoir is identified spatially as the land, which collects precipitation and contributes to the water resource of the river system or the reservoir. In this sense, a catchment is projected as a geographical entity to serve the needs of the creation of a water source and its augmentation. On the other hand, a catchment represents an eco-system comprising the basic resources of land, water, flora and fauna. All these basic resources continuously interact with one another and go to subserve the parameters of their sustainability and degradation. Inter-dependence among these resources is very high and requires to be given due recognition in any effort at conservation, management and development of a catchment. The management of these individual resources and the manipulation of their potential and status have crucial implications for the contribution of the catchment areas to the health of a river system or reservoir.

The benefits of a river system or reservoir are determined by the contribution of the catchment to the augmentation of the water availability and its propensity to silt deposition. The seasonality or the perennial nature of the run-off from a catchment would have implications for the use of water from the reservoirs; the peak run-off, duration and velocity and the silt load affect the lower reaches in terms of floods. The behaviour of a catchment has three dimensions, relating to run-off, sediment production and productivity of the land in the catchment.

LAND DEGRADATION AND EXTENT OF PROBLEMS

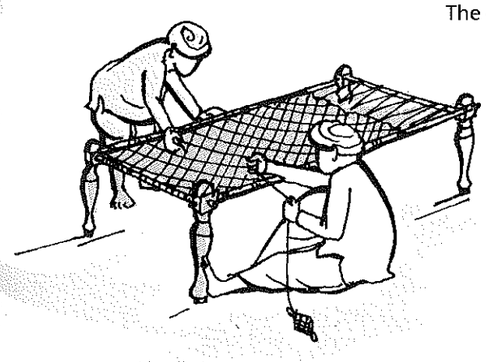
The landmass is the physical base for all activities of mankind. In order to ensure that all requirements are met from the limited geographical area of about 329.00 m. ha., it is necessary that the potential and problems regarding resource base and

other allied inputs are identified. Out of a total geographical area of 329.00 m. ha., 174.95 m. ha. (53.20 per cent of geographical area) is affected by various types of land degradation viz. water and wind erosion, water logging, salinity, alkalinity, acidity, ravines, shifting cultivation, drought, desertification etc. It has been estimated that about 6000 – 12000 m tons of fertile soil gets eroded annually with an average annual soil loss of 16.40 tons per ha, which is much higher than the permissible limit (20 tons/ha/year in hilly and steeply sloping areas and less than 5 tons/ha/year in dense good quality forests). Thus with the above rate of soil erosion, the loss of major plant nutrients of NPK varying from 5.37 to 8.4 m tons occur annually. In terms of annual foodgrain production loss, the loss on account of topsoil erosion equals 27 lakh tons of foodgrains. Also, the arable land is shrinking due to the continuous process of soil erosion and land degradation as well as diversion of cultivable land for various non-agricultural activities, such as, housing, roads, industries, mining, etc. The critical input, namely, water is becoming scarce. Therefore, soil and water management assumes special importance and plays a vital role not only in increasing the production of bio-mass but also in reducing soil erosion, moderation of flood hazards and maintenance of ecological balance.

PRIORITY DELINEATION AND CODIFICATION OF WATERSHEDS

One of the first requisites for planning is to delineate and codify the catchments of the country into watersheds and sub-watersheds. The All India Soil and Land Use Survey Organisation are doing this through development of a National Watershed Atlas. In all, 3537 watersheds have been identified in 35 basins, 125 catchments and 500 subcatchments. Priority delineation method developed and improved over the decades has used weighted Silt Yield Index (SYI) for each of the watersheds computed from weighted erosion intensity and adjusted by delivery ratio. The whole or parts of 45 catchments of River Valley Projects and Flood Prone Rivers, nearly 34160 sub-watersheds have been delineated and intense, very high, high, medium, low and very low priorities determined. The validity of this approach has been tested by the following methods:-

- Comparison of weightage value of different mapping units with sediment yields estimated from predictive equation.
- Comparison of Silt Yield Index (SYI) with erodibility index obtained from subsequent detailed soil survey of some of the priority watersheds.
- Comparison of SYI with sediment load obtained from runoff and sediment gauging stations.



The comparable trends have fairly established the reliability of the methodology. At the instance of the National Land Conservation Board, an Expert Committee examined various aspects of the methodology and suggested its continued application. Concurrently, All India Soil and Land Use Survey Organisation has been carrying out test studies for application of remote sensing technology for catchment characteristics particularly with reference to soil erosion, treatment yield and prioritisation of watersheds.

MODULES FOR CATCHMENT AREA TREATMENT

With a view to minimising soil erosion, sediment deposit in the reservoirs, reduce flood peaks and volume and ultimately increasing the productivity, soil and water conservation measures have been adopted under centrally sponsored schemes of soil conservation in the catchments of River Valley Projects (RVP) and Flood Prone Rivers (FPR) on watershed basis in an integrated manner throughout the country.

River Valley Projects

This centrally sponsored scheme of soil conservation in the catchments of River Valley Projects is primarily meant for treatment of catchment areas of multipurpose reservoirs with appropriate soil and water conservation measures, which extend over more than one State. The scheme was launched in the Third Five Year Plan and is still continuing in 33 catchments (719.52 lakh ha.) spread over 18 States.

Description of the Scheme and its Objectives:

The Scheme is primarily for enhancing the productivity of degraded lands, minimising the soil loss and restoration of ecological imbalances of the catchment areas of River Valley Projects. The main objectives of the Scheme are summarised as follows:-

- Enhancement of productivity of degraded lands by adoption of integrated approach in the catchment areas of River Valley Projects.
- Improvement of land capability and moisture regime in the watersheds.
- Prevention of soil loss from the catchments for maintaining soil fertility which will in turn increase the lives of reservoirs.
- Creation of awareness among the people for care of catchments.
- Upgradation of the skills in planning and execution of land development programmes.
- Optimisation of resources for socio-economic upliftment of the beneficiaries.

Methodology

Till the end of the Eighth Plan only about 19 percent of the treatable area of the RVP catchments had been treated. It is, therefore, felt that if the RVP programme is to gain momentum, it could be done only by generating sufficient interest in the village communities for the programme. Experience gained over the years also indicate the need for a holistic approach to the treatment of catchment areas with more emphasis on in-situ moisture conservation, water harvesting and ground water recharge, employment generation and low cost conservation practices by involving the local community in a big way to bring about integrated development and management of micro-watersheds within the watershed or catchment area. The strategy of implementation of the RVP scheme during the Ninth Plan would seek to bring about a conceptual change in the implementation of the scheme by shifting the attention to the needs of the people living in the catchment. Resource development would be focussed to create enduring stakes in sustaining the catchment status by emphasising measures to change the dynamics of environmental parameters in preference to responses to a given set of parameters.

Approach

The treatments of watersheds are planned on a project basis for a total period of five years. For this purpose, a watershed would be divided into Micro-Watersheds (MW) of 500 –1000 ha. and the work programme would be disaggregated on the

basis of MW . The treatment of each MW would be phased over 3 to 5 years, so as to saturate the whole watershed within a period of 5 years. Treatment measures for soil and moisture conservation and afforestation would be planned in a synchronised manner so as to complete, from all aspects, the treatment of the whole watershed within the planned period.

Financial Pattern

The financing pattern of the scheme upto Nov., 2000 was 100 per cent central assistance, comprising 50 per cent grant and 50 per cent loan to the State Governments and in case of the Damodar Valley Corporation it is 50 per cent grant on a matching basis. From Nov., 2000 this scheme has been subsumed with Micro Management Mode & financing pattern thereafter is in the ratio of 90: 10 between Central and State Governments and funds are provided as 80% Grants and 20% as Loan to State Governments.

Achievements

The plan-wise physical and financial achievements under this Scheme since its inception are as follows:

Period	Phy. (Lakh ha.)	Expenditure (Rs. Crore)
a) Upto Seventh Plan	23.950	307.333
b) During 1990-91	0.905	34.046
c) During 1991-92	1.414	46.685
d) During Eighth Plan	7.321	285.830
Total	33.590	673.894

The approved outlay during the Eighth Five Year Plan was for Rs 400.00 crore for the treatment of 10.50 lakh ha. area. However, allocation made available during the entire plan period was Rs 289.57 crore (72.39 per cent), out of which Rs 285.83 crore has been utilised. Therefore, physical achievement was also 7.321 lakh ha. (69.7 per cent) against the target of 10.50 lakh ha.

The State-wise catchment area, priority area and area treated since inception upto the Eighth Plan i.e. 1996-97 is given in Annexure-I. About 25.00 per cent (180.23 lakh ha.) of the total area of RVP catchments (719.52 lakh ha.) is identified as very high, high priority areas needing urgent attention. Due to resource constraints and increase in cost of treatment, only 18.64 per cent of the total priority area (180.23 lakh ha.) could be treated upto 1996-97.

Flood Prone Rivers

Land and water resources conservation, and appropriate land use are crucial for reducing hazards of floods, which are an annual feature in the Indo-Gangetic Plains and in the Brahmaputra basin. In order to mitigate the flood hazards a Centrally Sponsored Scheme of Soil Conservation in the Catchments of Flood Prone Rivers (FPR) was launched in the Sixth Plan. At present, the FPR Scheme is in operation in 12 catchments (240.67lakh ha.) spread over 10 States.

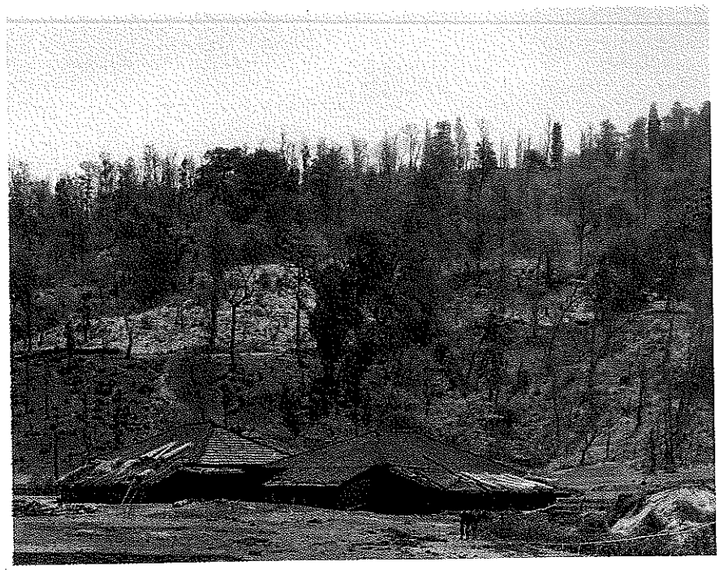
Annexure – I Statement showing total catchment area, treatable area and area treated since inception under centrally sponsored schemes of soil conservation in the catchment of river valley projects

(Area in Lakh Ha.)

S. No.	States\treated Catchments	Total Catchment Area	Total Priority Area	Area treated since inceptions upto 1996-97	% treated area w.r.t. total priority
1.	**ANDHRA PRADESH**				
	i) Machkund-Sileru	3.23	2.52	1.12	44.44
	ii) Upper-Kolab				
	iii) Pochampad	5.97	1.69	0.48	28.40
	iv) Nizamsagar	7.62	1.91	0.3	15.71
	v) Nagarjunasagar	38.98	7.39	0.21	2.84
	Sub-total	**55.80**	**13.51**	**2.11**	**15.62**
2.	**ASSAM**				
	i) Pagladia	0.59	0.33	0.16	48.48
3.	**BIHAR**				
	i) Rengali-Mandira	15.91	1.46	0.56	38.36
	ii) Mayurakshi	1.76	0.82	0.24	29.27
	iii) Damodar-Barakar			0.03	-
	Sub-total	**17.67**	**2.28**	**0.83**	**36.40**
4.	**GUJARAT**				
	i) Dantiwada	0.81	0.41	0.40	97.56
	ii) Damanganga	0.38	0.23	0.10	43.48
	iii) Mahi	2.25	0.87	0.24	27.59
	iv) Ukai	1.00	0.20	0.20	100.00
	v) Sardarsarovar	0.37	0.35	0.00	0.00
	Sub total	**4.81**	**2.06**	**0.94**	**45.63**
5.	**HIMACHAL PRADESH**				
	i) Sutlej	10.20	2.64	1.52	57.58
	ii) Beas	10.69	4.52	0.32	7.08
	iii) Thein dam	4.34	4.13	0.03	0.73
	Sub-total	**25.23**	**11.29**	**1.87**	**16.5**
6.	**JAMMU AND KASHMIR**				
	i) Pohru	1.89	0.64	0.28	43.75
	ii) Thein dam	0.86	0.53	0.06	11.32
	Sub-total	**2.75**	**1.17**	**0.34**	**29.06**
7.	**KARNATAKA**				
	i) Nizamsagar	3.71	1.28	0.51	39.84
	ii) Nagarjunasagar	75.39	19.85	0.85	4.28
	iii) Tungbhadra	27.78	5.02	2.92	58.17
	iv) Kabini	0.49	0.00	0.00	-
	Sub-total	**107.37**	**26.15**	**4.28**	**16.37**

S. No.	States\treated Catchments	Total Catchment Area	Total Priority Area	Area treated since inceptions upto 1996-97	percent area w.r.t. total priority
8.	**KERALA**				
	i) Kundah	0.60	0.43	0.25	58.14
	ii) Kabini	1.64	1.07	0.00	0.00
	iii) Vaigai-Periyar	0.61	0.07	0.00	0.00
	Sub-total	**2.85**	**1.57**	**0.25**	**15.92**
9.	**MADHYA PRADESH**				
	i) Chambal	22.69	5.62	2.79	49.64
	ii) Mahi	6.64	3.98	2.56	64.32
	iii) Matatila	18.49	7.82	0.77	9.85
	iv) Hirakud	73.72	2.74	0.57	20.80
	v) Ukai	9.78	0.47	0.48	102.13
	vi) Tawa	5.37	2.11	0.38	18.01
	vii) Rengali-Mandira	1.44	0.18	0.15	83.33
	viii) Upper-kolab	0.00	0.00	0.00	0.00
	ix) Upper-Indiravati	0.00	0.00	0.00	0.00
	x) Sardarsarovar	77.64	22.37	0.06	0.27
	Sub-total	**215.77**	**45.29**	**7.76**	**17.13**
10.	**MAHARASHTRA**				
	i) Damanganga	1.32	0.54	0.13	24.07
	ii) Ghod	3.49	0.24	0.18	75.00
	iii) Nagarjunasagar	75.10	21.84	0.34	1.56
	iv) Nizamsagar	9.63	1.92	0.11	5.73
	v) Pochampad	57.14	14.90	0.31	2.08
	vi) Ukai	48.76	5.40	0.28	5.19
	vii) Sardarsarovar	1.64	1.16	0.06	5.17
	Sub-total	**197.08**	**46.00**	**1.41**	**3.07**
11.	**ORISSA**				
	i) Hirakud	9.28	0.88	1.26	143.18
	ii) Machkund	1.34	0.83	0.57	68.67
	iii) Rengali-Mandira	6.00	1.50	0.46	30.67
	iv) Upper-kolab	1.56	0.47	0.00	0.00
	v) Upper-Indiravati	5.36	3.10	0.00	0.00
	Sub-total	**23.54**	**6.78**	**2.29**	**33.78**
12.	**PUNJAB**				
	i) Thein Dam	0.08	0.08	0.01	12.50
	ii) Sutlej	1.23	0.27	0.26	96.30
	Sub-total	**1.31**	**0.35**	**0.27**	**77.14**
13.	**RAJASTHAN**				
	i) Chambal	3.93	1.50	1.96	130.67
	ii) Mahi	15.77	3.63	0.70	19.28
	iii) Dantiwada	1.83	0.82	0.76	92.68
	Sub-total	**21.53**	**5.95**	**3.42**	**57.48**

S. No.	States\treated Catchments	Total Catchment Area	Total Priority Area	Area treated since inception upto 1996-97	percent area w.r.t. total priority
14.	**SIKKIM**				
	i) Teesta	9.68	2.14	0.25	11.68
15.	**TAMIL NADU**				
	i) Lower Bhawani	2.63	0.93	0.62	66.67
	ii) Kundah	0.60	0.42	0.41	97.62
	iii) Kabini	0.23	0.05	0.00	0.00
	iv) Viagai-Periyar	2.25	0.07	0.00	0.00
	Sub-total	**5.71**	**1.47**	**1.03**	**70.07**
16.	**TRIPURA**				
	i) Gomti	0.45	0.35	0.08	22.86
17.	**UTTAR PRADESH**				
	i) Matatila	0.87	0.47	0.49	104.26
	ii) Ramganga	3.11	1.04	0.87	83.65
	Sub-total	**3.98**	**1.51**	**1.36**	**90.07**
18.	**WEST BENGAL**				
	i) Kangsabati	3.85	2.02	0.79	39.11
	ii) Teesta	2.98	0.68	0.09	13.24
	Sub-total	**6.83**	**2.70**	**0.88**	**32.59**
19.	**DAMODAR VALLEY CORPORATION**				
	i) Damodar-Barakar	16.57	9.33	4.06	43.52
	Grand Total	**719.52**	**180.23**	**33.59**	**18.64**



Objectives

The main objectives of the schemes are:

- Enhancement of productivity of degraded lands by adoption of integrated approach in the catchment areas of Flood Prone Rivers.
- Improvement of land capability and moisture regime in the watersheds.
- Reduction of runoff from the catchments to reduce peak flow into the river system.
- Creation of awareness among the people for care of catchments.
- Upgradation of the skills in planning and execution of land development programmes.
- Optimisation of resources for socio-economic upliftment of the beneficiaries.

Financial Pattern

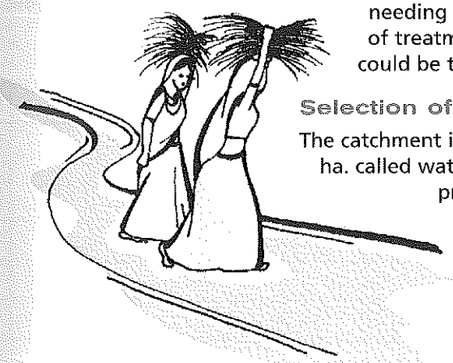
The financing pattern of the scheme prior to November 2000 was 100 per cent central assistance comprising 50 per cent grant and 50 per cent loan to the State Governments. From November, 2000 onwards this scheme has been subsumed under Micro Management Mode and financing pattern thereafter is in the ratio of 90: 10 between Central and State Governments. The funds are provided to State Government as 80% central assistance as Grants and 20% Loan.

Achievements

The Plan-wise physical and financial achievements under this Scheme since its inception are as follows:

Period	Phy. (Lakh ha.)	Expenditure (Rs. Crore)
a) Upto Seventh Plan	3.65	90.90
b) During 1990-91	0.43	16.05
c) During 1991-92	0.67	21.93
d) During Eighth Plan	3.96	136.44
Total	**8.71**	**265.32**

The State-wise catchment area, priority area and area treated upto Seventh Plan is given in Annexure-II. About 32 per cent (75.58 lakh ha.) of the total area of FPR catchments (240.67 lakh ha.) is identified as very high, high priority and needing urgent attention. Due to resource constraints and increase in cost of treatment, only 11.52 per cent of the total priority area (8.71 lakh ha) could be treated upto 1996-97.



Selection of Watersheds

The catchment is divided into smaller units ranging from about 1000 ha. to 2000 ha. called watersheds, based on stream orders. These watersheds are codified and prioritised by adopting Silt Yield Index (SYI) method by All India Soil and Land Use Survey Organisation. In this methodology various factors such as soil type, topography, soil erosion, vegetation condition etc. are considered. Each of the watersheds were computed for weighted erosion intensity and adjusted by delivery ratio. The whole or parts of 45 catchments of River Valley Projects and Flood Prone Rivers, nearly 34160 sub-watersheds have been

delineated as intense, very high, high, medium, low and very low. Out of above watersheds, about 15,200 watersheds belong to very high and high categories. Due to resource constraints only very high and high category watersheds are adopted for treatment under FPR schemes.

The high and very high-degraded watersheds, once selected, are treated on watershed basis in an integrated manner irrespective of their land uses as the entire watershed contributes silt and runoff to the streams/reservoirs. Therefore, the various departments namely Agriculture, Soil Conservation, Forestry, Horticulture etc. are involved for treatment of agricultural land, wasteland and forests with appropriate site specific soil conservation measures including drainage line treatment measures. Therefore, scientific management of arable land after development would be emphasised during the Ninth Five-Year Plan.

Annexure-II Statement showing total catchment area, treatable area and area treated since inception under centrally sponsored schemes of soil conservation for enhancing productivity of degrade land in the catchment of flood prone rivers

S. No.	State / catchments	Total catchment area (lakh ha)	Total priority area (lakh ha)	Area treated since inception	% treated area w.r.t. total priority area
1.	**ASSAM**				
	i) Singla # # 0.00				
2.	**BIHAR**				
	i) Sone	14.77	9.31	0.39	4.19
	ii) Ajoy	3.55	1.21	0.16	13.22
	iii) Punpun	9.19	2.31	0.19	8.23
	iv) Kosi	20.75	2.85	0.00	0.00
	Sub total	**48.26**	**15.68**	**0.74**	**4.72**
3.	**HARYANA**				
	i) Sahibi*	6.31	0.60	0.32	53.33
	ii) Ghaggar	5.69	2.55	0.12	4.71
	Sub total	**12.00**	**3.15**	**0.44**	**13.97**
4.	**HIMACHAL PRADESH**				
	i) Upper Yamuna	7.00	5.19	0.66	12.72
	ii) Ghaggar	0.43	0.43	0.02	4.65
	Sub total	**7.43**	**5.62**	**0.68**	**12.10**
5.	**MADHYA PRADESH**				
	i) Sone	43.26	23.52	0.83	3.53
	ii) Banas	0.62	#	0.00	
	Sub total	**43.88**	**23.52**	**0.83**	**3.53**
6.	**MIZORAM**				
	i) Singla	#	#	0.00	

S. No.	State / catchments	Total catchment area (lakh ha)	Total priority area (lakh ha)	Area treated since inception	% treated area w.r.t. total priority area
7.	**RAJASTHAN**				
	i) Sahibi	5.58	2.72	2.02	74.26
	ii) Banas	47.82	#	0.00	
	Sub total	**53.40**	**2.72**	**2.02**	**74.26**
8.	**UTTAR PRADESH**				
	i) Gomti	31.01	9.32	2.83	30.36
	ii) Sone	3.94	1.99	0.38	19.10
	iii) Upper Ganga	21.46	8.91	0.25	2.81
	iv) Upper Yamuna	3.74	3.00	0.26	8.67
	Sub total	**60.15**	**23.22**	**3.72**	**16.02**
9.	**WEST BENGAL**				
	i) Ajoy	2.57	0.13	0.03	23.08
	ii) Rupnarain	9.35	1.11	0.19	17.12
	Sub total	**11.92**	**1.24**	**0.22**	**17.74**
10.	**DELHI**				
	i) Sahibi**	0.88	0.08	0.03	37.50
11.	**PUNJAB**				
	i) Ghaggar	2.75	0.35	0.03	8.57
	Grand Total	**240.67**	**75.58**	**8.71**	**11.52**

* Saturated in 1992-93

** Saturated in 1991-92

Under survey

Package of Treatment for RVP and FPR Schemes

Appropriate soil conservation measures such as vegetative hedges, contour/graded bunding, agro-forestry, horticulture plantation, silvipastrol developments, pasture development, afforestation, drainage line treatments, water harvesting structures, percolation tanks, tanks/ponds, sediment detention dams etc. in agricultural lands, forest lands and wastelands as per need are adopted along scientific lines.

On the basis of experience gained over the years, the guidelines for Catchment Area Treatment (CAT) have been modified to provide a holistic approach with more emphasis on employment generation and adoption of vegetative measures and low cost sustainable conservation practices, by involving the local community in a big way to bring about integrated development. In the guidelines, an attempt has been made to put the village community of the catchment areas at the centre stage in order to generate a real people's programme.

The approach of all soil and water conservation programmes has been on Integrated Watershed Management for all types of land and associated drainage systems. It is to protect and restore the problem areas to higher productivity and provide

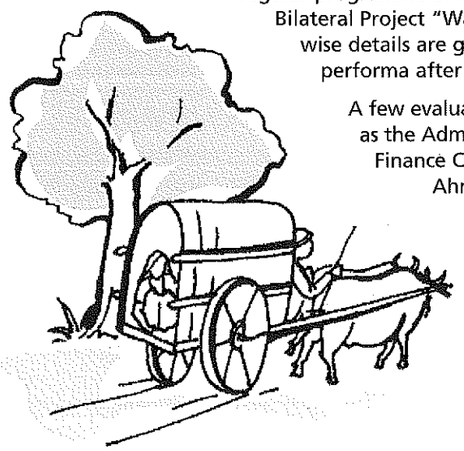
correctives and additives to improve moisture regime in the soil profile, channel system and shallow hills. In turn, the land having greater depth of soil is being put in operation for producing varieties of crops, grasses, shrubs and trees to meet the requirements of foodgrains, fuel, fodder and other necessities. Planning and implementation have been to improve aggregate production from the same volume of soil by utilising available scarce water over longer periods.

MONITORING AND EVALUATION

The implementation of various programmes, physical and financial progress, sediment yield data from selected watersheds etc. are being monitored by the Soil and Water Conservation Division at the National level. The physical and financial progress reports along with qualitative and quantitative impact analysis are obtained through annual appraisal reports for these schemes. A Standing Committee for reviewing River Valley Projects and Flood Prone Rivers schemes, meets annually on a regional basis. The Committee also visits the work done under these schemes and provides guidance for improvement. These meetings help in promoting inter-departmental co-ordination and mid-session corrections.

The treatment package for these schemes is similar in nature except that in the case of the FPR scheme, more emphasis is given to treatment measures which help in in-situ conservation of rain water and ultimate reduction in peak flow and volume from the watersheds/catchments so that the flood magnitude is reduced, whereas in case of RVP, the major task is to reduce the flow of sediment into reservoirs from the watershed so that the serviceable life of reservoirs is sustained. With a view to assess the impact of soil and water conservation treatment measures, different evaluation studies are entrusted to outside agencies who had been conducting sample surveys on increase in crop area, crop yield and intensity, and increase in income of individual farmers. They also conduct sample surveys on increase in ground-water recharge.

In addition to the above, the concept of observing hydrologic and sediment behaviours, before and post treatment is also being adopted. For these purposes there is an inbuilt provision of 3 per cent of the total cost of treatment of watersheds in the revised guidelines. In this methodology a Sediment Monitoring Station (SMS) is established at the extreme outlet of the watershed which is easily approachable and accessible and data on precipitation/rainfall (P), runoff (Q) and sediment flow (S) are collected as per guidelines. At present there are 228 SMS functioning in India as regular programme of RVP/FPR schemes and established under the Indo German Bilateral Project "Watershed Management" (IGBP). State wise and catchment wise details are given in Annexure – III. These data are reported in prescribed performa after converting the collected data into daily and monthly basis.



A few evaluation studies have been carried out by external agencies such as the Administrative Staff College of India, Hyderabad; Agricultural Finance Consultants, Bombay and Indian Institute of Management, Ahmedabad in the catchments of Machkund, Pochampad, Nizamsagar, Ukai, Matatilla and Sahibi. Evaluation studies have also been completed for the catchments of Sutlej, Beas, Ramganga, Kundah, Hirakud and Chambal – through Administrative Staff College of India, Hyderabad and Agro-Economic Research Centres at Jabalpur, Madras and Waltair. Some of the major benefits identified and quantified by various appraisal and evaluation studies are described as follows:-

Principles and Practices of Integrated Watershed Management in India
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ANNEXURE – III Hydrologic and sediment monitoring network under river valley projects and flood prone rivers schemes

(AS ON JAN 1999)

S. No.	Name of the State	Name of Catchment	Sediment Monitoring Station		
			RVP/FPR	IGBP	Total
1.	Andhra Pradesh	Machkund Sileru	5	1	6
		Nagarjunasagar	3	-	3
		Nizamsagar	1	-	1
		Pochampad	1	-	1
		Upper Kolab	-	-	-
2.	Assam	Pagladia	2	-	2
		Singla*	-	-	-
3.	Bihar	Mayurakshi	3	-	3
		Rengali Mandira	-	-	-
		Sone*	-	-	-
		Ajoy*	-	-	-
		Punpun*	2	2	4
		Kosi*	-	-	-
		Damodar Barakar	-	-	-
4.	Gujarat	Damanganga	1	-	1
		Dantiwada	11	-	11
		Mahi	1	-	1
		Ukai	3	2	5
		Sardar Sarovar	-	-	-
5.	Haryana	Sahibi*	-	-	-
		Ghaggar*	-	-	-
6.	Himachal Pradesh	Pradesh Beas	1	-	1
		Sutlej	1	1	2
		Upper Yamuna*	-	-	-
		Ghaggar*	-	-	-
7.	Jammu and Kashmir	Pohru	6	-	6
		Thein dam	-	-	-
8.	Karnataka	Nagarjunasagar	2	-	2
		Nizamsagar	3	-	3
		Tungabhadra	4	-	4
		Kabini	-	-	-
9.	Kerala	Kundah	4	-	4
		Kabini	-	-	-
		Vaigai Periyar	-	-	-
10.	Mizoram	Singla*	-	-	-
11.	Madhya Pradesh	Chambal	5	-	5
		Hirakud	4	2	6
		Matatila	-	-	-
		Rangali Mandira	3	-	3
		Tawa	-	-	-
		Ukai	-	-	-
		Mahi	3	-	3
		Banas*	-	-	-
		Sone*	-	-	-
		Sardar Sarovar	-	-	-

S. No.	Name of the State	Name of Catchment	Sediment Monitoring Station		
			RVP/FPR	IGBP	Total
12.	Mahrashtra	Ghod	-	-	-
		Nizamsagar	-	-	-
		Nagarjunasagar	-	-	-
		Pochampad	10	-	10
		Ukai	9	-	9
		Damanganga	-	4	4
		Sardar Sarovar	-	-	-
13.	Orissa	Hirakud	5	2	7
		Machkund	8	-	8
		Rangali-Mandira	5	-	5
		Upper Kolab	-	-	-
		Upper Indravati	-	-	-
14.	Punjab	Thein Dam	-	-	-
		Ghaggar*	1	-	1
15.	Rajasthan	Chambal	30	-	30
		Dantiwada	17	-	17
		Mahi	11	-	11
		Sabibi*	5	6	11
		Banas*	-	-	-
16.	Sikkim	Teesta	-	-	-
17.	Tamil Nadu	Lower Bhavani	2	3	5
		Kundah	1	-	1
		Kabini	-	-	-
		Vaigai Periyar	-	-	-
18.	Tripura	Gomti	-	-	-
19.	Uttar Pradesh	Ramganga	4	-	4
		Matatila	5	-	5
		Upper Ganga*	-	-	-
		Upper Yamuna*	-	2	2
		Sone*	2	-	2
		Gomti*	2	2	4
20.	West Bengal	Kangsabati	2	-	2
		Teesta	-	-	-
		Ajoy*	-	-	-
		Roopnarain*	-	-	-
21.	D.V.C.	Damodar Barakar	10	3	13
Grand Total			**198**	**30**	**228**

* Catchments of Flood Prone River Scheme

- The increase in treatment of catchments has resulted in declining trend of sediment production in respect of Bhakra, Maithon, Panchet, Machkund, Hirakud, Matatilla, Nizamsagar, Ukai, Ramganga, Tawa and Tungabhadra reservoirs. The extent of decrease ranged from 49 per cent in respect of Tawa to 22.6 per cent in case of Bhakra.
- Silt load from small watersheds in the catchments of Chambal, Hirakud, Damodar-Barakar, Machkund, Mayurakshi, Mahi-kadana and Tungabhadra have been studied variously with moving average and progressive average series besides normal time series. The trend analysis made in respect of Chambal watersheds in Rajasthan showed that decline in sediment production rates with increasing watershed treatments ranged from 0.62 to 1.65 ha m/100 sq. km. per year.
- In Orissa, upto 1986-87, nearly 37.957 ha could be rehabilitated by planting cashewnut and other trees, 1150 ha. by planting sisal and 29,343 ha. was protected by erosion control-cum-water harvesting structures in the 3 catchments of Hirakud, Machkund Sileru and Rengali Mandira.
- In Machkund Sileru catchment, about 37 per cent of additional area could be brought under cultivation in Andhra Pradesh and 22 per cent in Orissa.

FUTURE STRATEGIES AND APPROACH

The programme implementation in the past plan periods has resulted in increase in crop yields and crop area besides increase in ground water recharge. These impacts were, however, not of the order which is required to manage the present rate of land degradation. Since inception upto the Eighth Plan we have treated about 19 per cent priority area under RVP and 12 per cent under FPR. The experience of impact assessment reveals that a few major corrective measures needs to be adopted for further improvement in programme implementation of both major RVP and FPR schemes.

- adoption of a project approach to the treatment of catchment and assurance of funds are as per needs of the area;
- integration of sectoral measures for comprehensive watershed development and maintenance;
- consolidation of treatment efforts through project approach and proper choice of work areas;
- emphasis on water harvesting measures as these act as military encampment for sustainability of other treatment measures adopted upstream and downstream;
- involvement of the farmers, dependent on a watershed, in the planning execution and maintenance, for its sustainable development;
- promotion of skills of farmers and field functionaries through appropriate institutional linkage for socio-economic development of the area;
- effective administrative arrangement for direction, control and co-ordination of the programme;
- locally manufactured equipment on slight modification can give better results as the spare parts availability, repair and maintenance of such equipment is cheaper as compared to imported equipment. The imported equipment are no doubt effective and can store data for longer durations but get stolen very frequently.

Major Thrust Areas

Based on the experiences gained during the past plan periods, the following steps are suggested for the improvement of RVP and FPR schemes:

Transfer of technology

Only critically degraded watersheds (Very High and High categories of watersheds) are being treated due to resource constraints, whereas other categories viz. medium, low and very low also need treatment for sustainable production. To achieve this goal the transfer of technology at watershed level be taken up so that the beneficiaries are actively involved in the programme. As such, it is envisaged that training/workshops need to be organised for staff working for the FPR and RVP schemes beside farmers' training. Also field demonstrations, visits to model watersheds, publication of pamphlets and leaflets in local languages etc. would help in creating catchment attitude among the beneficiaries, giving emphasis to women and landless beneficiaries.

Cost ceiling on treatment package

An integrated treatment package has been evolved for treatment of agricultural lands, wastelands and forestlands including drainage line treatment based on needs and site conditions. These treatment measures are labour intensive, utilising about 90 per cent of treatment cost for generating labour opportunities in the remote rural areas.

For adoption of need based packages of treatment, with higher size of water harvesting structures, the ceiling for Category-I watersheds have to be Rs 6500 per ha. and for Category II, Rs 10,000 per ha.

Monitoring mechanism

The programme needs to be closely monitored by State Level Implementation Committees (SLIC) and Project Level Implementation Committees (PLIC) at State and Project levels respectively. At the National level, programmes would be monitored on matters relating to project preparation, intersectoral co-ordination, hydrological and sediment data studies, creation of awareness etc. The changes in crop yields, cropping intensity, land use, bio-mass production, improvement in ecological system and employment generation would also be analysed to assess the impact of the scheme.

Hydrologic and sediment monitoring

After having the list of very high and high priority watersheds from AISLUS, the Sediment Monitoring Station (SMS) should be established in respect of year of starting treatment so that sufficient pre-treatment data can be collected and only those watersheds need to be considered for the treatment where SMSs are established.

Institutional mechanism for people's involvement

Watershed Management programmes are being implemented with full involvement of beneficiaries/farmers of the watershed. For this purpose, it is emphasised that a definite mechanism for maintaining and repairing of structures and regeneration of biological resources are created. The project must identify existing institutions/NGOs for attending to this task. A corpus of fund is created in respect of each watershed for the maintenance of community assets created under the programme.

The beneficiaries are organised into a corporate body, society or self-help group which is called upon to contribute this corps. This corpus is managed by beneficiary organisations for the purpose of maintaining structures in the community land and other structures in the watershed, which benefit the community at large.

Creation of awareness and capacity building

For a holistic approach efforts would be made to involved people right from the planning stage. In the pre project period efforts should be made to build capacity of the people by training, sensitization, exposure, etc. so that they can participate effectively in sustainable development and post project care and maintenance.

Gender Participation

The stakes of women of a household are high as they play a very strategic role in both hills and plains. They contribute about the 80 per cent of farm labour input and perform all operations except ploughing. Thus women have to play a great role in watershed management and other land-based activities. As such, there should be adequate representation of women at the Project Level Implementation Committee (PLIC) so that their contribution right from planning to maintenance is ensured.

Training and awareness

Training and awareness are two very important links in the process aspect of any watershed development programme. Unfortunately, training is considered a very low priority area in the state sector. For training, besides the ICAR, the Damodar Valley Corporation organises 90 days training on Soil Conservation one each for Project Officers (PO) and Field Officers (FO) every year. In addition to these, short orientation trainings of 10 days duration for POs and FOs are organised. Unfortunately State Governments either do not depute any officials or depute the most unwanted persons. Until trained staff are deployed for programme implementation and also for collection of hydrologic and sediment data, the expectation of fruitful results and sustainable development would only be a dream. Excellent training infrastructure created at MANAGE, NIRD, ICAR, State Agricultural Universities, State Institutes/Academies of Rural Development and with some NGOs, which need to be fully utilized in addition to the existing system of trainings and workshops.

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SOIL DEGRADATION PROBLEMS AND MANAGEMENT IN INDIA

Shamsher Singh • Government of India • Ministry of Agriculture • New Delhi

INTRODUCTION

The soil conservation measures and reclamation of degraded lands are decided considering the land capability and land uses. The developments of degraded lands have resulted in increasing the productivity of the lands, reduction of unemployment

According to an estimate, about 175 million ha. (53% of the geographical area of India) is affected by various types of soil erosion and land degradation problems. It is also estimated that about 6,000 million tones of top soil are lost annually along with valuable plant nutrients such as Nitrogen, Phosphorus and Potassium and micro nutrients. As a result of the loss of top soil along with nutrients, there is low agricultural production of about 2.7 million tonnes annually. Thus, the management of basic natural resources of soil, land and water, assumes special importance and plays a vital role, in improving the country's economy and environment.

At national and state levels various schemes (central sector, state sector and foreign aided) have been launched for prevention of land degradation, reclamation of special problem areas for increasing productivity of the land, preservation of land resources and improvement of ecology and environment. These schemes are being implemented on watershed basis i.e. taking small independent hydrological units of about 500-2000 ha. area. The soil conservation measures and reclamation of degraded lands are decided considering the land capability and land uses. The developments of degraded lands have resulted in increasing the productivity of the lands, reduction of unemployment, improving the environment of the area, social and economic upliftment of the people, etc. The evaluation studies conducted by various agencies have confirmed these positive responses and have recommended the active involvement of local people and beneficiaries under the programmes.

TYPES AND EXTENT OF LAND DEGRADATION

The main types of land degradation in the country are: (i) Gullied and Ravinous Land; (ii) Upland with or without scrub; (iii) Water Logging; (iv) Salinity and Alkalinity; (v) Shifting Cultivation; (vi) Soil Erosion due to Water and Wind; (vii) Degraded Pasture and Grazing Land; (viii) Sands, Deserts (Inland and Coastal); (ix) Barren Rocky/Stoney Areas; and (x) Snow cover and glaciers. The extent of areas affected under these categories are as follows:

Gullied and/or ravinous land

Gullies are formed as a result of localised surface runoff affecting the unconsolidated material resulting in the formation of perceptible channels causing undulated terrain. Gullies are the first stage of excessive land dissection followed by their networking which lead to the development of ravinous land. The word ravine is usually associated with a network of gullies formed generally in deep alluvium and entering nearby river, flowing much lower than the surrounding table lands. About 4.0 million ha are affected in this category mostly in the states of Gujarat, Madhya Pradesh, Rajasthan and Uttar Pradesh.

Upland with or without scrub

The lands, which are generally prone to deterioration due to erosion may or may not have scrub cover belong to this category. Such lands occupy relatively high topographic locations. About 13.57 million ha. (6.67%) of geographical area comes in this category.

Water logging

Water-logged lands are those where the water is at/or near the surface and water stands for most of the year. Nearly 8.53 million ha. of land is subjected to serious water logging problem. Water logging results in restriction of the normal circulation of air inside the soil. When the water table rises upto 2 m and above below to ground surface, problems of water logging are felt. Immediately after the monsoon rains, vast tracts of land are subjected to surface flooding. In irrigated areas of 37 major irrigation projects situated in 15 states, water logging is felt in 0.74 million ha.

Salinity and alkalinity

Saline ground water, high water table, ingress of sea and irrigation without the provision of drainage result in salinization in arid, semi-arid and coastal areas. As per 1984-85 statistics, 5.50 million ha. of land is subjected to soil salinity. The alkali soils, occur in Indo-Gangetic plains and parts of Madhya Pradesh covering nearly 3.58 million ha.

Classification of saline and alkaline soils

Electrolyte	Type of Salt Affected Soil	Environment	Main Adverse Effect
NaCl & SO_4	Saline Soil	Arid and Semi arid	High osmotic Pressure/ toxic effect.
Na ions capable of Alkaline hydrolysis	Alkaline soil	Semi-arid, semi semi-humid and Humid	Alkali^{PH} effect on physical property

Areas with shifting cultivation

The areas with shifting cultivation are developed due to cyclical land use consisting of felling of trees and burning of forest areas for growing crops without any management. After one or two crop seasons as yields decrease, new forest areas are cleared for the purpose, leaving the earlier area to the vagaries of nature causing serious soil erosion. The allotment of lands for shifting cultivation depends on the tribe in the region. About 4.91 million ha. of land has been subjected to degradation due to shifting cultivation practiced mainly in the hilly areas of the north- eastern states of India.

Soil erosion by water and wind

The causes of soil erosion are deforestation, over-grazing increasing agricultural practices in undulated lands, improper cropping pattern and other kinds of poor and unscientific lands management practices. As a result of soil erosion by water, recharge of ground water gets reduced, low lands are flooded and sedimentation of water harvesting tanks and reservoirs occurs. It has been estimated that about 145 million ha. of land is degraded due to water and wind. At many locations other forms of degraded lands also overlap this area.

Degraded pasture and grazing land

Due to a large animal population, the traditional pasture and grazing lands have been degraded as they are over exploited. The study of 241 districts has indicated that about 1.34 million ha. equivalent to 0.66% of the geographical area is covered under this

category. One district i.e. Bhilwara in Rajasthan accounts the maximum area under this category. More than 10% of the geographical area of the district is affected.

Sands, deserts (inland and coastal)

Sandy areas are those areas which have developed due to accumulation of sands, in coastal, riverine or inland areas. The Indian desert situated in the North-West occupies about 28.6 million ha. area falling in Rajasthan, Gujarat and Punjab. Nearly 70% of the desert region is covered by wind eroded sandy soils, sands, loamy sands and sand dunes. India has also a long coastline of 5,600 kms. Sand dunes occupy large areas, and during cyclone periods, there is blowing and shifting of sands causing damage to standing crops in the neighbouring areas.

Barren rocky/stony area

Substantial land still remains as barren (un-utilised) and stony/rocky in the country. Most of these areas are found in the mountainous regions of the country. The main problems in such regions are serious soil erosion, mining activities in stony/rocky areas, landslides, grazing etc. According to an estimate, about 2.58 million ha. (1.26% of geographical area) comes in this category.

Snow covered and glaciers

A large area of the Great Himalayas remain covered with snow and affected by glaciers. This category accounts for 0.46 million ha. equivalent to 0.23% of the geographical area. The States viz. Jammu & Kashmir, Himachal Pradesh and Uttar Pradesh have lands which belongs to this category.

SOIL CONSERVATION AND WATERSHED MANAGEMENT PROGRAMMES

A number of programmes have been launched under the state and central sectors since the First Five Year Plan after independence. Under the state sector, the major programmes are aimed at providing treatments to agricultural lands for control of erosion and conservation of moisture, so that improved crop husbandry could be practiced. Specific measures have also been aimed to restore some of the degraded lands. Reclamation of alkali soils through application of amendments and better cropping pattern have also been in progress in the states of Punjab, Haryana and Uttar Pradesh. Under the central sector, the major programmes are as follows:

Soil conservation in the catchments of river valley projects

The Centrally Sponsored Scheme of River Valley Projects (RVP) is being implemented in 31 catchments spread over 18 states. The scheme aims at controlling the premature siltation of reservoirs, enhancing productivity of catchment areas through integrated planning of watersheds by appropriate measures such as vegetative hedges, contour/graded bunding, agro-forestry, horticulture plantation, silvi-pasture developments, pasture development, afforestation, drainage line treatments, water harvesting structures percolation tanks, sediment detention dams, etc. covering all land uses i.e. agricultural land, forest lands and wastelands based on scientific lines. Only 'Very High' and 'High' categories of watersheds identified by All India Soil & Land Use Survey (AISLUS) are taken for treatment under the scheme. Till 1996 -97, about 3.4 million ha. have been covered.

Soil conservation in the catchments of flood prone rivers

The scheme is being implemented with the objectives of reducing peak rate of runoff, by increasing in-situ conservation of water and ground water recharge by increasing the time of concentration which helps in reducing flood hazards, etc. The package of soil and water conservation treatments are the same as for RVP. At present, 10 catchments are covered spread over in 8 States. So far 0.84 million ha. have been covered.

Reclamation of alkaline soils

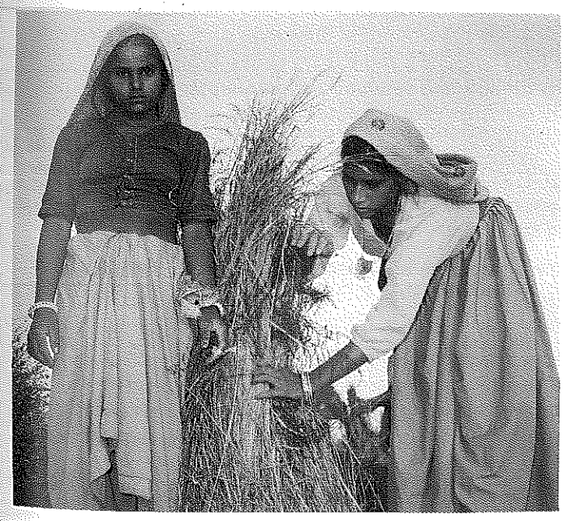
The Centrally Sponsored Scheme of Alkali Reclamation of Alkaline lands was launched during the 7th Five Year Plan and is continuing in the states of Haryana, Punjab and Uttar Pradesh. It aims to improve physical conditions and productivity status of alkaline soils for restoring crop production. The major components include assured irrigation water on farm development works like land leveling, bunding and deep ploughing, community drainage systems, application of soil amendment, organic manure, etc. So far about 0.50 million ha. has been covered.

Control of shifting cultivation

The scheme for control of shifting cultivation was launched in 1987-88 covering all seven states of the north eastern region and in the states of Andhra Pradesh and Orissa with 100% central assistance. The scheme aimed at settlement of 25,000 Jhumia families by appropriate measures of soil conservation and watershed management in affected areas. These measures have helped in stabilizing the affected areas.

National land resources and conservation board

Recognizing the need for optimal land use planning, a National Land Use and Conservation Board (NLCB) was established in 1983, and restructured in 1985 with the main objectives of formulation of National Land Use policies, perspective plan for optimum utilization of land resources and to coordinate similar activities in states undertaken by State Land Use Boards. It accords high priority to land resources conservation and has adopted perspective plan approach to reconcile the growing demands of land for satisfying various needs of the society.



Strengthening of state land use boards

State Land Use Boards (SLUB) in the States and Union Territories work as organic linkages between NLCB and the State Governments with the main objectives of formulation and implementation of land use policies. Their other activities include coordinating and reviewing the land based programmes among the line departments of States, organising of studies/seminars and launching of awareness campaigns for promotion of scientific land use etc.

For monitoring the effectiveness of soil conservation measures a few studies have been carried out by the external agencies which are not engaged in implementation such as the Administrative Staff College of India, Hyderabad; Agricultural Finance

Corporation, Bombay and Indian Institute of Management, Ahmedabad in the catchments of Machkund, Pochampad, Nizamsagar, Ukai, Matatilla and Sahibi. Similar studies have also been completed for the catchments of Sutlej, Beas, Ramganga, Kundah, Hirakud and Chambal – through the Administrative Staff College of India, Hyderabad and the Agro-Economic Research Centres at Jabalpur, Madras and Waltair. Some of the major benefits identified and quantified under evaluation studies are as follows:

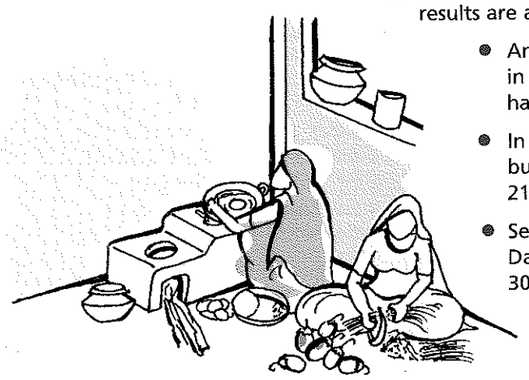
Productive and restorative benefits

These include reduction in silt load in the streams of small watersheds, reduction of silt inflow into the reservoirs, restoration/reclamation of degraded lands, etc. A few illustrative results are as follows:

- The increase in treatment of catchments areas has resulted in declining trend of sediment production in respect of Bhakra, Maithon, Panchet, Machkund, Hirakud, Matatilla, Nizamsagar, Ukai, Ramganga, Tawa and Tungabhadra reservoirs. The extent of decrease ranged from 49% in respect of Tawa to 22.% in case of Bhakra.
- Silt load from small watersheds in the catchments of Chambal, Hirakud, Damodar-Barakar, Machkund, Mayurakshi, Mahi-Kadana and Tungbhadra have been studied applying moving average and progressive average series besides normal time series. The trend analysis made in respect of Chambal watersheds in Rajasthan showed decline in sediment production rates with increasing watershed treatments ranged from 0.62 to 1.65 ha.m/100 sq. km. per year.
- In Orissa, nearly 37,957 ha. lands could be rehabilitated by planting cashewnut and other trees, 1150 ha. by planting sisal and 29,343 ha. protected by erosion control-cum-water harvesting structures in the 3 catchments of Hirakud, Machkund Sileru and Rengali Mandira.
- In Machkund Sileru catchment, about 37% of additional area could be brought under cultivation in Andhra Pradesh and 22% in Orissa.

Water harvesting, ground water recharge and re-use of water

Soil conservation structures generally have multiple objectives such as arresting soil erosion and encroachment of land by gullies and stream banks; intercepting eroded materials from depositing into streams and reservoirs; storing water to provide supplementary irrigation, recharge ground water and soil profile. Illustrative results are as follows:



- An area of 8595 ha. in Hirakud and 1521 ha. in Rengali Mandira in Orissa are being irrigated through thousands of small water harvesting structures.
- In the sample watersheds in Matatilla catchment, 390 trap-cum-bunds have stored rain water for supplementary irrigation in 21734 ha.
- Seventy six erosion control-cum-water harvesting structures in Damodar Barakar with aggregate micro-irrigation potential of 300 ha. m structure served as focii for many intensive land husbandry operations at micro level including drought proofing.

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Protective benefits

Some conservation programmes aim at increasing total bio-mass production of crops, fodder, forest and vegetation by bringing additional area under cultivation, improvement in cropping pattern/intensity, increase in fodde and forest produce etc. Some of the achievements under the programme:

- Yield from agricultural land per ha. increased by 0.6 to 7.3 quintals (100 kg) for paddy, minor millets, maize and groundnut in the catchments of Damodar-Barakar, Hirakud, Machkund Sileru, Matatilla, Nizamsagar and Ukai.
- Average yield of potato in Lower Bhawani catchment (Tamil Nadu) increased by 5.11 tonne per ha. (27.2% increase) through bench terracing. Yields of maize grain and straw increased by 1.34 quintals per ha. (11.3%) and 15.7 tonne per ha. (51%) respectively by contour bunding.
- In Nizamsagar catchment due to 6692 nala bunds (water cropping Harvesting structures), intensity increased by 13.6% for Kharif and crop yield by 2.7 to 11.3%.
- The crease due to tree cover (canopy) in 7 completed watersheds of Matatila catchment has been 34%.

It has been realised that for sustainable development of degraded lands, involvement of people (landless and beneficiaries) is very very essential. For the last five years, efforts have been made to institutionalize the organisation of community and beneficiaries, and ensuring their involvement in planning, project formulation, implementation and maintenance

People's involvement in the programmes

It has been realised that for sustainable development of degraded lands, involvement of people (landless and beneficiaries) is very essential. For the last five years, efforts have been made to institutionalize the organisation of community and beneficiaries and ensuring their involvement in planning, project formulation, implementation and maintenance. People's participation is focussed on consultation for identifying treatment measures, for securing consent and commitment for protection of common resources, training and orientation programmes for improved farming techniques and land uses. There has been successes of such organisations in the states of Maharashtra, Tamil Nadu, Karnataka etc. It needs special thrust in future development plans.

Summary and conclusions

The soil conservation programmes implemented in the last 30-40 years in the country have generated vast experience for treatment of various types of degraded lands in the country. The package for the treatment of degraded lands need to be refined keeping in view the research findings with active involvement of beneficiaries. The research centres of Indian Council of Agricultural Research and State Agricultural Universities have evolved suitable packages for treatment suited to regional needs. A combination of research, experience and effective involvement of people would ensure success.