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APPENDIX I: BACKGROUND OF SAHIBI PROJECT

Background

The Sahibi river catchment was taken up under the centrally sponsored scheme of integrated watershed management in the catchment of the flood prone rivers on the recommendation of the working group set up by the Government of India for flood control in Indo-Gangetic Basin. This catchment was taken up under the centrally sponsored scheme of integrated watershed management in the catchment of flood prone rivers in 1983-84 and was to be implemented by the Forest Department of the Government of Rajasthan. The main objectives of the project are:

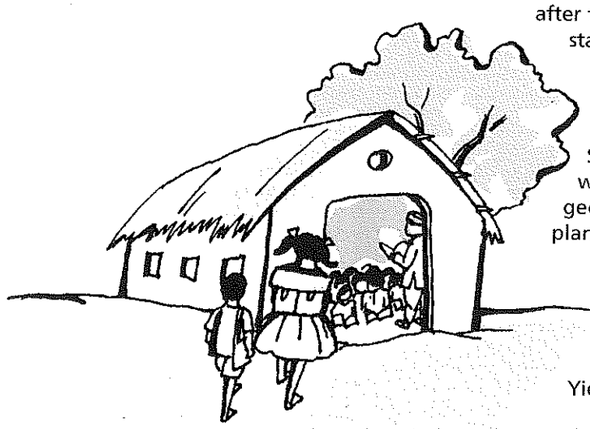
- To reduce flood hazards in the catchment area of Sahibi river and.
- To reduce silt flow in the main river thereby increasing the life span of the Masani Barrage downstream.

The series of engineering, afforestation and vegetative measures undertaken as a part of integrated watershed management are directed towards the achievement of these ecological objectives. They have, in addition, a number of important effects on livelihoods of the people of the region. The catchment area of Sahibi river lies between 75° 45′ and 77 latitude and 27° 15′ to 28° 15′ longitude. It consists of 7 sub catchments, 27 watersheds and 206 sub-watersheds in Rajasthan and covers parts of Jaipur, Alwar and Sikar districts in Rajasthan as seen in Table A 1.

Table A1: Districts and Tehsils under Sahibi catchment in Rajasthan

S. No.	District Name	Tehsil
1	Sikar	Neem ka Thana and Srimadhopur
2	Alwar	Bansoor, Mundawar, Kishangarwas, Tijara and Behror
3	Jaipur	Virtnagar and Kotputli

The total area of the catchment is 4, 57, 768 ha, divided into watersheds, sub-watersheds and micro watersheds. In Rajasthan, it is drained by Shabi and Sota tributaries. These two streams join to form the Sahibi River near Jalalpura after traversing a distance of 75 kms. After crossing the state boundary, the Sahibi drains into the Masani Barrage situated near National Highway No. 8 in Haryana state.



Detailed integrated watershed management in the Sahibi catchment is being carried out on micro-watershed basis, though a sub-watershed is the geographic unit for survey, priority delineation, planning and execution of soil conservation measures. These micro watersheds vary in area from 500 to 1000 hectares. The All India Soil and Land Use Survey, (ALSLUS) has categorized watersheds in the basin into very high, high, medium, low and very low priority watersheds on the basis of the Silt Yield Index (SYI) method. The number of watersheds falling in each category and the area they cover is indicated in Table A2. The watershed

management programme in the Sahibi is being limited to only very high and high priority areas and the treatment is taken up on a yearly basis.

Of the 206 watersheds into which the catchment can be divided, 106 were taken up for treatment after having been identified as the most degraded. These comprised about 50% of the total area of the catchment. Of these, 35 were reported to have been completed by 1993. Up to 1992, the main features of the programmes consisted of head water control structures such as head water dams, soil detention structures, farm ponds, land treatment covering gully control, bunding, leveling, horticulture, plantations, afforestation and grassland development. This package is representative of the technology of watershed management as adopted in several projects all over the country.

Table A2: Prioritization of sub-watersheds in the Sahibi catchment in Rajasthan

S.No	Priority	No. of Sub-Watersheds	Area (ha.)	Percentage
1	V. High	77	165580	36.2
2	High	29	64397	14.1
3	Medium	26	63727	13.9
4	Low	67	152935	33.4
5	V. Low	7	11089	2.4
	TOTAL	206	457768	100.0

Erosion was the major problem in the watersheds studied, being caused by the intensity with which the rainfall came down from the denuded hillsides. As such, the main trigger for the initiation of change in the area was the capture of runoff.

Execution and technology packages

It is important to understand, in the context of the operational aspects of the project, that the choice of technology was in accordance with the guidelines issued by the Government of India for such projects in 1978. At present, it is being implemented as per the revised, guidelines of 1992. This has imposed some restrictions on the choice of the technology[31].

The main components of the project technology have been engineering and water harvesting structures, afforestation measures and bunds and vegetative measures. The precise mix of these measures undertaken shall be looked at in the context of the two watersheds to be studied in depth.

For the project as a whole, the area treated annually under different kinds of soil conservation measures increased from 160 to

18825ha for the period from 1978-79 to 1994. The per hectare cost of investment during the same period was Rs. 1738 to Rs. 2933 at 1991-92 with Rs. 3107 and Rs. 3054 in that order[32].

Table A3: Annual physical and financial achieved in Sahibi project

S.No	Year	Achievemt of Targets		Cost in Rs./Ha
		Physical in Hectares	Financial in Lac rupees	
1	1978-79	160	2.78	1738
2	1979-80	1062.5	20.81	1959
3	1980-81	1413	34.54	2444
4	1981-82	751	16.65	2217
5	1982-83	4352	88.77	2040
6	1983-84	9065	175.25	1933
7	1984-85	8580	190.00	2214
8	1985-86	8291	212.53	2563
9	1986-87	8744	209.10	2391
10	1987-88	7368	199.99	2714
11	1988-89	9535	239.87	2516
12	1989-90	11319	283.00	2500
13	1990-91	11746	365.00	3107
14	1991-92	118007	50.00	3054
15	1992-93	22727	655.58	2885
16	1993-94	18825	552.21	2933
	TOTAL	1,41948.5	3796.08	2674

Note: Area treated includes agricultural, forest and waste lands.

Source: Chief Conservator of Forests, Forest Department, Govt. of Rajasthan, Jaipur (undated).

It is stated that contour bunding is done on lands where the slope is less than 6%, mainly for in situ moisture conservation. The cost comes to Rs. 500-680 per hectare. The bunds are supported with vegetation such as Munja and Ratanjot to ensure stabilization. Water harvesting structures are constructed at strategic points to form a network by resorting to micro-level interception and storage structures. These structures have helped in detention of silt and recharging of ground water. However, small earthen embankments and dugout ponds constructed in large numbers have proved to be one of the most ideal conservation practices and source to recharge the ground water apart from acting as flood cushions during peak runoff periods.

Afforestation has been carried out under alternative schemes or models. The first extends to barren hills and ravenous areas and envisages a species mix with 70% fuelwood, 15% fodder and 10% timber species. The second is undertaken on ecologically degraded hills with good root stock. Seed grasses are sown in sandy patches and tree species in interspaces.

The impact of the project as reported by the Government of Rajasthan (undated) includes increase in crop production to the extent of 10-15%; prevention of a recession in the water table and in some cases increase in water table; additional land brought under plough due to land reclamation; decrease in silt load of 20-40% in various watersheds; employment generation to the extent of 2.5 lac man days per annum etc. In this exercise, two sub-watersheds shall be selected to study the direction and magnitude of some of these impacts.

Selected watersheds in Sahibi: Tatarpur and Pithalpur

Two representative sub-watersheds were selected from the Sahibi project area for in depth study of effects, both ecological and economic. These are Tatarpur (watershed code no. Mb2k) work on which was undertaken in 1984-85 as part of the project focus on the very high priority areas and Pithalpur (watershed code no. Mh5m) undertaken in 1990-91 under the focus on high priority regions. Tatarpur is located in the south-western part of the project region in district Alwar, and Pithalpur in the south, south-eastern part in district Sikar[33]. A large part of the land of both is agricultural. However, in a total area of 1890 hectares, Tatarpur had about 375 hectares of forest land and 160 hectares of wasteland. Similarly, Pithalpur, had 168 hectares of wasteland and 158 hectares forest land in a total area of 1625 hectares.

In some sense, these two watersheds represent different aspects of the Sahibi project. Tatarpur, undertaken in the early phases of the project, is seen to have received focused attention in terms of formulation of technology[34]. Pithalpur on the other hand, was undertaken much later, with an emphasis on people's participation, in addition to technology. It also happened to be located in an economically poorer region, situated in a remote region with very little developmental activity[35].

The two watersheds differed in the extent of erosion existing, as found in the detailed study on erosion intensity indices. The sediment yield index estimated after in-depth study of different parts of the watershed was 1002 in Tatarpur and 561 in Pithalpur. There also existed a difference in terms of the relative significance of different components of the technology adopted in the intervention undertaken, with water harvesting receiving a greater emphasis in Pithalpur.

Cost of conservation structures in the two sub-watersheds

The conservation structures constructed in Tatarpur include drop and chute spillways and dams, box inlets and outlets, retaining walls, gunny bag structures, and earthen dams. In Tatarpur, the cost of soil conservation structures located on agricultural lands was Rs. 815 per hectare, constructed in an area of 775 ha during the year 1984-85. The per hectare cost increased to Rs. 949/ha, for an area of 1000 ha in the year 1985-86. The details of investment for Tatarpur is presented in Table A4.

Four farm ponds were constructed at Raipur, Tatarpur, Ranoth and Badli villages with catchment areas of 55, 40, 25 and 30 hectares respectively. The expenditure incurred on these ponds was Rs. 80,000 each in Raipur and Tatarpur while it was Rs. 35,000 each for Ranoth and Badli. The average cost worked out to be Rs. 57,500 for each pond.

Drop spillways and loose stone check were constructed in forest lands with a cost of Rs. 450/ha in around 300 ha. In waste lands - drop spillways, dry stone check dams and earthen dams were constructed with an expenditure of Rs. 43/ha. The cost estimates for forest and waste lands pertain to the year 1984-85 only.

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Apart from these engineering structures, Munja planting on bunds was taken up during the year 1985-86 with an amount of Rs. 13,000. Besides, afforestation programs in forest and waste lands was taken up with an expenditure of Rs. 18.17 lakhs during the period 1984-89. This works out to be Rs. 3488 per hectare on an average.

Further, there are trees in the farmers' fields which were grown naturally. The naturally grown trees include Prospis cinararia (khejde), Acacia nilotica (babul) Azadirachta indica (neem), Dalbergia sissoo (shisam) etc. These trees are also useful in reducing the intensity of rain and wind erosion.

Table A4: Investment undertaken in Tatarpur sub-watershed

S.No.	Year	Nature of the Structures	Area Covered (ha)	No. of Units	Cost (Rs. in lakh)
1	1984-85	Construction of marginal bunds with suitable outlets including retaining walls and earthen dams	775	-	6.32
	1985-86	"	1000	-	9.49
2	1984-85	Construction of check dams and drop spill and watersheds	521	-	2.71
3	1984-851	Storage pond with suitable outlets	-	1	0.75
	1985-86	Constructing farm pond	-	3	1.60
	1985-86	Munja planting on buds	-	-	0.13
4	1984-89	Afforestation of forest and watersheds	521	-	18.17

* The afforestation work is carried out in 5 years from 1984-85 to 1988-89 with an expenditure of 6.03, 6.95, 3.67, 1.04, and 0.48 lakhs rupees, respectively.

Pithalpur sub-watershed: The construction of conservation structures was taken up during the period 1990-91 to 1992-93. The per hectare cost was Rs. 2023 in 1990-91 for peripheral and marginal bunding on agricultural lands along with the construction of drop spill ways (10), retaining walls (2), silt detention dams (1), boxpipe inlet/outlets (25), check dams (26), earthen dams (40), village ponds and water harvesting structures (2), percolation tanks (6), etc.

Around 10,000 mango and other plants were planted by farmers themselves in their lands. During the period 1991-92 about 22,000 plants were planted in 35 ha of forest land. The average cost is around Rs. 1168/ha. Besides forest land, 50 ha of waste land was also treated in the same year.

In 1992-93 about 150 ha of forest was treated. The per hectare expenditure was Rs 3500. The conservation structures include loose stone check dams (150), earthen check dams (72), contour trenches (25,200) etc. In collaboration with the farmers, two big storage structures were constructed at two places. The year-wise details are presented in Table A5.

Table A5: Investment in Pithalpur sub-watershed

S.No.	Year	Nature of the Structures	Area (ha)	Units (No.)	Investment Cost (in lakhs)
1	1990-91	Soil conservation work in Agr. Lands[1]	1248		25.25
	1990-91	Percolation Tanks	-	5	
	1990-91	Structures[2]	-	2	
2	1992-93	Soil Conservation works in forestry area[3]	185		9.93
3		Afforestation			5.25
	1991-92	Forestry Plantation	35	21875 plants	
	1992-93	Forestry Plantation	150	75000 plants	

1 Includes bunding (marginal/peripheral/graded) in 790 ha, Drop spillways 10, Retaining wall 2, pipe outlets 25, check dams 26, earthen dams 40, Marginal/peripheral/graded bunds have been constructed to treat agriculture and waste lands.

2 Structures include water harvesting structure and silt detention dam.

3 Include loose stone check dams 150, earthen check dams 72, contour trenches.

APPENDIX 2: THE RALEGAN SIDDHI EXPERIMENT IN MAHARASHTRA

In the arid regions of Mahrashtra, the experiment in the village of Ralegan Siddhi in Ahmednagar district comprises a successful case of soil and water conservation with people's participation. It has been selected by the Maharashtra government for replication in 300 villages of the state. The experiment extends to the management of four watersheds in the village over a time period of over a decade and a half, starting in 1978. Soil and moisture conservation has been included in this development - oriented project. A brief and social aspects have also been included in this development - oriented project. A brief introduction to the village and the nature of investments carried out there is given here.

Watershed management in Ralegan Siddhi

Ralegan Siddhi village is in Parner taluk in the Ahmednagar district of Maharashtra. The village is situated at a latitude 19°22'N and a longitude of 74° 27'E, at an altitude of about 750 m above msl. The rainfall in the village is erratic, ranging from 200mm to 850mm. The average annual rainfall is estimated at 574mm. Most of the rain occurs from July to September, with 35 rainy days. The daily maximum temperature in the months of April, May, and June is 44°C, with a mean daily minimum temperature of 23°C. December is the coldest month, with a maximum temperature of 28°C and a minimum of 12°C. Occasionally, the temperature drops to 2 to 3°C.

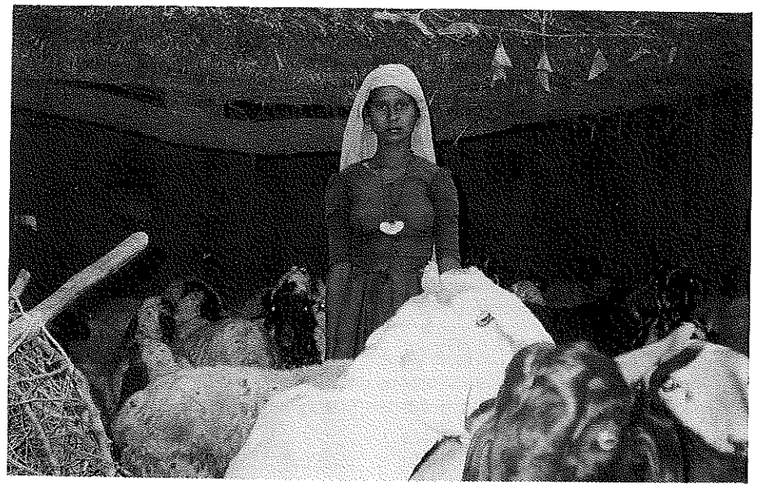
The land is undulating with a shallow soil cover. The plains are made up of black cotton soil which is good for Rabi cultivation. The soil at higher elevations becomes inferior and is not suitable for cultivation. The total geographical area is 971.44 hectares, of which 67% is the cultivated area. Government forests occupy an area of 14.09% and wastelands about 12.63%. The other forms of land use are pastures and common lands. The area under crops was 187 and 439 hectares under Kharif and Rabi seasons respectively at the initiation of the project. This increased to 377 and 482 hectares with the project implementation.

According to the 1981 census, the population of the village is 1508 distributed over 234 households. About 94 persons belong to the scheduled castes and tribes. About 40% of the population is literate. There was a high drop-out rate and hardly 10% of the children attended school on a regular basis. The total number of workers is 700, of which 475 are cultivators and 163 work as agricultural labourers. There are only 5 landless families and 13 artisan families in the village. The non workers are 796.

The average size of land holdings is 2.6 hectares. Most of the holdings are small and marginal, having less than two hectares of- these constitute 67.67%. The medium holdings, having land between 2 to 4 hectares, constitute 27.82%. The remaining 4.51% of holdings fall under the large hectares of land. Ganesh and Vasudha Pangare (1992) report that there are 12 farmers (3%), having more than 6 hectares of land, who own 18% of the total area of the village.

Table A6 provides the details on the works executed and the expenditure incurred in the development of the four watersheds. The soil conservation works executed include pasture development in 185 hectares and land-levelling in 604.54 hectares. The total expenditure over a period of time was 18.32 lakhs. Over a period of time 1,85,800 trees were planted in the village. Of the total no. of trees planted, 18.19% belonged to dry land horticulture plantations, namely ber, custard apple, guava, mango, sapota and tamarind. The remaining related to forestry plantations including eucalyptus, subabul, sisu, etc.

The impact of the project is compared in terms of incremental yields of jowar, bajra and onion crops, incremental milk yields, employment etc. which are provided in Table A7. It is documented extensively that before the initiation of the project, Ralegan Siddhi was a village plagued by poverty, drought, alcoholism, indebtedness, low productivity, social conflicts, unemployment, illiteracy, thefts and caste system. Anna Hazare, the one individual responsible for the work on different fronts done in the village, has transformed the village through the participation of the local villagers with greater emphasis on the adoption of watershed technologies. Several lakhs of trees were planted, a village high school was set up and output and yield of agriculture and livestock increased. In addition, irrigation schemes were adopted, biogas plants set up, solar street lights installed and a grain bank established. The starting point of all these activities was the adoption of watershed management techniques, the digging of wells and the introduction of social fencing to protect pasture and woodlots.



It is also stated that all this has been possible due to the participation and backing of the villagers. They were involved in the entire process from the initial stages and participated in the decision making. The success of Ralegan Siddhi has been due to internal leadership which sustained the process. While evolving strategies of watershed management, it is important to examine how other projects stand in relation to such a one which is widely considered as successful. Some impacts of investments made are reported in Table A7.

Table A6: Works executed and expenditure incurred in the development of watersheds: Ralegan Siddhi

Watershed No.	Area for development (ha)	Pasture development (Area) (Rs.)	Area needing levelling (Area)	Bunding Exp. Exp. (Rs.)	Nala Bunding (No.) (Rs.)	Land leveling (Area) (Rs.)	Supervision on soil conservation works (Rs. in lakhs)	Total expenditure
1	136.79	35.0 0.57	661.0	0.07	5 0.67	20.0 0.66	0.01	1.98
2	421.39	65.0 1.03	218.41	0.32	15 3.60	52.0 1.70	0.02	6.67
3	424.63	63.0 1.45	243.87	0.37	10 2.25	85.0 2.74	0.02	6.83
4	233.37	22.0 0.50	76.16	0.06	5 1.02	8.0 1.25	0.01	2.84
Total	1216.16	185.0 3.55	604.54	0.82	35 7.54	165.0 6.35	0.06	18.32

Source: Pangare and Pangare (1992).

Table A7: Economic impact of investments in Ralegan Siddhi watershed

Particulars:	At the initiation of the project (1979-80)	With the Project (1992-93)	Incremental benefit
Yield of crops (a) Jowar (kg./bigah) (b) Onion (tons/bigah) (c) Bajra (kg./bigah)	 81.97 98	 245.90 4.10 163.00	 163.93 4.10 65.00
Increase in area brought under cultivation (ha.)			1.51
Area under horticulture (ha.)			26.00
Area under plant protection (ha.)	45	265	220.00
Increase in livestock (SCU/hh)	0.47	3.07	2.60
Increase in milk yield (liters/buffalo/year)	420	1470	1050.00
Employment (Man-days/year			105.00
Investment (1995-96 prices) (a) Cost of engineering structures (Rs./ha.) (b) Cost of water harvesting structures (c) Cost of afforestation (Rs./ha.)			 1921.22 2,60,000.00 394.21

Source: Pangare and Pangare (1992) and NABARD (1995)

APPENDIX 3: SOFTWARE PACKAGE USED

The DEFINITE software package (developed by Janseen et al) is used for the application of multi-criteria analysis. DEFINITE is a system to support decisions on a finite set of alternatives. It involves five modules which define and present the problem for evaluation.

The first phase consists of generating alternatives, generating the list of criterion (effects) and creating an effects table. For the purpose of the study, four alternatives standing for different combinations of location and technology used are considered. These are: Tatarpur (engineering), Tatarpur (water harvesting), Pithalpur (engineering) and Pithalpur (water harvesting). At a latter stage of analysis, Ralegan Siddhi, a project located in Maharashtra and undertaken under a different set of institutional conditions is also considered as a fifth alternative.

DEFINITE has a provision for handling effects in the form of both costs (-) and benefits (+). Each effect is expressed in a different unit and therefore has to be standardized in order to arrive at any result. Creating the effects table would involve listing the impact of each alternative according to the various criteria (effects). Problem presentation consists of presenting the effects table in the form that supports comparison of the alternatives without applying a formal decision rule. Problem evaluation provide a ranking of the alternatives by aggregating the effects table according to the decision rules assumed i.e. it would indicate the best option out of the four alternatives in the watersheds being compared.

DEFINITE contains five methods to transform the effects table in combination with the weights into a ranking of the alternatives:

- The Weighted Summation method derives the ranking from the weighted sum of standardized effects scores.
- The Electra method is based on graphs derived from pair-wise comparisons of all alternatives.
- The Regime method is specially designed to handle qualitative or partly qualitative effects tables. The method is based on partitioning the set of values in accordance with the ordinal effects scores.
- The Expected Value method derives the ranking from the weighted sum of the expected value of the effects scores and.
- The Evamix method ranks the alternatives according to a combination of a dominance index calculated from the quantitative scores.

Selection of a particular method to determine the best alternative depends on the nature of the decision situation. The first two methods deal only with quantitative data, whereas the last three are useful in handling problems involving both qualitative and quantitative data. We intend to use the Expected Value method to evaluate the most beneficial project in terms of both the environmental and the physical benefits as the transparency of this method is "good" as compared to the other two whose transparency is only "reasonable". The Expected Value method standardizes all the effect scores and then calculates an appraisal score for each alternative by its appropriate weight followed by summing the weighted scores of all the effects.

The "sensitivity analysis" module within DEFINITE contains procedures to assess the sensitivity of the ranking to the evaluation method applied or to changes in scores and weights. for example, how would the result of the analysis change if the weights given to different effects were changed. Uncertainty analysis can also be taken up by inclusion or addition of some of the variables or of different levels of uncertainty to

different effects. For example, in our analysis, it is expected that there is greater uncertainty in environmental variables. Further, the sensitivity of the results to alternative levels of uncertainty can be tested for.

The judicious use of sensitivity analysis comprises one of the major advantages in the adoption of this methodology in particular in the context of policy making in a changing scenario. Reality can only be identified within broad bands of approximation and it is important to know levels of uncertainty within which the project impacts do not change.

END NOTES

1 See Chopra and Kedekoli (1993) for a comparison of watershed development programmes with more conventional development schemes.

2 See GOI (1990) for details of various programmes related to watershed and soil conservation.
See also Vaidyanathan (1991) for a review on the integrated watershed development programmes in India. The review includes the evolution of the concept, people's participation, distributional aspects in the light of Indian experience.

3 See Joshi and Bantilan (1997) for details.

4 He contended that these estimated may probably include the amount spent on measures to raise productivity of crops and animal husbandry in the watershed.

5 See Grimshaw (1988,1989) and Grimshaw and Helfer (1995) for relative performance of vegetative measures in different places.

6 See Government of Rajasthan (undated) and Government of India (1983).

7 See NABARD (1995) and Panagare and Panagare (1992).

8 From discussions with project staff, it is understood that this consequence is mainly the result of a limitation imposed on the expenditure.

9 See UNIDO (1972) for a detailed exposition of the theoretical basis and the earliest applications in the context of developing countries.

10 See among others the discussions in Dasgupta and Pearce (1972).

11 See in this context Pearce et al. (1989).

12 For an analysis of this kind, see Dasgupta and Murty (1985) on paper and pulp industry.

13 See the analysis of investments undertaken in the Sukhomajri watershed in Chopra, Kadekodi and Murty (1990).

14 See the study on Nepal in Hufschmidt et. al. (1983) for onsite effects in terms of increased productivity.

15 See the work of Hueting, (1991) in this context.

16 In the area of soil and water conservation, see the studies of the Agricultural Finance Corporation (1992 and 1988) on the Chambal and Matatila river valley projects respectively.

17 See the Planning Commission's evaluation studies of rural development programmes, for instance see GOI (1979a, 1979b, 1980 and 1985).

18 See Appendix III for details of the software package used and its assumptions.

19 This is the approach that has been preferred to the "before" and "after" approach for the identification of benefits. See the literature on project appraisal, for instance, UNIDO (1972), Pearce and Dasgupta (198..).

20 Weights used in the calculation are areas under different crops, as is usually done.

21 Conversion factors are taken from National Commission on Agriculture (1976).

22 Employment on the project does not include departmental employment since that component is not likely to create employment for the regional population.

23 See the Pithalpur story document.

24 See Sud (undated) for the details.

25 Low and high uncertainty are taken to stand for a combination of different levels of uncertainty in the environmental, economic, cost related and participation related variables as explained in the text earlier.

26 See in particular, the overviews in Chapters 2 and 6 of Chopra and Subbarao (1996).

27 The alternative technologies stand for the engineering and the water harvesting and the afforestation options as they are found to have been put in operation in the project. The watersheds selected represent different locations.

28 Tatarpur and Pithalpur are the two locations where watersheds are fairly representative of the Sahibi project as a whole.

29 The economic effects are defined to include crop productivity, employment generation, availability of direct consumer goods. The environment effects are runoff capture, sediment yield capture and flood control.

30 Low and high uncertainty are taken to stand for a combination of different levels of uncertainty in the environmental, economic, cost related and participation related variables as explained in the text earlier.

31 From discussions with project staff, it is understood that this consequence is mainly the result of a limitation imposed on the expenditure.

32 These estimates fall within the range mentioned by Rammanna (1991) as the average for such measures in Karnataka. They are lower than Alagh's average figure of Rs. 10,000 per hectare for some model projects undertaken by N..G.Os in the eighties.

33 See Maps 2 and 3 for the location and the details of the two watersheds.

34 This is evidenced by the existence of departmental studies on the project. See Government of Rajasthan, Forest Department's study, among others.

35 See the documentation by Sud (undated) on this watershed.

NATURAL RESOURCE MANAGEMENT: LESSONS FROM INDIAN EXPERIMENTS

R.K. Mukherji • Society for the Promotion of Wastelands Development • New Delhi

INTRODUCTION

India did make tremendous economic progress in the past four decades through developmental planning. Production of foodgrains increased from 40 million tonnes in 1950 to 135.6 million tonnes in 1991 and, consequently, per capita availability of foodgrains went up from 395 grams per day in 1950 to 476 grams in 1991. Milk production increased from 17 million tonnes in 1950 to 56 million tonnes in 1990. Production of coal rose from 32 million tonnes in 1950 to 229 million tonnes in 1990. Finished steel registered an increase from 1.04 million tonnes in 1950 to 14.3 million tonnes in 1990. Similarly, crude oil production went up from just 0.3 million tonnes in 1950 to 30.4 million tonnes in 1990. These are impressive achievements about which the country can be proud.

However, this overall rosy picture without reference to the country's needs and production potential is highly misleading. Micro-level realities show that although per capita availability of foodgrains has increased considerably as a result of higher food production, almost half the rural population is still unable to eat two square meals a day because of grossly inadequate purchasing power. In relative terms, for instance, the level of poverty may have been substantially reduced. Yet in absolute terms about 353 million of the 850 million Indians (1991 figures) live below the poverty line. Bare minimum requirements of food apart, a large section of the population in rural areas is also deprived of other basic needs like drinking water, shelter and healthcare. For these people, higher national production of steel, cement, oil or coal makes no sense. Producing more foodgrains without raising the people's purchasing power is a mockery of developmental planning.

Low land productivity, inefficient use of available natural resources and social inequity have also contributed to the grim situation

It is not difficult to see that lack of gainful employment is the root cause of the widespread rural poverty. Low land productivity, inefficient use of available natural resources and social inequity have also contributed to the grim and ironical situation. For instance, although only 3 to 5% of the population is unemployed, 50 to 60% of the rural work force comprising of more women than men, is underemployed. The exploding human and livestock population, limited arable lands, degraded pastures and vanishing forests are the major constraints hampering efforts to give our people a decent living. Fortunately, India is not poor resourcewise. It still has a rich and productive bio-physical natural resource-base, proper husbanding of which can remove the abysmal poverty of its people. How can this be done? The answer is, communal autonomy and informed community awareness and action in natural resource management. The immense promise it holds for the country's socio-economic development has yet to get the attention of the government.

COMMUNAL NATURAL RESOURCE MANAGEMENT

Traditionally, the village was the basic unit of production and self-government in India, and its economy, agro-industrial in nature, aimed at self-sufficiency. Each village had an elected panchayat with executive as well as judicial powers. A larger panchayat supervised these village panchayats. Under this time-tested system of village self-government, families in each village community had rights and

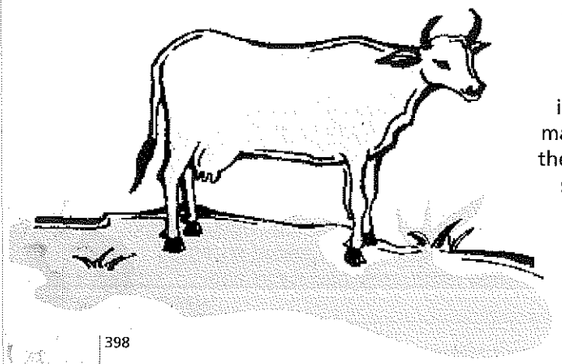
obligations which were determined and protected by strong customary law and established conventions. The village community used and managed its natural resources — land, water and vegetation — in an equitable and sustainable manner. Land was distributed among the families by the panchayat. The system worked on the basis of cooperation and joint action, where needed. Community assets, facilities, services and institutions were maintained through contributions in cash or kind. Relatively rich natural resources and a wholesome social climate facilitated adequate production and comfortable living.

In those days panchayats collected taxes on land produce and paid the share of the king or the ruler of the area on behalf of the village. The king respected the autonomy of the village communities and panchayats, and seldom interfered with customary laws. It is pertinent to mention that the landlord system as understood today was unknown then. The individual peasant was the absolute owner of his patch of land, a custom that implied the primacy and supremacy of village communities. Available records, although fragmentary, show that it was an efficient system of self-government and the community enjoyed full autonomy. It was this happy and prosperous community that was able to build and sustain a highly developed civilization that lasted centuries.

This traditional system of village self-governance which had continued for hundreds of years was disrupted by foreign invaders. However, the Mughal rulers did not directly interfere much with the old customs and conventions, nor did they introduce any fundamental changes in the Indian way of life. Nevertheless, conflicts and subjugation and increasing centralization of power in the government played havoc with the prevailing smooth and equitable practices and slowly eroded away the respect given to customary law.

During the Mughal period (1526-1757), emperor Akbar attempted to introduce some comprehensive reforms in the land revenue system. He tried to strike a balance between the welfare of the peasant and the revenue requirements of the government. At that time, land revenue formed the backbone of the governments funds. To achieve a steady flow of funds, therefore, Akbar addressed various issues relating to the land revenue system, like ownership of land, rate of revenue, mode of assessment and enforcement, clean and timely collection with minimum coercion, tax remissions in years of crop failure, recovery of arrears and so on. He acknowledged that the peasant was the true proprietor of his holding and that the king had a right to demand a tax but only for the purpose of protecting the peasant's life and property and promoting his welfare. The great Mughal emperor tried to be benevolent so that the peasantry would be happy and contented and be loyal to the crown.

Succeeding Mughal emperors continued with the land revenue system introduced by Akbar, making only marginal changes. But the system got corrupted. Oppression, exploitation and bribery of local officials increased, and heavy tax demands became strident and unbearable. The lot of the peasants was naturally very bad by the time the British came on the scene.



During their 200 year long rule, the British made drastic changes in the prevailing system of village self government and introduced in its place a complicated system of government and made arrangements for revenue collection on the model existing in the West. These innovations disrupted not only the indigenous system of village self-government but also India's economic and social structure evolved over the centuries.

The new land revenue system introduced by the British was basically of two types: Zamindari and Ryotwari. A third type

called Mahalwari (a modified version of the Zamindari System) was introduced in the Central Provinces Region.

The Zamindari System introduced in eastern India (Orissa, Bihar, Bengal) and the Madras Presidency was designed to collect revenue from tenant farmers. The zamindar served as an intermediary to collect revenue on behalf of the colonial administration. The Ryotwari System was introduced in Bombay in 1850: under this dispensation the ryots or tenant farmers paid revenue directly to the Government. The Ryotwari system has been basically the land revenue system introduced by the Marathas in the peninsular India. The revenue collector in this system was the link between the tenant farmers and the colonial administration. The Mahalwari system was introduced for collection of revenue of "mahal" or estate comprising of village or villages (termed as "mahal" in areas of central India). Here the village headman/patel acted as revenue collector.

The main features of the Zamindari System, the most important of the three were:

- Zamindars or landlords were eventually recognized as owners of the tract of land, but subordinate to the government.
- Cultivators were reduced to the status of tenants.
- Under the Permanent Settlement, the zamindars were responsible for collecting annual rent from cultivators. They were directed to pay a fixed amount (assessed) to the government and keep the balance for themselves.
- The cultivators were deprived of their customary right to use pastures, forest lands, homestead plots, irrigation canals and fisheries.

The zamindars acquired the proprietary right over land under the instrument called "Permanent Settlement" introduced by Lord Cornwallis as Governor General in 1793 mainly to ensure a guaranteed income to the state from the land. This decision to grant the ownership of land to zamindars was partly due to a misunderstanding of the landlord system prevailing in England, and partly on account of political, financial and administrative expediency.

In all the systems mentioned above, the land revenue paid to the government was as high as 33 to 55% of gross produce. In Permanent Settlement Zamindari areas, it some times shot up to 60% , 45% paid to the government and 15% retained by the zamindars.

The colonial rulers, however, did not stop at crop lands. In the process of looking for ways of raising revenue for the government, the colonial administration was struck by the rich Indian forests. Realizing the immense potential for increasing revenue it took control of a major part of Indian forests under the pretext of their better management and simultaneously extinguished the traditional rights of the local people for forest produce. This take-over of forest by the government had far-reaching consequences — far worse than the zamindari curse —

in that it adversely hit the social, economic and political life of the rural people, and disrupted traditional agriculture, industry and trade. For instance, agriculture declined as peasants were heavily taxed and their freedom curtailed. Community autonomy and village self-government became a thing of the past and traditional local initiative, enterprise and investment in agricultural development were neglected to the extent of crippling village economy as a whole.

Community-based natural resource management had become quite complicated during the colonial rule. The sweeping changes since independence added a new dimension to various issues of conserving and using natural resources. The main issues that needed straightening up immediately may be listed as follows:

- Restoration of community autonomy and village self-government
- Restructuring of agrarian relations and natural resource use to achieve an egalitarian social order
- Adequate access for the rural poor to natural resources
- Abolition of the still remaining aspects of the exploitative and oppressive Zamindari System
- Efficient and sustainable use and management of natural resources to meet people's present and future needs
- More stringent steps towards consolidation of land holdings
- Need-based development mechanisms and support systems
- Updating land records and simplifying revenue structure
- Revision and reform of legislation relating to land and other natural resources
- Correcting of disoriented community thinking, especially of the elite

There have been some legislative efforts since 1947 to remove the aberrations and distortions introduced in the past regarding various aspects of natural resource management. These are:

- Abolition of the Zamindari System so as to eliminate intermediaries
- Ceiling on land holdings to abolish uneven distribution of land and redistribution of ceiling-surplus land among the landless
- Tenancy reforms to ensure security of tenure for peasants, regulation of rent and ownership
- Regulation of share-cropping to safeguard the interests of the share-croppers
- Protection against alienation of land belonging to weaker sections like scheduled castes and tribes
- Consolidation of fragmented landholdings
- Provision of homestead to the landless
- Ensuring statutory minimum wages for agricultural labour
- Provision of government land to the landless on a long-term lease

...in Nagaland, Mizoram and Meghalaya collective community action in the management of natural resources evolved earlier is continuing happily even after Independence

In recent years the Government of India has initiated steps to involve beneficiary communities and NGOs in wasteland development as well as the conservation, regeneration and management of forests. Establishment and restructuring of the National Wastelands Development Board, introduction of programmes like social forestry and village woodlots, adoption of the National Forest Policy Resolution, 1988, and issuance of the 1 June 1990 circular on involvement of village communities and voluntary agencies in the regeneration of degraded forest lands, may also be mentioned in this regard. These government responses in the form of enabling legislations, policies, and mechanisms have improved the situation considerably compared to what was prevailing during the British rule. However, more measures of a radical nature need to be taken to improve the overall situation.

For instance, community action in the management of natural resources supported by village/State Governments is yet to take shape. While in Nagaland, Mizoram and

Meghalaya collective community action in the management of natural resources evolved earlier is continuing happily even after Independence, in other states, the same British laws which destroyed our time-tested community-based management systems are finding a place in the statute. In fact, today, about one-third of the land and the entire water resources are owned by the government. Private individual ownership of the rest of the lands and direct link of individual peasants with the government by-passing the community have created a situation in which there is little room for the community to play any significant role except in the case of common property resources which have been largely misappropriated or encroached upon by influential individuals.

What is equally bad, despite legislation and efforts to enforce laws to redistribute ceiling surplus lands among the landless, the implementation is highly uneven

As a result of continuing situations antithetical to socio-economic development and communal living, village communities have lost interest in the management of their ecological assets. For the real freedom to flower and a new social order to emerge- one that will include community action and popular participation - no less a person than Mahatma Gandhi had advised that power should be shared with the 700,000 villages. However, this recommendation was ignored; the Constitution-makers drafted a make-believe provision for village panchayat in the non-justiciable part of the statute. (Although the current government's initiative to provide a constitutional basis for effective democratic decentralization and Panchayati Raj has yet to show results, it is nonetheless a step in the right direction.) What is equally bad, despite legislation and efforts to enforce laws to redistribute ceiling surplus lands among the landless, the implementation is highly uneven. Centralised government control and management, complicated laws and procedures and corrupt and inefficient bureaucracy multiply land-related disputes, litigation and strife in the community. Total elimination of vested interests in natural resources is the only way out of this impasse.

NGO initiatives

India's vibrant NGO sector has an impressive record of promoting community-based natural resource management. Largely people-centred and/or community-based, the NGOs are large in number, wide in spread and diverse in strategy. The responses of these organizations in the post-independence period can be discussed under two broad categories; social movements and community-based action.

There have been a series of social movements and struggles after independence on the vital areas of land reform, agrarian relations and natural resource management under the banner of "new social order". A few of these significant movements are briefly discussed below.

SOCIAL MOVEMENTS

Bhoodan-Gramdan movement

A Gandhian movement led by Vinoba Bhave, it began on 18 April, 1951. Its focus was on the distribution of donated land among the landless. Its main aim was to generate fellow feeling and harmony in the community. Though in principle one-sixth of the land was to be donated to the landless, in practice, lesser area was parcelled out.

In all 47,83,821 acres of land were given as gift across the country. Of this, 16,88,498 acres have been distributed among 7,09,209 poor households, mostly scheduled castes and tribes. This achievement compares well with the Government's earlier redistribution of ceiling surplus land. In Bihar, where the movement's goals were intensely pursued and achievements were high, a late

1960s survey revealed that about 75% beneficiaries of Bhoodan were in control of the allotted land, while only less than 20% allottees under the ceiling surplus scheme were able to gain possession.

By 1957, the Bhoodan Movement had evolved into Gramdan Movement. Declared donated were 1,49,000 grams (villages), settlements or hamlets.

However, follow-up action, confirmation and operationalisation have been extremely poor and as a result, 91% of Gramdan still remains at the initial stage of paper-pledging.

Why did it happen ? What went wrong ? The Government was sympathetic to the movement. Many State governments accorded legal recognition to Bhoodan land redistribution and Gramdan by enacting laws such as the Bhoodan Act and the Gramdan Act. To facilitate handling of the massive task of land redistribution, State Bhoodan Committees also received financial and official support from State governments.

To make Gramdan widely acceptable, the government also made certain conditions imperative. These were.

- The ownership of village land should be vested in the village assembly (Gram Sabha) and 1/20th of the land held by each constituent household transferred to the village assembly for redistribution (while each landholder retains possession and tenancy rights over the remaining 19/20th).
- Each constituent household should contribute 1/40th of its agricultural production and 1/30th of labour and cash income to the common village fund (Gram Kosh).
- There should be a village-assembly (Gram Sabha) comprising adult men and women with unanimously elected office-bearers and an Executive Committee.
- For a Gramdan to come into effect, at least 75% of the households are required to sign a pledge and accept its conditions.

These deliberate and helpful steps notwithstanding, the governments did not address itself to fundamental aspects like facilitating the functioning of village assemblies as effective units of village self-governments, a concept provided in the Gramdan Act and the Sarvodaya philosophy.

...apart from small gains in pockets where there was intense follow-up activity, the larger objective of creating a new social order eluded it

If translated into practice, Gramdan Movement would have established effective village self-government and community-based natural resource use. But apart from small gains in pockets were there was intense follow-up activity, the larger objective of creating a new social order eluded it. It gradually fizzled out in the 1970s with the passing away of its two great leaders, Vinoba Bhave and Jayaprakash Narayan.

The movement nevertheless left a deep impact and provided valuable lessons on the vital issues of self-government and community-based natural resource management. Village assemblies backed by the Gramdan Act do offer a workable model of a community level people's organisation. Furthermore, it became obvious that persuasion alone was not adequate and that an organised and peaceful pressure of the poor was necessary to restrictive agrarian relations. Finally, experience showed that greater social preparedness and stronger people's movements were prerequisites to real progress towards a new social order.

The Naxalite movement

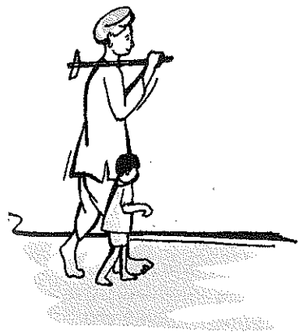
Although a Marxist political vehicle, the Naxalite movement is extremely relevant to the present discussion because of its unique nature and impact on the issue of land and agrarian relations and natural resource use.

The Naxalite Movement is named after its place of origin; Naxalbari in Gopivallabhpur (West Bengal). It was launched in the late 1960s and was spearheaded by the Communist Party of India (Marxist-Leninist) with social changes through violent revolution as its creed. Strategy-wise, it started with attempts at physical annihilation of their perceived class enemies like big landholders, moneylenders, police-informers and political opponents, a move which created panic in society and the government. Naxalites tried to sensitize and organize the rural poor (the landless agricultural labourers, the scheduled castes and tribes) to do acts of violence purportedly to break the existing exploitative and oppressive socio-economic structure and to create a new socio-economic order.

Besides West Bengal, the movement brought under its influence a few other pockets: Srikakulam in Andhra Pradesh, Sahar (district Bhojpur) and Musahri (district Muzaffarpur) in Bihar. Its ideology attracted some brilliant youths disgusted with existing economic inequities. But the movement lost its momentum during the 1970s because of inner contradictions, inadequacies of strategy, lack of class-based mass support in the highly stratified Indian society and ruthless suppression by the government. It has regained some of its lost ground in recent years and has made progress in regenerating and enhancing areas of influence in States like Andhra Pradesh, Bihar, Madhya Pradesh, Maharashtra, West Bengal and Orissa. In many of these pockets, the governments find it difficult to meet the Naxalite challenge.

...it has created among the poor, awareness about their rights and self-confidence to fight for these rights

The movement has failed in its prime goals of achieving political revolution and a new social order, but it has made vital contributions to debate and action on issues relating to land and agrarian reforms, poor people's access to natural resources, and the wider issues of poverty eradication and social change. It has also put tremendous pressure on the government and society to effect faster changes in the social order. Lastly, it has created among the poor, awareness about their rights and self-confidence to fight for these rights.



The Chipko movement

Chipko laterally means embracing or hugging. The movement was named as such because in 1974 women of Garhwal (U.P.) embraced trees in their area and saved them from being cut by forest contractors. The Chipko movement has since gained worldwide acclaim as an important ecological event. In recent years the movement has expanded its activities to include wide-ranging cultural, social, economic and ecological issues on its agenda. Deserving special attention is the extremely successful afforestation programme organised and spearheaded by the NGO, Dasholi Gram Swarajya Mandal (DGSM), in Gopeshwar. Because of the far greater stake of women in environmental health, DGSM has organized informal village level institutions of women, Mahila Mangal Dals. These Dals have slowly taken possession and management of village forests and other community lands in respective villages. Fodder, fuel and small timber from the community forests are shared equally among the households in the village. Mahila Mangal Dals, Van Panchayats (village forest councils), statutory gram panchayats and DGSM have been able to work together for the common good as a result of the action taken and awareness generated by the movement.

Narmada Bachao Andolan

Narmada Bachao Andolan is now an internationally known movement. Spearheaded by an informal group of social activists and NGOs, it is opposed to the construction of the multi-purpose Sardar Sarovar dam in Gujarat and Indira Sagar dam in Madhya Pradesh. The two enormous dams apart, the Narmada Valley Development Project envisages eight other large dams, 300 medium-sized dams

and 3000 small dams. The Narmada river being the lifeline of the valley, the opponents of the Narmada project contend that the huge dams will submerge vast areas of agricultural and forest lands and uproot thousands of families from their ancestral homes. So the movement is trying to stop construction of the World Bank-financed Sardar Sarovar dam altogether. The basic questions posed by them are: who benefits from the project, to what extent, at whose cost and for how long? What about the inalienable rights of the communities in the Narmada Valley to their natural resources?

The movement has generated forceful debate and as deeply influenced the thinking on growth-centred development policies. It has also enhanced the prospects of proper resettlement and rehabilitation of communities displaced by the Narmada project.

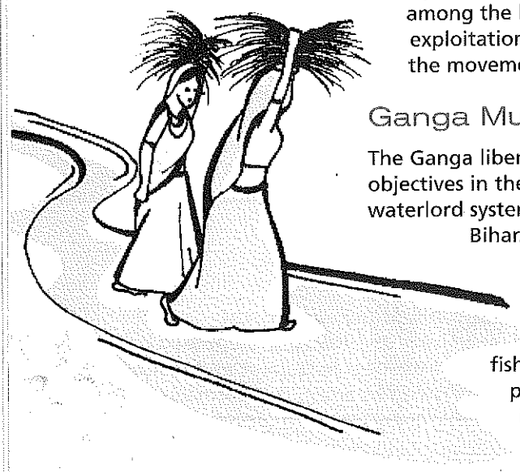
There are a number of other similar movements across the country. These include one against the World Bank-financed Suvarnarekha Project (Chandil dam) in Bihar and another against the Baliapal firing range in Orissa. These movements have been extremely effective in generating awareness about and action on people-centred development. They have also facilitated efficient and equitable management of natural resources in ways appropriate to the country's ecological and cultural diversities.

Bodh Gaya Bhoomi Andolan

The Bodh Gaya land movement started in the late 1970s and continued for about a decade. Comprising landless agricultural laborers drawn from 42 villages in four blocks of the Gaya district in Bihar, it was led by a social activist youth organisation called Kshatria Yuva Sangharsh Vahini (KYSV). Committed to peaceful and democratic means, the basic issue it addressed was the redistribution of some 9000 acres of ceiling-surplus land held by the Bodh Gaya Matt, a Hindu monastery which evaded the ceiling laws of the State.

It started by organising labour-peasant committees (Mazdoor-Kisan Samitis) and networking at the area level. With the organisation and local leadership in the vanguard, there was tremendous popular enthusiasm. Women were in the forefront of the struggle. Apart from basic issues of land, gender equity, prohibition, freedom from supersition and rights of the poor to live with dignity were promoted by the movement.

In the late 1980s the movement concluded with considerable success. The ceiling-surplus land of the matt was acquired by the government and redistributed among the landless. Equally important, the poor labourers were freed from the exploitation and oppression of the matt. Notwithstanding some inadequacies, the movement recorded many gains against formidable odds.



Ganga Mukti Andolan

The Ganga liberation movement started in the early 1980s; achieved its major objectives in the latter part of the decade. It was launched to abolish Panidari or waterlord system on a stretch of 80 km of the river in the Bhagalpur district of Bihar. The Panidari of two rich waterlords continued because of a ruling of the high court that the Zamindari (landlord system) abolition law earlier enacted by the government did not apply to the waterlord system. The two waterlords continued to collect an annual water revenue of Rs. 30 to 40 million from about 40,000 fisherfolk drawn from 60 villages situated along the river, apart from perpetuating various other forms of exploitation and oppression. As in Bodh Gaya, the social activist youth organisation, the KYSV,

spearheaded the movement and organized the fisherfolk. The social pressure generated by the movement led to necessary legislation being enacted by the State Government abolishing the Panidari system.

COMMUNITY-BASED ACTION

Non-governmental community-based action in respect of natural resource management has accumulated equally rich experience in a variety of cases across the country. A few interesting cases are enumerated here.

Community-based water management

In India, the starting point of community-based resource management often is not land or trees, but water. The Association of Voluntary Agencies for Rural Development (AVARD), which organized community-based action on water management for irrigation in three areas of Bihar is an example proving this statement. The three areas are:

- Pratappur block in Hazaribagh (now Chatra) district during 1968-1972.
- Musahri block in Muzaffarpur district during 1972-1982.
- Jamui block in Munger (now Jamui) district during 1972-1982.

Through community effort, each area was able to procure implements and build infrastructure for irrigation. Availability of irrigation facilitated double and triple cropping and substantially increased production. It also enhanced employment by way of intensive agriculture providing much-needed food security and better quality of life. The most vital outcome, however, was the futuristic initiative taken in setting up equitable water management as opposed to an exploitative irrigation system which was individually owned and which resulted in uneven distribution of water.

Pani panchayat

The Pani Panchayat or water council is another community-based water management system. It evolved from the initiative of Gram Gaurav Pratisthan (GGP) in Pune district (Maharashtra), an NGO that aimed to facilitate efficient harvest and equitable sharing of scarce water resources. Schemes of Pani Panchayat are based on the following principles:

- A group of people share water equitably on a per capita basis.
- The people in the group do not use water for growing high water-consuming crops like sugarcane.
- Water rights are non-transferable.
- People contribute 20% of the scheme's cost.
- Water rights are made available even to landless families.

Each Pani Panchayat consists of marginal farmers, landless labourers and scheduled castes in a village. The council plans, executes and manages its own irrigation schemes with the assistance of GGP. In 1986, 51 schemes were functioning, providing irrigation to 1500 hectares of land and benefiting 1800 families. These families have been able to improve their economic status through increased productivity on their land and greater food security. The highly successful community action has also strengthened their self-confidence.

The work has made much progress since, and moved on to sustainable ecosystem planning and development with the village as the basic unit. These successful efforts

have facilitated higher food production through appropriate cropping pattern, grassland development, tree cover on barren lands and zero water run-off.

The concept of Pani Panchayat has spread steadily. A similar initiative under the dedicated leadership of Anna Hazare, a social activist based in the Ralegan Sidhi village of Maharashtra, has produced equally commendable results. Starting with micro-watershed planning and irrigation, the project now envisages an entirely holistic approach to village ecosystem planning and development. Its achievements include a shared water supply for domestic and irrigation use, sustainable village ecosystems, increased agricultural production, more employment, education, healthcare and sanitation, renewable energy in the form of biogas plants and easier reconciliation of village disputes.

Sukhomajri

This is a small village in the Ambala district of Haryana, which has been successful in community-based watershed development. The village is located in the fragile foothills of the Shivalik range of the western Himalayas. Assisted by an NGO the villagers organized themselves into a Water Users Association (WUA) consisting of one member from each of the 56 households in the village. A small water reservoir was built on a flood-prone stream. Through community forum, the WUA agreed upon the following principles:

- Water from the reservoir must be shared equally irrespective of the size of landholdings.
- WUA members must protect the vegetation in the reservoir's catchment area from open grazing.
- Beneficiaries must pay for the water used for agriculture so as to create a common fund for the village.
- The WUA shall manage and maintain the water harvesting facility and distribution system.

As a result of WUA efforts, vegetation in the degraded forest land forming the catchment area was regenerated and a sustainable micro system established. They also helped to raise household incomes considerably. For instance, assured irrigation from the reservoir helped to triple agricultural production, while the grass and fodder from the forest area facilitated stall-fed buffalo rearing and increased milk production.

Rope-makers of Saharanpur

In this case, community-based action and social movement combined to empower the rope-makers of Ghad area in the Saharanpur district of Uttar Pradesh and to enable them to regain their traditional rights to use and sustain a natural resource-Bhabbar grass.

A large section of the rural poor in Ghad survives by rope-making, using Bhabbar as raw material. However, as a result of the unimaginative forest policies of the government, Bhabbar has gradually

become scarce and too costly for the poor ropemakers. Their access to it has also been highly restricted. To cap it all they are harassed by forest officials. On the other hand, a major part of Bhabbar harvest is sold through contractors and the Uttar Pradesh Forest Corporation to paper mills at much cheaper rates! Hence the rope-makers struggle for their rights and survival.

In 1982-1983, with the intervention and assistance of a local NGO, Vikalp, the rope-makers organized themselves into cooperatives (Baan Uptadak Samitis) with the following objectives.

- To ensure to themselves adequate supply of raw-material (Bhabbar) at fair prices.
- To facilitate marketing of rope (baan) produced.
- To upgrade skills so as to improve productivity, remove drudgery and enhance quality of products.

Due to continuing hurdles, the rope-makers organized themselves into an area-level organization, Ghad Kshetriya Mazdoor Morcha (or Ghad area labour front) and started a movement in 1986. Their charter of 29 demands included adequate educational facility, health care, transport and communication arrangement along with the main demand relating to adequate Bhabbar grass supply and traditional rights of access to forest.

After an year-long struggle, the rope-makers were able to regain some of their traditional privileges to collect forest produce — special rights for the people of the 81 scheduled villages (Haqdari Ravana) and general rights for the residents of all villages (Aam Ravana). But this recognition lasted only one season. Hence the struggle continues.

Chakriya Vikas Pranali

Chakriya Vikas Pranali (CVP), or cyclic system of development, is based on a unique and promising concept of an efficient community-based natural resource management system drafted by a social and development activist, P R Mishra, who was actively involved earlier in the successful Sukhomajri experiment initiative. He has been working and refining this concept in the hilly areas of Palamau district, South Bihar. He has established an NGO called Society of Hill Resource Management School (SHRMS) and built up a team of workers to spearhead CVP. There is also a strong support group for CVP.

Starting in 1986 with one village named Bhusaria, CVP has now spread out to 28 villages, 23 of which are located in the district of Aurangabad and two in Buxar. CVP seeks to blend modern science and technology with traditional wisdom in order to promote — layered, multi-cropping based on the compatibility of different plant species. It seeks to optimise sustainable management and use of the entire natural resource base of the village which includes land, water, vegetation, sunshine, air and human resources.

A small village or hamlet is selected as the basic unit under CVP. An effective Sahayogi Samaj, a community based on cooperation and sharing, is constituted in the unit. Available land in the village is gathered into a block. Likewise, willing village workers are pooled. Workers joining a CVP are called "resource students" (Sadhan Vidyarthi) because their work combines manual and intellectual tasks and action research. Accordingly, these students are paid stipends, not wages. Thus, human resources and creativity are effectively developed and dignity and self-satisfaction in work, instilled.

Initially, investment is mobilized from outside funding agencies (government, non-government, indigenous as well as foreign). However, the multi-layered multi-cropping cycle is planned and implemented in such a way as to generate resources for stipends and further development within the system.

CVP seeks to make optimum use of all available land and to conserve all its resources. The village community pledges to achieve zero run-off. It also does "social fencing" , completely stopping open grazing and promoting stall-feeding of livestock instead. The pooled land is readied and developed scientifically by building ridges and harvesting structures such as tanks, check dams or reservoirs. So far only wastelands and degraded lands in the villages have been pooled and successfully covered under CVP. Hence, CVP focuses on main tree crops for timber, fruits, fuel and fodder along with grasses, root and tuber crops, vegetables, legumes and short duration fruits such as papayas planted in-between, depending on agro-climatic and socio-economic conditions.

CVP has introduced a unique and equitable system of income-sharing where 30% is equally divided among resource students and teachers; 30% going to the landowners pro rata ; 30% going to the village development fund for further investment and the remaining 10% going to the village welfare fund to support educational and health care services.

Each village unit under CVP is expected to achieve self-reliance after seven years and to start repaying the initial investment. Each resource student is expected to plant and care for 3000 trees apart from other plantations and crops. The project promises a high level of income to students, landholders and the village community in general. Conservation of water and soil, use of organic manures and proper selection of crop-mix ensure sustainable use and management of natural resources and optimisation of production.

CVP has an open system with regard to accounts and holds a social audit. Each village community settles its disputes locally as they arise. Attitudinal changes and physical development are monitored closely to make adjustments when required so that the system moves forward and grows in harmony with nature.

Thus, CVP addresses social, cultural, economic, political, environmental and moral issues and problems. In other land and agrarian reform movements in India where goals were reached or planned either through legislation and pressure, through non-violent means and persuasion (Bhoodan-Gramdan movement), through violence and coercion (Naxalite movement) or through a combination of pressure and persuasion (Bodh Gaya Bhoomi Andolan), the focus has been on transfer and redistribution of ownership of land and in certain cases on redistribution of limited income with little attention to adequate follow-up action.

CVP efforts in this respect are a major improvement and have potential for sustainable development through community-based natural resource management. The impact of CVP in villages where it has been in operation for the past six to seven years- on natural resource management, biomass regeneration and human resource development—has to be seen to be believed. The process in its evolution throws up multifarious dimensions of development and hence must be addressed in a creative and innovative manner.

LESSONS FROM EXPERIENCES

Some basic lessons emerging from governmental and non-governmental responses to multi-dimensional issues involved in community-based natural resource management in India since Independence are briefly discussed here.

Community-based management

The assortment of experiences described earlier makes a convincing case for community-based natural resource management. The essential elements of successful management emerging from these cases are given here.

Village Micro-ecosystem-based management
This approach is suitable to India. It takes into account ecological and social dynamics and diversity of each microsystem. It is at this level and scale that people and communities participate and contribute directly.

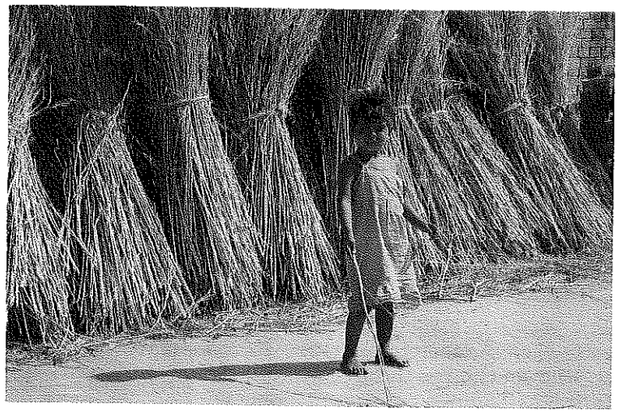
Management assumes different forms and borrows various types of water harvesting devices, land shaping, vegetation and crop planning with varying emphasis on crop lands, grazing lands or tree plantations depending on the nature of the village ecosystem. It may take time to reach a holistic level of village ecosystem management. However, there is no shortage of resources: watersheds and micro watersheds, degraded commons, degraded government lands and privately-owned degraded lands and wastelands. A village ecosystem-based natural resource management will be integrated into the management plan of a larger ecosystem as part of a bottom-up development process. This will ultimately lead to the national resource management plan.

A cohesive village/hamlet level people's organization
Such organizations based on shared concerns, perceptions, interests, and objectives are essential to facilitate popular participation with minimum conflict. They will provide a workable forum where the community can make decisions and formulate management plans based on its needs, priorities and view-points as well as reconcile disputes and resolve conflicts.

About 75% of India's villages have populations of less than 1000 persons (200 households) each. Thus, they readily offer manageable units. Larger Indian villages are also generally clustered into small cohesive hamlets. Hence, there can be hamlet-level people's organizations in larger villages.

At the village level, people's participation is direct rather than indirect (i.e. through elected representatives and small executive bodies). Experience shows that direct participation works better and is far more equitable, effective and less conflict-prone. This decentralization is essential for building a more meaningful democracy.

Community level organization must also be linked together on the basis of shared concerns. It would be expedient to let these basic units remain as people's organizations outside the government's statutory structure so that they would be able to effectively perform their functions of voluntary participation and vigilance.



Efficiency, equity and sustainability
To succeed, a village ecosystem and community-based, participatory resource management must combine efficiency, equity and sustainability. This implies regenerating and harnessing the natural resource base to optimize biomass production, ensure equitable sharing to meet the basic needs of the participating households and adopting environmentally sound systems of natural resource management. This will ensure environmental as well as social and economic sustainability.

Technology
As seen from various grassroots level experiences, the basic elements needed for equitable and sustainable resource management already exist in the Indian tradition. They only have to be renewed and modernized by blending them with appropriate technologies in order to enhance efficiency, productivity and sustainability to meet present and future challenges. India has adequate capability, but innovations and improvements need to be intensified and expanded to cope with the fast changes taking place in all human endeavours.

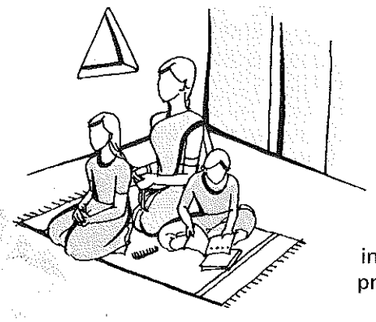
Initial investment
Adequate resources are required for operationalising community-based natural resource management. Initial investment in this regard may be raised from governmental, non-governmental, indigenous or foreign sources, but much bigger amounts may be needed. Once government policy changes in favour of community-based resource management, substantial resources will be released from the outlay of the national plan. This can be further supplemented by resources raised through NGOs. In the long-term, community will have to generate its own resources from within, in order to achieve self-reliance.

Policy support
Community-based natural resource management requires adequate policy support for smooth and speedy functioning. It also requires appropriate legislative measures and beneficial changes in official policies and programmes.

Sustained NGO support The critical role of NGOs in promoting and facilitating community-based natural resource management need not be overemphasized. The support extended by NGOs to community organizations should include capability building, technical and promotional support, raising of resources as well as effective policy advocacy. NGO support should be made available to the community organisations on a long-term basis to facilitate continuity and self-reliance. NGOs must also assist in making innovations, generating alternatives and monitoring the effects of development. Appropriate adjustments should be made in the process. NGOs also play a critical role in ensuring support from educational and research institutions.

Networking
Networking is vital for strong and healthy evolution especially to generate awareness and build up pressure for structural changes. But today adequate networking among organizations is lacking. NGOs have a critical role in promoting and facilitating networking.

Compulsions and options
Extreme ecological and cultural diversities of the country, inconceivable degradation of natural resources and rapidly increasing biomass needs for survival, pose formidable challenges. The situation can be met only by harnessing renewable energy, people's creativity and willing participation. Community-based natural resource management is the best instrument to accomplish the gigantic task.



Structural constraints
Notwithstanding the few success stories, community-based natural resource management is easier said than done because it faces structural constraints. These arise from government policies and control, centralized planning and development, inequities implicit in private ownership and control of land, and the overall social, economic and political structure. To make matters worse, the existing natural resource management system in India is archaic and alien and therefore totally inappropriate to meet the present needs and challenges, not to speak of the next century.

...watersheds and micro-watersheds, degraded commons, degraded government lands and privately-owned degraded wastelands, can serve as the threshold for community management programmes. The experience here can lead to development of holistic village microecosytem management later on

Nevertheless, there are some happy signs that can greatly facilitate community-based resource management a functioning reality. First, the Constitution (22nd) Amendment for effective democratic decentralization and Panchayati Raj in rural India is a step in the right direction. If all the States pass appropriate legislation establishing Panchayati Raj, there will be welcome changes soon. A critical issue which must be directly addressed is genuine devolution of power, responsibilities and allocation of resources to Panchayati Raj institutions. It is expected that this limited yet vital change once effected will generate awareness and facilitate genuine democratic decentralization.

Secondly, the Eighth Five Year Plan says: "In the process of development, people must operate and the Government must cooperate. " It underlines the proactive role of the people and the enabling role of the government. It seeks to rectify the existing anomalous situation. If acted upon, especially after effective democratic decentralization, it will facilitate community-based natural resource management and overall rural development through the ample resources made available to Panchayati Raj institutions.

Third, watersheds and micro-watersheds, degraded commons, degraded government lands and privately-owned degraded wastelands, can serve as the threshold for community management programmes. The experience here can lead to development of holistic village microecosytem management later on.

Lastly, a forceful lobby and sustained policy advocacy are prerequisites to overcoming structural constraints. It calls for sustained and regular NGO-government dialogue through multi-point, multi level mechanisms which still have to be created. However, drastic restructuring of the system can be effected only through empowering movements, a few of which have been discussed earlier.

Social change

Undeniably popular social movements are an integral part of the democratic process because they generate awareness and pressure to effect change. Accordingly social movements are part of the strategy to boost community-based natural resource management, especially in areas where radical changes are called for. As effectively demonstrated by Mahatma Gandhi, movements can be both peaceful and democratic. Generally speaking, there is agreement among Indian NGOs and social activists in favour of peaceful and democratic means in their struggles for change.

Multiplication and networking of initiatives will contribute greatly to quality, effectiveness and success of social movements by bringing into play the dynamics of peaceful social change through popular participation. Isolated local initiatives and social movements need to be linked to large movements to generate adequate awareness and pressure for change at the state and national levels.

Appropriate Indian framework

At this stage, it is pertinent to recall the appropriate framework for community-based natural resource management from post-independence experiences and history. The development framework must, in essence, be grounded in the traditional system, but adapted to the present needs and challenges. Thus, it would have the basic elements of community autonomy and village self-government as well as efficient, equitable and sustainable natural resource management. A deeper participatory democracy with genuine devolution of power, responsibilities and resources to people enabling them to shape their destinies is imperative. The framework must be flexible and fitted in the ecological and cultural diversities. It should be within the broader framework of a "new people-centered polity."

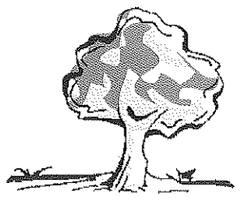
Policy and action

Policy and action on community-based natural resource management in India, emerging from the preceding discussion, especially from the NGOs point of view, are outlined as follows:

- The goal is countrywide community-based natural resource management within the "appropriate Indian framework". NGOs must work more vigorously for new policies and for restructuring the existing system in order to achieve this goal.

Strategies to achieve this goal are as follows:

- Proven NGO initiatives of community-based natural resource management should be refined and multiplied across the country in order to intensify and expand effective grassroots action.
- There should be multi-level networking of community initiatives, strengthened through a process of mutual friendship, cooperation and interaction. The networking may be at the level of district, state, zone or the country.
- Successful community-based action interlinked in multi-level networks should be used to generate awareness and pressure for effective policy advocacy.
- Where necessary, strategic networking may also be pursued for peaceful democratic struggles and social movements.
- NGOs should work with communities as promoters and facilitators. To strengthen policy advocacy, they should also push for multi-point, multi-level NGO Government mechanisms in the form of regular dialogue on community-based resource management and other development policies and issues. However, NGOs need to be united and prepared in order to be effective.
- The Constitution (22nd) Amendment which provides for effective decentralization and the Eighth Five Year Plan (1992-1997) which seeks greater proactive popular participation are among the readily available grounds for action. NGOs should work together to bring the above amendment to its logical conclusion and establish Panchayati Raj institutions in the country. NGOs should then work for proactive involvement of these institutions and people in implementing the Five-Year Plans according to local needs, priorities and perceptions.
- Community level people's organizations, Panchayati Raj institutions and local NGOs should work in tandem to intensify, refine and expand effective community-based natural resource management.
- Apart from using their own organs of communication, NGOs effective alliance with media will be extremely helpful in disseminating information and generating awareness and building up pressure for change.
- A long-term strategy of sustained development action and struggle, however, is called for.



PARTICIPATORY WATERSHED MANAGEMENT FOR SUSTAINABLE DEVELOPMENT: A CASE STUDY OF U.P. HILLS

B.L. Dhyani • J.S. Samra • Ram Babu
Central Soil and Water Conservation Research and Training Institute • Dehradun • Uttaranchal

INTRODUCTION

The Himalayas is characterized as an inaccessible, resource poor, fragile and ecologically important region with inadequate infrastructure and marginalized inhabitants. This is primarily due to uncertainties associated with the rainfed production system. Only about 20.6% of the total geographical area is cropped and usufruct rights in the reserve, civil soyam and panchayat forests contribute substantially towards livelihood and security of the people. The Himalayan ecosystem is known for several kinds of environmental externalities especially for the natural water bodies and the Indo-Gangetic plains. Open access, common property resource management for equity, minimized social conflicts, local institutions and self-sustainable resource use are being afflicted with the tragedy of commons.

The role of technical/developmental institutions is to facilitate and accelerate the interaction process on the right path by providing opportunities i.e. technical know-how, demonstration on live model, infrastructural support, people's participation and mobilization of resources after a detailed analysis of strengths, weakness and threats

The hill zone of Uttar Pradesh is a vast area (51,12,500 ha) comprising the Garhwal and Kumaon divisions. Due to high population pressure, 22.5% of the Garhwal Himalayas is under agriculture. About 42% of the area has more than 50% slope and only 19% of the total area has less than 33% slope and could technically be used for arable farming. A steep channel gradient of 75 m/km in Dhauliganga to 42 m/km in Bhagirathi (Agarwal and Narain, 1992), unscientific and non-coordinated efforts of development have yielded high erosion rates varying from 1 to 20 mm/yr for average and catastrophic storms, respectively (Valdiya, 1985). Consequently, 34.2% of its total geographical area is severely eroded and critically degraded.

Demographic pressure, ineffectiveness of state interventions and the rising trend of free riding behavior of self-centered individuals is over stretching the capacity of natural resources. Conflicts of politics, resource ownership and sharing of benefits between state and local communities are severe impediments to resource conservation. Women contribute about 75-80% to the farm labour and male migration for supplementing family income is quite common.

Development is a dynamic process which emerges with the interactions among technology, economics and sociology. Technology explores and outlines the development options with the premise of technical feasibility. Economics evaluates the viability of options within the domain of resource availability. Sociology determines the acceptability of options within the framework of culture, ethics, traditions and objectives of the society. The role of technical/developmental institutions is to facilitate and accelerate the interaction process on the right path by providing opportunities i.e. technical know-how, demonstration on live model, infrastructural support, people's participation and mobilization of resources after a detailed analysis of strengths, weakness and threats.

The Central Soil and Water Conservation Research and Training Institute (CSWCRTI), Dehradun fulfilled this role by undertaking an area development project on watershed basis at Bhaintan watershed popularly known as 'Fakot watershed' in Tehri Garhwal district of Uttar Pradesh (Fig 1). The broad objectives of this operational research project based on demonstration approach were:

- Integrated planning of the area for proper landuse and management to generate higher productivity per unit area, per unit time and per unit of resources use.
- Transfer of technology so developed in the field for improvement of socio-economic conditions of the hill population.
- Training of local people engaged in soil and water conservation and development for landuse planning in hilly terrain.
- Develop effective means to coordinate activities of research, training and developmental programmes of Central/State agencies and institutes.
- Monitoring the changes in environment as affected by changed landuse management practices.
- Identify constraints and suggest remedial measures.

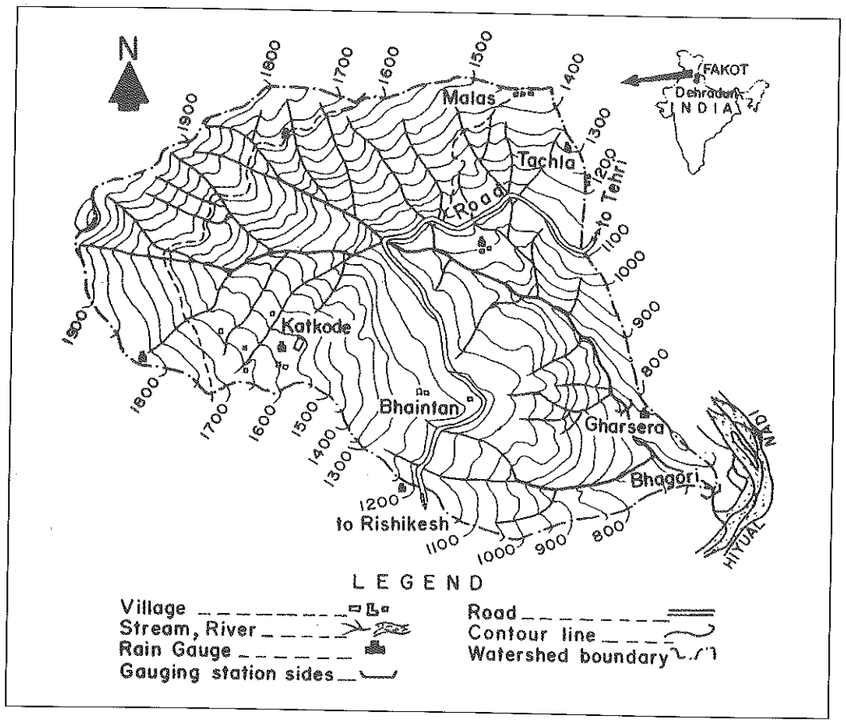


Figure 1: Fakot watershed in Tehri Garhwal district of Uttar Pradesh

EXPERIMENTAL WATERSHED

To demonstrate sustainable production through participatory resource conservation, an operational research project on watershed management in Fakot (78°20′ to 78°22′ E and 30°13′ to 30°15′ N) in Tehri Garhwal district of Uttar.Pradesh. was taken up by CSWCRTI, during 1974-75. The watershed covers an area of 370 ha with an average slope of 72% and elevation range of 650 m to 2015 m above mean sea level. The average annual rainfall in the area is about 1900 mm. The watershed forms a part of the river Hiul, a tributary to the Ganga. The watershed supported 818 human and 555 livestock population with an average productivity of 7 and 15

q/ha of arable and non-arable land, respectively. The majority of the land (92 to 98%) was not found suitable for cultivation (Table 1), however, 22% of the land was under agronomical crops. Although the watershed was suitable for horticultural crops and permanent vegetation, the baseline survey revealed that fruit trees occupied an area of 0.5 ha only. The remaining parts of the watershed were mostly covered with uneconomic bushes except some areas which were with the Forest Department. Out of 132.5 ha reserve forest area in the watershed, 34 ha was practically devoid of canopy, 15.5 ha was covered with thin canopy and only 83 ha was under moderately dense forest (Anonymous, 1978).

Table 1: Distribution of land in Fakot watershed according to two land use criteria (1974-75)

Land use criteria	Area (ha)	Percentage	Potential land use
A. Land capability class			
III	5.4	1.4	Moderately good cultivated land
IV	2.2	0.6	Fairly good for cultivation
VI	4.4	1.2	Sustainable for orchard development
VII	312.9	84.6	Sustainable for afforestation and pasture development
VIII	45.1	12.2	Suitable only for wildlife recreation
B. Slope class			
15-25	11.1	3.0	Good cultivated land
25-30	18.5	5.0	Fairly good for cultivation
34-50	74.0	20.0	Suitable for permanent vegetation
51-100	207.2	56.0	Afforestation and grass development
>100	59.2	16.0	Afforestation and wildlife recreation

Methodology

Baseline surveys (hydrology, engineering, plant, soil, land capability and detailed socio-economic) were conducted to prepare an integrated watershed management plan for the sustainable development of the watershed. By sustainable development, we mean the process which meets the needs of the present generation without diminishing productivity for the future. This, naturally called for people's participation for maintaining integrity of bio-chemical cycles. Farmers and a multidisciplinary team of experts prepared the watershed plan considering farmers, priorities in activities, approach and implementation of plans. Various soil and water conservation works were undertaken during 1975 to 1986 where farmers, participation was in the form of family labour, supply of locally available materials, FYM and crop seeds. Further, implementation of various watershed management activities was carried out by local people only so that they would understand the programme fully and carry out these activities independently in the future.

After financial withdrawal of the programme, monitoring was continued in the treated and nearby watersheds (control) to analyze sustainability of the programme. The control watershed is located 10 km away from the treated watershed. In the control watershed, various soil and water conservation works were carried out by the State Soil Conservation Department on sectoral basis. The control watershed also

A view of diversified integrated watershed management project - Fakot

represented similar physiography, aspect, soil, vegetation, socio-economic conditions of farmers and land degradation problems prevalent in the treated watersheds. Average holding size was 0.8 ha and 0.76 ha in the control and the treated watersheds. About 16 and 15% of arable area (pre-project) was irrigated in the control and treated watersheds, respectively. Area under horticulture was less than one% of cultivated area in both the watersheds (Dhyani et al, 1994).

Table 2: Watershed management works in the Fakot watershed during two phases of the project

Name of Work	Quantity of work done during	
	Active operation phase (1975-86)	After financial withdrawal (1987-97)
A. Water resource development		
Cement lined tanks (Nos.)	7 (5 new + 2 renovated)	3
LDPE lined tank (Nos.)	17	1
Cement lined Guhl (m)	2316	1150
B. Terrace Management		
Renovation of irrigated terraces (ha)	7.9	-
Conservation of rainfed terraces into irrigated (ha)	12.8	4.5
Renovation of rainfed terraces (ha)	20.0	5.5
C. Plantation development		
Horticulture plantation on wasteland (ha)	14.2	3.5
Horticulture plantation on agricultural land (ha)	7.6	2.2
Grassland development (ha)	1.5	41.0
Fuel-fodder plantation on wasteland	22.4	2.6
D. Other works		
Gully plugs (Nos.)	66	85.0*
Trail erosion works (km)	6	2.5*
Retention wall gabion (km)	2	2.2*
Live contour wattling and brushwood check dams	-	70.0
Road side erosion control (km)	1.5	5.0*

*Financial support is partly made available from Jawahar Rojgar Yojna and material support for a few structures was made available from Directorate of Border Road Organization due to cutting of road widening work.

**Financial assistance was provided by State Soil Conservation Department for material and skilled labor. Agave and napier grass is planted in this area by the farmers.

For efficient utilization of rain water, vegetation and other natural resources various soil and water conservation measures were undertaken in the treated watershed as per need of the land and priorities of the farmers. Some of these were implemented during 1975-86 by farmers with technical and material inputs from CSWCRTI and the rest of the works were carried out from their own resources (Table 2). Some of, the biological and socio-economic indicators of the watershed management programme's performance at three points of time i.e. pre-project (1974-75), during financial support of project (1985-86) and after withdrawal of the financial support (1994-97) are discussed.

Results and discussion

People's participation for sustainability of the programme

The community was convinced by the results of various demonstrations as reflected through continuing of all the watershed management activities by the farmers specially after withdrawal of financial support (Table 2). Similarly, an average investment of Rs. 1230/ha in the treated watershed as compared to Rs. 300/ha per annum to the control watershed on soil conservation works was a quantitative indicator of farmer's participation (Dhyani et al, 1994). Thus the Watershed Management Programme became self sustainable and community driven by creating awareness and bringing attitudinal change within the farming community (Dhyani et al, 1997).

Adoption of improved crop production technologies

Sample surveys are being conducted every year in the treated and control watersheds. The recent survey of 1996-97 revealed that all the farmers of the treated watershed used improved crop varieties on irrigated lands as compared to less than 30% farmers of the control watershed. In case of rainfed conditions adoption rate of improved crop varieties varied from 55 to 60% within the treated watershed while it ranged between 10-15% in the nearby untreated (control) watershed. A similar situation existed in the use of chemical fertilizers (Table 3) which helped to increase the productivity of arable lands by five to seven times.

Table 3: Percentage of farmers adopting improved crop production technology in the treated and control watersheds

Crop	Improved Seed		Chemical Fertilizer			
			N		P_2O_5	
	TW	CW	TW	CW	TW	CW
Paddy (I)	100	30	100	20	92	25
Wheat (I)	100	21	87	15	90	17
Wheat (R)	60	10	58	10	70	Nil
Maize (R)	55	15	80	10	75	10
Tomato (I)	70	15	80	30	70	20
Ginger (R)	80	40	15	Nil	80	30

TW = treated watershed, CW = control watershed, I = irrigated, R = rainfed.

Crop diversification

Persistent impressive demonstrations and effective interactive persuasion by the team of multidisciplinary experts have brought favorable changes in cropping pattern (Table 4). Area under crop production came down from 80 ha in 1974-75 to 74 ha in 1985-86 and declined further to 72 ha in 1996-97. The corresponding figures for area under millets were 41, 35 and 24 ha, respectively. Land use pattern further indicated that farmers tried to put maximum irrigated area under paddy and wheat during project period (1975-86). Cultivation of cash crops continued to increase at a much faster rate after withdrawal of financial support to the farmers. In cash crops too, the area under low value crops e.g. potato, Ramdana (Amaranthus spp.) decreased from 3.6 to 0.6 ha, whereas the area under high value crops e.g. tomato, ginger, chillies, oilseeds and pulses increased from 4.1 ha in 1974-75 to 17.5 ha in 1985-86 and rose further to 31.1 ha in 1996-97. This generated handsome incomes to the farmers beside improving the quality of their daily diet. Further, this brought a change in the attitude of the farming community in the use of other farm and natural resources.

Table 4: Crop diversification in the treated watershed during various phases of the project

Crops	Area under each crop (ha)		
	Pre project (1974-75)	During financial support (1985-86)	After withdrawal of financial support (1994-95)
NET CROPPED AREA	79.9	74.0	71.6
Cereals			
Paddy (I)#	11.8	23.5	22.6
Paddy (R)	13.3	6.0	Nil
Maize (R)	0.6	6.5	8.0
Wheat (I)	8.8	18.5	21.5
Wheat (R)	27.8	30.6	19.5
Barley (R)	9.2	6.5	4.5
Sub Total	**71.5**	**91.6**	**76.1**
Millets			
Jhingora (R) (Paspalum scorbiculatum)	20.8	15.5	9.5
Mandua (R) (Eleusine corecane)	20.6	13.2	9.5
Cheena (I) (Panicum milliaceum)	Nil	6.5	4.5
Sub Total	**41.4**	**35.2**	**23.5**
Cash Crops			
Pulses (R)	31*	11.0 (3*+8)	8.5 (5* + 3.5)
Ramdana (R) (Amaranthus spp)	0.2	Nil	Nil
Oilseeds (R)	0.2*	1.0	3.0
Chillies (R)	0.6	2.0	4.5
Potatoes (I)	3.4	0.2	0.6
Ginger (R)	0.2	2.5	9.0
Peas (R)	Nil	0.5	2.5
Tomato (I)	Nil	0.5	3.6
Onion + Garlic (I)	0.1	1.5	2.5
Lady finger	Nil	0.5	1.0
Sub Total	**7.8**	**19.7**	**35.2**

#I = irrigated, @ R = rainfed, * grown as mixed crop.

Resource use diversification

Land, livestock, human and capital are the major resources of an agrarian community. The development of the farming community depends on the combination pattern of resource use at the farm level. The extent and composition of their use in the watershed at three points of time of watershed development is presented in Table 5.

Perusal of data in Table 5 reflects many interesting patterns in the resource allocation. In case of land resources, the area under horticulture increased from 0.5 ha in 1974-75 to 21.8 ha in 1985-86 and 25.3 ha after withdrawal (1994-95). Area under fuel, fodder and grasses in the community managed land (Civil Soyam) increased from almost nil to 22.6 and 28.5 ha during the same period. The land under horticulture, fuel and fodder was diverted from wasteland and rainfed agriculture use. Therefore, there was a reduction in the area under these categories of land uses. Livestock increased in the watershed to a maximum in 1988-89 but declined slightly after the financial withdrawal. The noteworthy feature was a drastic and favorable shift from low quality animals (cow) to improved buffaloes. As a result, grazing became unsuitable and stall feeding became common. Good grasses were developed in the grazing lands and this increased total milk production in the watershed.

Table 5: Resource use diversification in the treated watershed during various phases of the project

Resources	Pre project (1974-75)	At the end of financial support (1985-86)	After withdrawal of financial support (1994-95)
A. Land (ha)	370.0	370.0	370.0
Net cultivated area	79.9	74.0	71.6
Gross cropped area	120.7	146.5	134.8
Cropped intensity (%)	151.0	198.0	188.3
Orchard plantation	0.5	21.8	25.3
Fuel, fodder & grass plantations	Nil	22.6	28.5
Waste land	157.1	126.8	112.3
B. Livestock composition (nos.)			
Cow	68	40*	6
Sheep and goats	250	272*	35
Buffaloes	109	289*	350
Bullocks	128	212	238
Total	555	813	629
C. Human Resource work force (nos.)			
Seasonal migrant	47 (26.7%)	23 (9.3%)	2 (0.7%)
Own farm employment	116 (65.9%)	206 (83.4%)	256 (93.4%)
Service	14 (8.4%)		

The available work force in the watershed increased from 177 to 247 during 1985-86 and further increased to 274 in 1994-95 (after withdrawal). The significant achievement of the watershed management programme was a sizeable reduction in the number of seasonal migrants from the watershed. The number of seasonal

migrants from the watershed reduced from 47 (26.7%) in 1975 to 23(9.3%) in 1985-86 and 2(0.7%) in 1994-95. It was possible mainly through the development of horticulture and off-season vegetable cultivation beside intensive use of land and adoption of improved crop production technology. Use of capital inputs in the form of chemical fertilizers also registered a 10 to 13 times increase which helped to boost agricultural production.

Economics

Economic viability of various soil and water conservation works carried out in the watershed till 1988 was worked out utilizing 14 years processed data, considering 25 years project life and 10% discount rate (Table 6). The overall benefit cost ratio of the whole project worked out to be 1.93 which is quite favorable. Relative contribution indices of each sector for overall feasibility of the project i.e. cost effectiveness (last column) in Table 6 indicated that irrigated agriculture was most rewarding followed by horticulture whereas fuel-fodder sector was least efficient in making the project economically viable. Overall, the investment on soil and water conservation works on watershed basis for management of degraded natural resources and balanced development of Garhwal Himalayas was found to be an economically sound and socially acceptable proposal.

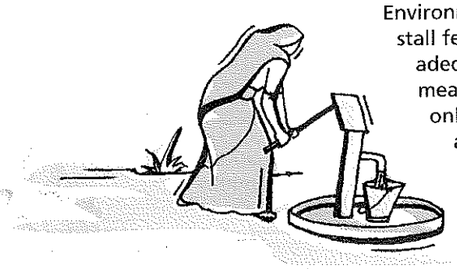
Table 6: Economic viability and cost effectiveness of treated watershed

Sector	Present Value (000 Rs.) at 10% discount rate				NPV* (000 Rs)	Benefit cost ratio	Cost effectiveness
	Costs	Per cent	Benefits	Per cent			
Rainfed agriculture	133.9	27.1	237.7	24.9	103.8	1.74	0.90
Irrigated agriculture	109.4	22.1	234.5	24.6	125.0	2.14	1.11
Orchard plantation	200.5	40.6	399.2	41.8	198.8	1.99	1.03
Fuel-fodder plantation	50.5	10.2	82.9	8.7	32.4	1.64	0.85
Total	494.3		954.3		459.9	1.93	

* NPV = Net Present Value.

Production and protection impact

The watershed management programme adopted in Fakot has yielded many tangible and intangible benefits. The tangible benefits were increased quantity of utility products e.g. crop, milk, fruit and cash income in the watershed.



Environmental benefits were easing the burden on reserve forests by following stall feeding, reduction in runoff and soil loss from the watershed owing to adequate vegetative cover and was well supported by a series of mechanical measures (Table 7). The integrated watershed management programme not only increased the grain production by more than four to six times but also diversified the farming activities. Fruit production which was almost absent before project initiation reached 189 quintals during 1985-86 and further increased to 2015 quintals after withdrawal of financial support (1994-95). Similarly, a shift from the low yielding local cow to

high yielding buffaloes helped to boost annual milk production from 57 thousand litres (1974-75) to 185 thousand litres in 1988-89 and 260 thousand litres in 1994-95. Consequently, the quality of daily food intake improved and generated 10 and 80 times more income in 1985-86 and 1994-95 as compared to the base year. Adequate vegetative cover reduced dependency for fodder on reserve forests from 60% in the base year to 40% in 1985-86 and declined further to the level of 20% after the financial withdrawal. Runoff and soil loss data from the watershed also showed a significant reduction during the same period and rates were within the permissible limits. A higher level of productivity of all the resources at farm with the improvement or enhancement in the soil health, labor, capital and environment on a sustained basis indicated balanced and equitable development.

Table 7: Production and protection impact of watershed management programme

Crops	Pre project (1974-75)	During financial support (1985-86)	After withdrawal of financial support (1994-95)
A. Food crops (q)			
(i) Cereals + millets	683.3	2848.1	2610.0
(ii) Pulses	14.0	138.2	253.6
(iii) Oil seed	Neg.	8.5	30.5
(iv) Vegetables	71.6	980.5	2070.0
(v) Spices	53.0	208.3	730.5
Total	**881.8**	**4183.6**	**5694.6**
B. Fruit (q)	Neg.	189	2015.0
C. Milk (000 lit.)	56.6	184.8*	260.8
D. Income from sale of cash crops (000 Rs.)	6.5	62.2	525.5**
E. Animal rearing method	heavily grazing	partially grazing	stall feeding
F. Dependency on forest for fodder (%)	60	40	20
G. Runoff (%)	42	15	130
H. Soil loss (t/ha/annum)	11.1	2.7	2

* Figure relates to 1988-89
** Figure relates to 1995-96 and community diversified into horticulture from 1994.

Drought Mitigation

One of the objectives of the watershed management programme was to provide resilience in production against unfavorable weather conditions. It was more important in hill agriculture where more than two-thirds of arable land is rainfed. The region witnessed a severe drought in 1987. During this year, total rainfall in the watershed was 44.5% less than the long term average of the previous records. The reduction in the monsoon (July to September) rainfall was about 58%. Further, there were 4 dry spells of more than 15 days in the season. The whole region faced acute shortage of water in sowing crops. A significant decline in the production of food grains and fodder was expected.

The impact of the watershed management programme in mitigating drought was quantified in terms of net sown area, productivity or arable land and non-arable land as compared to the control watershed. The data collected from the experimental and control watersheds in 1987 are presented in Table 8. Various soil and water conservation measures adopted in the Fakot watershed helped farmers sow a large percentage of their arable land (96%). On the other hand, outside the watershed there was 18% reduction in the net sown area. The reduction in average productivity of arable land was only by 5% in the Fakot watershed as compared to 40% outside the watershed. Productivity of non-arable land was worst affected by severe drought in the district. However, small water harvesting structures (trench, pits, gully plugs, vegetation, check dams etc.) adopted in non-arable land in the watershed helped to produce good fodder. There was only 7% decline in the production of fodder within the watershed as against 80% outside the watershed. From the analysis it is clear that sustainable production from arable as well as non-arable lands could be obtained from treated watersheds even in a climatically unfavorable year.

Table 8: Performance of Fakot watershed during the drought of 1987

Indicators	Reduction (%)
Rainfall (mm)	44.5
Rainy season rainfall (mm)	58
Net sown area inside watershed	4
Net sown area outside watershed	18
Average crop yield inside watershed	5
Average crop yield outside watershed	40
Average yield of fodder inside watershed	7
Average yield of fodder outside watershed	80

Constraints

Fakot watershed is situated in a hilly terrain having ruggedness number 13.85 with dendritic drainage pattern. Therefore, all the constraints like inaccessibility, marginality and fragility are encompassed in the process of watershed development. Weak community organization, poor infrastructural facilities and lack of proper legislative support are the other major constraints. Watersheds have a large variation in micro climate owing to elevation difference and require a wide range of technologies to suit micro-agroclimatic situations. Available technological interventions are limited due to poor research efforts.

Farmers are poor and have little investible resources. Their primary goal is to meet their food requirements rather than environmental conservation. They try to cultivate marginal lands without proper land management practices. Out-migration of male workforce to the plains in search of gainful employment left women to perform all activities. Women are less educated, shy and introvert and posed problems in dissemination of technologies and creating awareness. Watershed management technology adoption is limited further by fragmentation into tiny holdings. A high number of uneconomical animals, overgrazing and usufruct right of people on reserve forests are the major impediments to the management of Civil Soyam land in the watershed. Poor financial support and absence of post harvest processing technologies hampered the progress in adoption of high technology commercial agriculture in the watershed.

CONCLUSIONS

Out of 23,37,000 ha area of the Garhwal Himalayas, 79,887 ha (34.2%) is severely degraded. For prosperity of people living here and in the lower reaches, immediate efforts are warranted to rehabilitate the watersheds. Operational research project on watershed management - Fakot (Tehri Garhwal) developed on demonstration basis by CSWCRTI, Dehradun clearly brought out that balanced and sustained development in the region is achievable with available technology, provided it is planned and implemented with people's participation. The watershed management programme adopted at Fakot brought about a favourable, self sustainable, economically viable, socially acceptable and environmentally desirable resource use pattern in the watershed which can take care of the unpredictable conditions. Water harvesting, storage, recycling and active participation of the local community were the main factors behind the improvement in the condition of the watershed and its inhabitants on a sustained basis.

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