INTEGRATED PARTICIPATORY WATERSHED DEVELOPMENT

A Study Of The Manhere Watershed Of Maharashtra

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Introduction

India is one of the countries affected by serious and vast land desertification. These areas are characterized by severe ecological degradation with uncovered forests and poor protective vegetation cover causing soil erosion and decline in the productivity of the land. The water table recedes causing shortage of water for irrigation and drinking purposes. An increase in human and cattle population adds to the huge pressure on the existing fragile ecosystems.

About 70 percent population of India is dependent on natural resource - land, water and forest; base activities such as agriculture, animal husbandry, and forestry for its livelihood. Over a period of time, owing to degradation of natural resource, rural employment opportunities diminish. It has been found, that yield rates of agriculture production are going down and fodder, fuel and other minor products are becoming scarce. Employment generation in the secondary and tertiary sectors of the Indian economy is not able to absorb the additional urban labour force, and thus the scope of the rural workforce for finding gainful employment in the urban sector is severely limited. It is therefore essential to regenerate rural natural resources, which can produce enough to create employment opportunities for the rural population.

After independence, the Government of India has made efforts to generate employment for rural people, mainly through three types of programmes: land reform, self-employment in the non-agricultural sector and wage employment. However these programmes were not targeted to improve productivity of natural resources and therefore has not resulted in sustained increase in rural income.

Approximately 170,000 hectares of land in India is classified as degraded. Long term experiments by a number of research organizations in India in the 1970s and 1980s confirmed that introduction of appropriate physical barriers to soil and water flows, along

with revegetation, could generate considerable increases in resource productivity and ensure food security and environmental safety. Realizing the importance of development of natural resources, the Government introduced development programmes like social forestry, soil conservation, land shaping and development, pasture development, and water conservation. But due to lack of integration, these programmes did not yield the expected results. Thus formulation of a number of projects, schemes and programmes in support of micro-watershed development found great favour and encouragement.

In 1990 the national water shed development programme for rainfed areas was introduced to coordinate and integrate the development of all natural resources. In this programme participation of people was ignored, therefore it remained a government programme alone and the structures developed by the government agencies could not be sustained for a long period. It probably failed to integrate people with the overall physical scenerio.

In 1995 based on the findings of Hanumant Rao Committee, the Integrated Watershed Project was introduced. The basic objective of this project is to develop micro-watershed, keeping land capability, site condition and needs of local people in mind. People are the focus in this programme. The emphasis is on the treatment and development of an entire compact micro-watershed, rather than pieces of wastelands or croplands scattered in different places within an area. Top to bottom treatment of watershed through various techniques can help significantly to improve the present state of land and water resources and, in turn, forest and grazing lands.

Components of Watershed Development

A watershed can be defined as the drainage basin or catchment area of a stream or river. In other words, it refers to the entire upstream topography around a defined drainage channel, which feeds water to the lower stream. Watersheds of small streams are the sub-watersheds of the watershed of a larger stream. A watershed may be nearly flat or may include hills or mountains. The size of the watershed varies from a few hectares to thousands of hectares.

Micro-watersheds are generally defined as falling in the range 500-1000 hectares. A mini-watershed comprises a number of micro-watersheds and covers around 5000 hectares. A

macro-watershed is equivalent to a river basin and may encompass many thousands of hectares (Farrington et al., 1999)

The original concept of watershed management focused on the management of medium and large valleys that would prevent rapid runoff of water and so would slow down the rates of siltation of reservoirs and limit the incidence of flooding in river courses. Managing watershed for rural development is a relatively new concept. It focuses on soil, water and vegetation with enhancing the productivity with ecological and institutional sustainability. Thus watershed development refers to the conservation, regeneration and judicious utilisation of all the resources: land, water, vegetative, animal and human. Watershed development seeks to bring an optimal equilibrium in the eco-space/ natural resources, human beings, and grazing animals.

Watershed development is thus a multi-sectoral, multidisciplinary approach that involves continuous interaction and exchange between and amongst various sectors and disciplines.

Wherever ecological degradation occurs, erosion in the quality and substance of life of the human community within that ecosystem also occurs. Because of degradation of forests and pasturelands, soil erosion increases. Along with the top soil nutrients also flow away. Increase in soil erosion results in decrease in depth of soil and in turn decreases water retention capacity. This results in decrease in land fertility and ultimately agriculture production. In addition, deterioration of land results in decrease in the availability of fodder for animals. Agriculture, animal husbandry and collection of forest products are the main occupations of the rural people. Degradation in their productivity severely affects the rural economy. It has a direct impact on availability of enough quantity and nutrition value of food. Nutrition deficiency reduces resistance power of people against diseases. Thus ecological degradation results in erosion in the quality of life of people.

Hence, it is advisable to treat a whole micro watershed collectively rather than treating single fields. Collective action of farmers treating a whole micro watershed can enrich the soil of the area and can increase availability of water. Individual efforts of a farmer for treating a micro watershed will have a limited effect unless all farmers whose fields are located on the same slope treat their land collectively and progressively from top to bottom. If a farmer whose field is located in the middle of the slope treats her/his field,

but the farmers at the top and bottom do not treat their lands, the high flow of water from upper fields can damage the treated field located down the slope.

The world over, many examples can be found where watershed treatment has helped in decreasing soil erosion and improving the quality of land through increase in the depth of soil and ground water table. The efforts of Anna Hazare in Ralegaon Siddhi of Maharashtra in 1978 and P. R Mishra the then Director of Centre for Soil and Water Conservation Research and Training Institute, Sukhomajari village, located in Shivalik hills near Chandigarh in 1975 are classic examples of collective action of people for treatment of watershed. In a period of twenty years the scenario of the villages has changed and they have become self-sufficient in food, fuel, fodder and water.

As a result of soil and water conservation carried out by the Aga Khan Rural Support Programme (India) through village institutions in about 250 villages of Bharuch, Junagadh and Surendranagar districts of Gujarat with contour bunds and gully plugging, yields of millet, paddy, wheat, pigeonpea, groundnut and cotton have gone up by 20 to 40 percent.

The Integrated watershed development programme was introduced by the government of Rajasthan in 1991 through participatory approach. The technologies include strip of vetiver and other grasses on the contour; contour bunds and contour cropping; field bunds; drainage line treatment; and regeneration of common lands with shrubs and trees. As a result of such a treatment yields of sorghum and millets have increased from 400 kg per hectare to 875 Kg per hectare (Krishna, 1994).

A comprehensive study of soil and water conservation activities in Machakos district in Kenya has shown that even though there has been a three-fold increase in population in this district since 1945, net imports of maize to the district have fallen from 17.4 to 7.6 kg per capita, because of increased production of maize within the district. (Tiffen et al., 1993). More conservation has led to increases in agricultural yields and the diversity of crops grown. Land that was severely degraded in colonial times is now intensively and sustainably managed. Conservation has led to increase in agricultural yield and the diversity of crops grown. Land that was severely degraded in colonial times is now intensively and sustainably managed. On the Mossi plateau in Burkina Faso, watershed project was introduced in seven villages in 1988 and this has expanded to cover over 200

villages by the Government with the support of GTZ. The work was carried out through local government and non-government institutions. The main technologies adopted have been permeable dams, stone bunds, protected zones for regeneration, composting and increased use of manure. The impact on the yield is immediate with sorghum yields increasing from 870 kg. per hectare to 1650-2000 kg per hectare.

BAIF is one of the prominent NGOs, who is involved in the rehabilitation of watersheds. BAIF has adopted an integrated approach while promoting sustainable development considering the resource poor family as the unit. While undertaking watershed development, BAIF ensures that all families settled in the catchment would be benefited and their land would be treated for soil and water conservation and brought under productive vegetal cover. The programme aims at the development of degraded wastelands through promotion of tree-based farming system, with watershed development as an integral component. While steep, sloppy and shallow lands are conserved with grass cover, marginally productive and barren lands are used for developing agri-horti-forestry crops (Kakade and Hagade, 1998).

Watershed development consist of five components:

- Area Treatment (Soil Conservation)
- Drainage Line Treatment (Water Conservation)
- Biomass Development
- Animal Resource Development
- Human Resource Development

Area Treatment

The name itself implies that treatment is to be done on the land that may be cultivated or uncultivated. Normally under area treatment, contour bunding, graded bunding, contour trenching, staggered contour trenching and terrace bunds are covered. Most of these are designed to check the surface flow of water and thus perform the dual role of water harvesting and retention. In high rainfall zones, only contour trenching is proposed. Contour trenches act as barrier to the surface runoff. This runoff water gets accumulated in the trenches and percolates into the soil. Water entered into the soil increases the level

of groundwater table. On the other hand, the accumulated water in trenches deposits the silt carried with it, which collectively results in reduction of soil erosion.

Drainage Line Treatment Works

Where rainfall is unreliable and inadequate, water shortage severely limits crop production. Water conservation and harvesting can make crops survive during the dry period and in turn can stabilize and increase production. In rural India, drinking water becomes scarce during summer and at times in winter. During drought the situation gets worse. In India, 80 percent rain fall is received in four months of monsoon. If the water is not conserved during this period, water becomes scarce during rest of the year. At micro level drainage line treatment is done through gully plugging, dry boulder bunds, gabian structures and check dams.

Gully plug

Gully plugs are basically soil conservation measures. These structures are constructed where the average slope is less than 10 percent. The main purpose of gully plugs is to check runoff velocity and soil. In this technique stones, wood or soil are placed across gullies or valleys, so as to capture nutrient silt and moisture. These materials are often bedded into the upper surface of spillway aprons and walls to provide support for the next layer. The principle is to capture runoff from a broad catchment area and concentrate it in a reduced area. Thus transforming meager rainfall into utilizable soil moisture element. As water flow slows, any suspended debris is deposited, helping to form organic-rich soils. A well-maintained silt trap creates flat, fertile and moist fields. Crops on these fields can be grown which may be of higher value than field crops on nearby dry lands. In the working area of AKRSP in Bharuch, [due to gully plugging]a thick layer (9”-18”) of soil was deposited in these streams, due to gully plugging which made it suitable for cultivation. Farmers use reclaimed gullies for growing high value crops like cotton, gram, wheat and paddy (Khanna, 1997). Gully-plugs can be made of stone, earth, wood etc.

Dry boulder bund

These are the medium size bunds and are made up of loose boulders. These structures were constructed across large gullies. The main purpose of this type of structure was to arrest the runoff water and catch eroded soil particles thereby reducing the velocity of water and reducing /controlling further erosion.

Gabion structure

Gabion structures are similar to dry boulder structures, except that a chain link is used in tying the boulders. These structures are constructed across gullies to check soil erosion resulting from heavy runoff. Body of loose boulder structure is tied with the help of chain links to make the structure compact **.** This structure is suitable where there is threat of over turning, due to high runoff.

Check-dams

Check-dams are low cost dams, which are built across streams to harvest rain water. Their capacity to conserve water varies from 0.01-0.1 mcft (million cubic feet). They are primarily built for two purposes: to provide direct irrigation for rabi and kharif crops, when the rains fail and to facilitate the recharging of surrounding wells through percolation of water. In Addition, check dams provide water for other uses such as drinking, bathing, washing clothes and animals.

Biomass Development

The grass, shrubs and trees that are planted on the contour can protect the soil and provide fruit, fodder, fuel-wood and timber. Trees and bushes with nitrogen –fixing capability have a beneficial effect on plants growing along with them or after them. Significant quantity of nitrogen can also be supplied by the leaf litter or from deliberate pruning. Trees further improve the micro-climate by acting as windbreaks, by improving the water-holding capacity of the soil and by acting as shade trees for livestock – thereby focusing the deposition of manure (Pretty, 1995). Looking at the importance of biomass improvement, tree and grass plantations have become the main activity of watershed

development. This activity is carried out under reforestation, afforestation, agro-forestry and agro-horticulture.

In reforestation, forestland (government land) having less than 75 percent plant population is planted with trees treated with the help of the Forest Department. Land having more than 30 percent slopes is selected for this treatment. On one hectare of land activities like excavation of 1000 running meter contour trench and planting of 1000 forestry plants are carried out. Forestry plants cover fruit, fuelwood, fodder and timber species.

This treatment is similar to reforestation. The only difference is that this treatment is carried out on private or community land. Land having 15-30 percent slope is considered for this type of treatment. On one hectare of land activities like excavation of 525 running meter contour trench and plantation of 525 forestry plants are undertaken. Forestry plants cover fruit, fuelwood and fodder and timber species. In addition to the plantation, the grass seeding is done to develop the pasture lands. For developing pastures grass varieties such as Styalo- Hemata, Styalo and Scabra are used.

This activity is taken on barren land having slopes up to 15 percent. Under this treatment, planting of fruit plants forms the main activity. The main intention is to generate additional income source through horticulture.

Animal Resource

As soil and water quality and quantity improve the availability of fodder increases. This gives opportunity to improve the productivity of livestock. Livestock productivity can be improved through better breeding, feeding and health practices. On an average, production of milk can be increased upto 2400 litres per cow per year. Livestock can become an integrated part of the watershed ecosystem. When plantations in watersheds become mature, only weeds can survive under them. It is expensive to control this through human labour. Here goat and sheep rearing is an advantage since not only is weed growth kept under control, an additional amount of rich manure is availed. An increase in the number of good quality animals, leads to a large scale availability of dung for organic manure, which further contributes to enriching the fields in the watershed.

Human Resource Development

All development programmes remain meaningless and are unsustainable if people are not developed. People's institutional, socio-economic and technical skills should be developed in order to use such improved resources or infrastructure efficiently. Past experience indicates that majority of government development schemes remained underutilized or did not yield expected results because they were either not planned with people's participation or were of people friendly.

Involvement of the people for whom the development projects are designed should be mandatory. People should be involved at all stages such as planning, implementation and management. Existing local genius should be valued and their skill and knowledge for participation in such projects need be improved.

In watershed development programmes, human resource development is an important component. Formation of people's institutions and working through these institutions at all levels, involvement of women through formation of Self Help Groups, and introduction of income generating activities are some of the activities undertaken to develop human resources.

BAIF Development Research Foundation is a non-government organisation working for rural development for more than 30 years. At preset BAIF is working in the eight states: Maharashra, Madhya Pradesh, Gujarat, Rajasthan, Uttar Pradesh, Uttaranchal, Karnataka, and Tamil Nadu. In Maharashtra, BIAF has developed more than nine thousand hectares under the watershed development programme since 1993. Professional efficiency in technical work and active participation of people have made BIAF's efforts more sustainable. The Manhere watershed development programme is one of the successful integrated development programmes of BAIF. The watershed is located in Akole taluka of Ahmednagar district of Maharashtra. It is the general impression that the approach to development of Manhere watershed helped in improving the quality of life of people through development of natural resources. To test the authenticity of the statement, a systematic study in February 2001 was carried out with the staff members of BAIF.

The overall objective of the study is to assess the impact of the watershed programme on natural resources (land, forest and water), livestock and human resources development.

Project Area

The Manhere watershed development project comprises four villages namely Manhere, Titvi, Ambevangan and Titvi in Akole Taluka of Ahmednagar district. The project area is situated between longitude $73^0$45' East & $73^0$55' East and latitudes $19^0$30' North and $19^0$40' North ranging from 600 to 1200 m above mean sea level. The area lies in the Deccan Trap region and forms part of the *Western Ghats* mountain range. *Kalsubai*, the highest peak of the Western *Ghats* is only about 5 km from the project area. About 99 percent population of the area is tribal. *Mahadev Kolis* and Koli *Thakurs* are the prominent tribes of the area. The project area lies in the tropical zone and receives all of its annual precipitation from the southwest monsoon. Annual rainfall varies from 1600 mm to 2500 mm. In spite of high rainfall, the area faces acute water scarcity in summer, the reasons for which are heavy runoff and hydrological properties of the bedrock. Most of the water sources available in the area are seasonal. There was hardly any area under year-round irrigation before this project began. Agriculture fields on the bank of the river Pravara and its tributaries were provided irrigation after the monsoon when there was water flowing in the nallahs. Major crops in the area were Nagali (a local coarse grain) , and Varai(a local coarse grains), Paddy, Wheat, Gram and Pulses.

Problems of the Area

Prior to Watershed Development; rainfall over high slope areas caused heavy runoff and low percolation of water in soil. Such runoff resulted in soil erosion. Continuous erosion caused degradation of soil, which further reduced the productivity of soil.

This area was once densely forested. But due to heavy deforestation, it got denuded and very little vegetation cover was left in the watershed area.

Locally grown grasses and crop residues, mainly paddy straw, met requirements of fodder. As paddy straw was also not available in sufficient quantity, the tribal people were forced to let loose their cattle and livestock for grazing. Apart from the environmental

hazards, grazing and browsing reduced the productivity of livestock, because physical energy got spent in search of fodder. The tribals reared the 'Dangi cow',a special local breed for agriculture and transport. Average milk production per lactation was 180 – 210 litres. There were no crossbred cows in the watershed area. Production of milk was largely seasonal, restricted to about four months in a year from October to January. During these four months milk was collected for the dairy. Daily milk collection in Manhere was about 200 litres.

Project Activities:

The watershed area was treated systematically from the upper to the bottom reaches with active participation of the people. A total of 1897 hectare land has been developed through various watershed treatments. The work was carried out in six years from 1993 to 1999 and has benefited 3200 people of the area. Activities carried out in the area are given below:

Table1: Watershed Development Activities in Manhere

Activities	Work Done (area / nos.)
1. Area Treatment	
Reforestation	118 ha
Afforestation	261 ha
Grass land with trees	516 ha
Agro-horticulture	375 ha
Terrace bund improvement	492 ha
2. Drainage Line Treatment	
Gully plugging (nos.)	7564
Dry boulder structure (nos.)	121
Gabion structure (nos.)	91
Check dam (nos.)	8

Source: BAIF records

The project helped to improve the capability of land as well as developed water resources. An effort was made to develop human resources through formation of village

institutions like watershed committee and Self Help Groups (SHG) of women. At present one central watershed committee with 15 village members (11men and 4 women) four village watershed committees and 18 SHGs with 242 women members are actively working in the area. One women's group named Sanyukt Mahila Samiti has been formed for carrying out employment generating activities such as: pickle making, vegetable production, poultry and dairy farming.

Table 2: Institutional Development

People's Organization	Number	Institution's fund/Savings (Rs.)
Village Watershed Committee (VWC)	4	249709
Central Watershed Committee (CWC)	1	860200
Self Help Group (SHG)	18	119648
Sanyukta Mahila Samiti (SMS)	1	741000

Source: BAIF records

Relevance of the Study

The watershed project was completed in 2000. One can assess the positive impact of the programme on the basis of demand for development of watersheds from people in the non-treated area. In the field of development, people are the best judge for assessing the impact of any intervention. This study will help the organisation in deciding future policy for replicating this programme. This information can be shared within an organisation with other sister concerns of BAIF as well as other organizations (government/non govt.) This study can also be useful for scientists and academicians for developing improved technology or carrying out further research.

Methodology

Sample surveys and participatory monitoring methods were used in this study. A survey was carried out through stratified proportionate sampling method. A sample of 640 beneficiary households was selected from all the four villages: Manhere, Ambevangan, Titavi and Kodani. From each village approximately 20 percent sample beneficiaries were

selected. For comparison, 15 non-beneficiary families from each village were also surveyed. Ideally the same number of beneficiaries and non-beneficiaries should have been selected for the study but since the majority of families have benefited from the project, it was difficult to get non-beneficiary samples. Sample beneficiaries were selected on the basis of treatments such as afforestation, grass land with trees, agro-horti-forestry, terrace bund improvement, gully plugging, dry boulder structures, gabion structures and check dams. Non- beneficiaries were selected from village Kodani where 50 percent of the village area falls under Manhere watershed. Secondary information was collected from BAIF and government records.

Findings of the Study

Increase in Water Ground Water Level

Because of watershed treatment, quantity of rainwater conserved increased. In PRA exercise people indicated that water retention capacity of their fields has improved. Now, their crops can survive for 10 to 15 days during a dry spell. They also indicated that the level of ground water has increased. Now, throughout the year, there is water in their wells. Table 3 shows that in 1993 with 1628 mm rainfall, wells in Ambevangan and Titavi villages were dry in May and in Manhere village the water table was only one meter. The years 1996 and 1997 were high rainfall years, but during these years water level in the wells was lower or same as in 2000, when the rainfall was only 1610 mm. The project was completed in 2000 and by this time the structures started functioning effectively. In 2000 rainfall was lower than that in 1993, but water level in the wells was quite high.

Table 3 : Year wise, Rainfall (in mm) and Water table (in meters) in month of May

Village	Year Wise Rainfall (In mm) & Water table (In summer)			
	1993 (rainfall 1628 mm)	1996 (rainfall 2940 mm)	1997 (rainfall 2304 mm)	2000 (rainfall 1610mm)
Ambe'gan (water table)	00.00 mts	0.80 mts	0.77mts	1.30mts
Titvi (water table)	00.00 mts	0.60 mts	0.80 mts	0.70 mts
Manhere (water table)	1.00 mts	1.25 mts	1.25 mts	3.00 mts

Source: field work, 2000

Improvement in Soil Fertility

Watershed treatment in the project area has resulted in an increase in the fertility of land owing to deposition and improvement in water retention capacity of soil. Increase in land fertility can be assessed from wasteland becoming suitable for cultivation and single cropped areas being converted into double-cropped areas. 17.03 (19%) hectares wasteland of the total 88.03 hectare covered under the watershed treatment became suitable for cultivation and 13.06 hectares (23.6%) of single cropped area was transformed into double-cropped area. The farmers reported improvement in soil fertility through following indicators:

- 75 percent farmers said that because of the treatments, water retention capacity of soil has increased.
- 83 percent farmers indicated that soil deposition has taken place in the trenches.
- 13 percent farmers said that because of the treatments, their requirement of number of irrigations in rabi has decreased.

Table 4 indicates that use of chemical fertilizers and high varieties of seeds have increased, which is a result of improvement in the quality of the soil and availability of water. Chemical fertilizers do not respond positively without the availability of adequate water. Increase in use of chemical fertilizer is an indicator, indicating increase in availability of water for irrigation. Use of improved seeds also indicates that farmers felt that the quality of land had improved and therefore felt confident about positive results through use of hybrid seed varieties. This reflects their confidence that their expenditure on inputs would not be wasted.

Table 4: Change in Use of Seed and Fertilizer

Agriculture Inputs	1993	2000
Per hectare expenditure on seeds (in Rs.)	60	326
Per hectare expenditure on chemical fertilizer (in Rs.)	44	577
Per hectare use of chemical fertilizer (in Kg)	5	60

Change in Cropping Pattern

The cultivated area of all sample farmers is 276 ha. On the basis of the study, it has been found that to some extent the cropping pattern has changed from low economic value crops: nagali and varai (local coarse grains) to high economic value crops such as paddy, wheat and pulses. Table 5 shows that the area under nagali and varai went down by 27.7 percent from 1993 to 2000, while the area under paddy, wheat and pulses increased by 34.1 percent during the same period.

Table 5: Change in Cropping Pattern (Area in Ha.)

Crops	Cultivated area (in ha.)		Change in percentage
	1993	2000	
Nagali	26.97	18.32	-32.07
Varai	15.70	13.38	-14.78
Total decrease	**42.67**	**31.7**	**-27.7**
Paddy	69.50	99.00	42.45
Wheat	20.22	25.01	23.69
Gram	16.41	19.52	18.95
Other	18.55	23.71	29.54
Total Increase	124.68	167.24	34.1

Source : field work 2000

Increase in Crop Intensity

Table 6 shows that area under cultivation increased by 9.06 percent from 1993 to 2000 and 23.67 of percent single cropped (kharif) area started taking double crops (kharif and rabi). Gross cropped area has increased by 12.38 percent . Increase in cropping intensity indicates improvement production capability of land. If the structures are maintained properly , capability of land may improve many fold.

Table 6: Change in Cropping Intensity

Cropping Intensity	Area (in ha.)		Change in Percent
	1993	2000	
Single Cropped Area	187.97	205.00	9.06
Double Cropped Area	55.18	68.24	23.67
Gross Cropped Area	243.15	273.24	12.37

Source: field work, 2000

Increase in Biomass

Table 7 indicates that on sample farmers' land of 276 hectares, the number of trees has increased three times in seven years. In 1993 number of trees were 36281 (131 trees/ha) while in 2000, numbers of trees increased to 120802 (438 plants/ha). Further classification indicates that the number of fruit trees have increased by 109 percent and forest tree species by 214 percent. Fruit tree saplings which were planted in 1993 have started yielding fruits. People talk proudly about production of fruits from their mango, guava, papaya and other trees.

Table 7: Increase in Number of Trees in Watershed Area

Type of Trees	1993	2000
Fruit	2276	4757
Forest species	34005	116045
Total Trees	38274	122802

Source: BAIF records

The quality and quantity of grass production on waste-lands has improved significantly. In 1993 per hectare production of grass was 1006 kg, which increased to 1567 kg in 2000. During PRA exercise village people said that many wastelands that did not have much vegetation before treatment, have now started producing good quality grass. Now, people get the grass from these pieces land for the whole year. In fact, they sell surplus grass and earn an extra income. Now women do not have to walk long distances for collection of grass, since it is available in their own fields nearby.

Table 8: Increase in Grass Production in Watershed Area

Particulars	1993	2000
Grass area (in ha.)	75.80	74.30
Grass production (in kg)	76260	116430
Per Ha. Grass production (in kg)	1006	1567

Source : field work 2000

Improvement in Quality of Cattle

Cattle development is an integrated part of watershed development. As production of grass increased and people's capacity to give better quality feed to cattle improved, BAIF introduced the cow cross-breeding programme. People also accepted the programme since they were confident about managing these animals now. In addition, as income from local resources has increased, people do not need to migrate, hence they can take

proper care of their cross bred animals. Table 9 indicates that the number of local cows decreased from 314 in 1993 to 143 in 2000 and the number of cross-bred cows increased from one in 1993 to 21 in 2000. There is not much change in the number of other cattle like buffaloes and goats. During PRA exercise people said that production of milk of a cross-bred cow is three to four times more than that of the local breed. Income has increased by Rs 500 to Rs 1000 an year and in addition home consumption of milk has increased. According to BAIF's field staff, demand for artificial insemination of local cows is increasing.

Table 9: Change in Number of Cattle from 1993 to 2000

Type of Cattle	Number of Cattle	
	1993	**2000**
Local cow	314	143
X-bred	1	21
Local Goat	125	112
Local Buffalo	66	66
Local Bull	204	195
Total	710	537

Source : field work 2000

Increase in Income and Savings

Due to watershed treatment land capability has improved and in turn agriculture productivity from crops and horticulture has also increased. Increase in production has resulted in an increase in income. On an average per family annual income has increased from Rs.4500 in 1993 to Rs.12000 in 1999 (Based on 10 percent inflation taking into account). In 2000 per family income decreased to Rs. 6000, the major reason for the decrease in income being irregular and low rainfall in 2000. Even during drought the people could face the situation and sustain themselves with a stable income. It is important to note that during the good years, after treatment, people saved some portion of their increased income, which they used during the low rainfall years.

Impact on Migration

As land quality has improved, people prefer to work on their own land instead of migrating and working as wage labors elsewhere. Migration has reduced significantly in terms of the number of days of migration and number of persons migrating. The number of persons

migrating for labour work has reduced by 40 to 50 percent in all the watershed villages. Of those who are still migrating, the number of days of migration has gone down from 93 days in 1993 to 45 days in 2000. Earlier after the kharif (monsoon) crops, farmers used to migrate; now some family members stay back for preparing their land for the Rabi (winter) crops. In the PRA exercise people indicated that when full impact of watershed treatment is felt people may not have to migrate at all.

Increase in Assets

In PRA exercise people indicated that after watershed treatment, income has increased and they could save money to buy essential assets like cycle, oil engine for irrigation, television, tape recorder and radio. Table 10 shows that there is a remarkable increase in assets. With an increase in income people's mobility increased, since they bought cycles to reduce traveling time. As availability of water in wells and check dams increased, people bought irrigation pumps to irrigate rabi and horticulture crops. Television, tape recorder and radio are means of entertainment and symbol of social status. After essential items, these commodities are the next choice. Increase in assets is an important indicator of economic prosperity.

Table 10: Assets in Sample Households in 1993 & 2000

Assets	**1993 [*nos.]***	**2000 [*nos.]***
Cycle	16	30
Irrigation Oil engine	3	20
Radio	17	44
Tape recorder	7	30
Television	2	9

Source : field work 2000

Impact on Women

Under watershed development programme of BAIF, though women issues are not addressed directly, women have received many indirect benefits. Major benefits are easy access to fuel, fodder and water. Earlier women would walk long distances to collect fuel, fodder and water. Now, these are available in their villages and near their fields. Table 11 indicates, there is 50 percent reduction in drudgery of work among women in terms of time spent. In 1993 women had to spend 8.5 hours a day while in 2000 they had to spend only 4 hours a day on collection of fodder, fuel and water. It is important to note a

significant change. Earlier women used to go barefoot in forest and hillsides for collection of fodder and fuel but now they wear slippers which protect their feet. Women have indirectly benefited through vegetable cultivation. As availability of water increased, women started growing vegetables in their homestead yards. This resulted in availability of vegetables for home consumption during a major part of the year and some additional income through sale of the surplus. Since vegetables are available in large quantities, women too get their share of vegetables in their daily meal, which has contributed in improving their health.

Table 11: Time Spent by Women on Various Activities

Activities	**Per Day Time Spent (in hours)**	
	1993	**2000**
Grass	3.00	2.00
Fuel	3.00	1.5
Water	2.5	0.5
Total	8.5	4.0

Source : field work 2000

Improvement in nutritional level

In the PRA exercise people indicated that because of increase in production of grains food intake has increased. Consumption of milk and fruits has also increased because of cattle breeding and horticulture programmes. Women started taking interest in vegetable growing, which provides different varieties of vegetables for home consumption. Availability of different varieties of fruits and vegetables helps in meeting the requirements of different minerals and vitamins. Milk provides protein and calcium, which are good for children and pregnant and lactating mothers.

Sustainability of Project through Institutional Building

Formation of watershed committees and establishment of a permanent fund are right steps to make the project sustainable in the long term. The committee members are trained and given responsibility to supervise and maintain the structures. Technical and management training programmes have been organized for men and women to improve their skills to take proper care of their fields. Under the watershed programme women self help groups are encouraged to undertake savings and to take up economic development programmes like poultry, dairy development etc.

Initially, people's participation was more consultative in nature. However later on the participatory approach was intensified and accelerated. Instead of the village watershed development committee (VDC) being elected by the entire village, self help groups, users groups, women's groups, and groups around common interests like occupation, landholdings, social classes were formed. One representative from each group constitutes the VDC. Elected village panchayat members are also members of the VDC. These members elect their executive committee. Executive committee of the VDC is rotated once every two years.

An elaborate training schedule, indicating various stages and steps for participatory learning, planning, implementation, monitoring and evaluation has been adopted. This enhances the capabilities of all the stakeholders in technical, social and financial aspects of the project and in record–keeping. VDC with 20-25 members are operational and more effective. If necessary, two or more VDCs may be constituted according to the size and diversity of the village.

A village general body comprising one representative from each household is organized. Once every six months, VDCs and project staff present their action plan to the general body, and would be accountable to it. This process aims to bring about transparency. During the implementation period from 1993 to 2000, a watershed fund was established for the repair and maintenance. Even after the completion of the project, VDC continues working and is responsible for maintenance of the structures on the common land. Role of VDC is also to encourage farmers to maintain watershed structures on their private lands. During the project period all the beneficiaries were trained and sanitized for proper care of the watershed structures through training programmes and exposure visits. Since people have enjoyed the benefits of watershed treatment during last five years, they are interested in continuing with them.

Conclusion

Integrated development of the Manhere watershed is one of the successful development interventions of BAIF. The project was able to develop both natural and human resources. The emphasis is on the sustainability of the project. Top to bottom treatment certainly has multiple impacts on conservation of soil and water. The important aspect of the project is

an active involvement of women in the project and efforts to empower them through savings, credit and employment generation programme. Looking at the success of the Manhere watershed, people from neighbouring villages started approaching the BAIF field staff for introducing similar projects in their villages. This is one of the indicators of success, where people are the judge. The Manhere watershed model can certainly be replicated elsewhere in the country with similar physical and social environment.

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