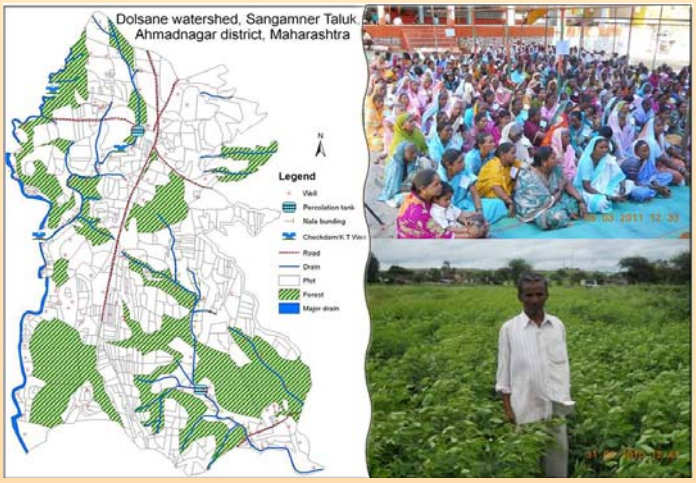
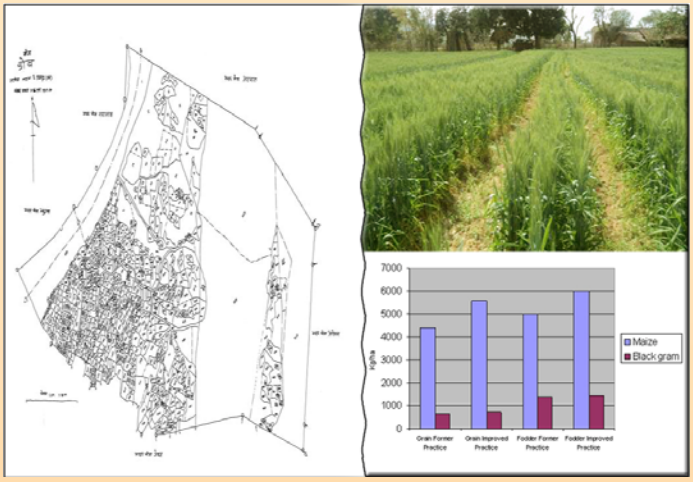
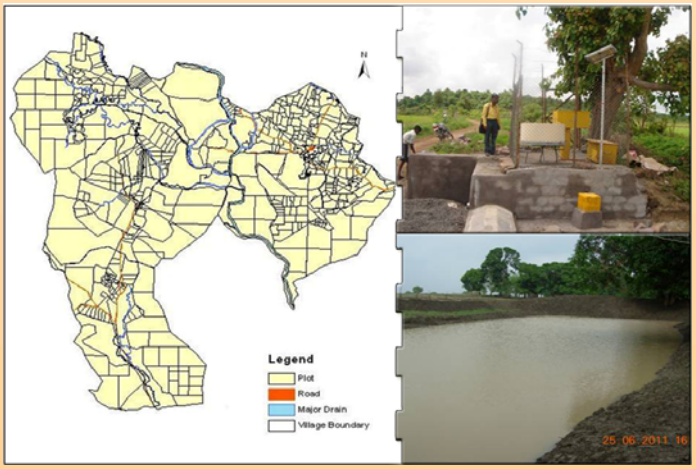
Progress Report
on
Model Watersheds

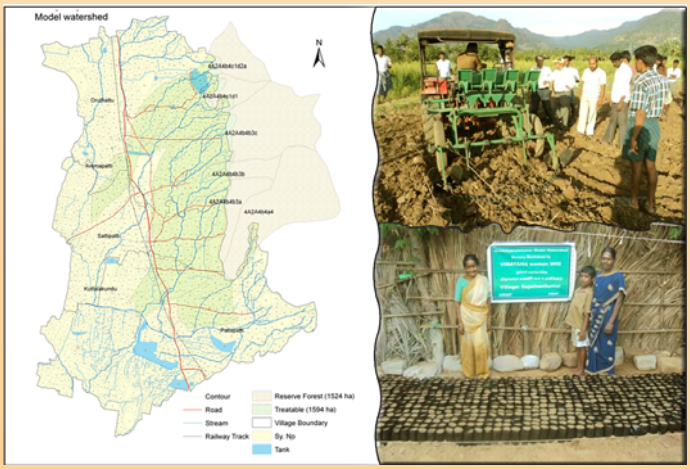
Ahemednagar District, Maharashtra
Udaipur District, Rajasthan
Raisen District, Madhya Pradesh
Dindigul District, Tamilnadu

Up to January 2013









Submitted to

Ministry of Rural Development

Government of India, New Delhi, India

ICRISAT
Science with a human face

International Crops Research Institute for the Semi-Arid Tropics

Patancheru 502 324, Andhra Pradesh, India

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Contents

Executive Summary

In most dryland regions, lack of technological progress and increasing population pressure are taking heavy toll on the productive natural resource base. Water scarcity, land degradation along with other technological and socioeconomic constraints are leading to lower productivity and income. Depletion of the resource base diminishes the capabilities of poor farmers to earn more and increases their vulnerabilities to drought and other natural disasters. For such areas, government of India and several other organizations and agencies have adopted integrated watershed management for improving the livelihoods of the community and conserving natural resources. Recently completed Comprehensive Assessment (CA) of the impacts of watershed program in India undertaken by the ICRISAT-led consortium showed that the watersheds are silently revolutionalising the dryland areas in the country and can become growth engine of sustainable and inclusive development. The Government of India released the New Common Guidelines for enhancing growth engine of sustainable development of rainfed areas by improving the performance of 65% of the watershed projects, which performed below average. Further, the CA revealed that "one size fits all" approach did not work and there is need to adopt the vast spread of rainfed areas in the country covering different agro-ecoregions, nature of watershed interventions in different rainfall zones (<700mm, 700-1100mm and >1100mm). The Department of Land Resources (DoLR), Ministry of Rural Development (MoRD) supported International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) establish four model watersheds in the low (<700mm) medium (700-1100mm) and high (>1100mm) rainfall regions of India to serve as sites of learning and capacity building in three different rainfall zones. The progress made in four model watersheds at Ahemednagar District, Maharashtra; Udaipur District, Rajasthan; Raisen District, Madhya Pradesh; and Dindigul District, Tamilnadu is briefly summarized.

To serve as representative benchmark watersheds in three representative benchmark site in terms of soils, landscape, rainfall, crops and socio-economic conditions; problem of water scarcity; high poverty level; willingness of the farmers to cooperate; good potential for increasing agricultural productivity, and major area under rainfed agriculture were applied for selecting model watershed sites. Multi- institutional team visited several sites in Udaipur district, Rajasthan; Raisen district, Madhya Pradesh; Ahemednagar district, Maharashtra and Dindigul district, Tamilnadu**.** At each site, farmers meetings were conducted and detailed discussions were held with government officials, local institutions and community members. Based on these discussions and the observations collected, Dob, Nevaj and Atwal villages in Jhadol block, Udaipur district, Rajasthan; Dolasane and Bambalewadi villages in

Sangamner taluk of Ahemednagar district in Maharashtra; represent (<700 mm rainfall y^{-1}); Nakkampatti, Sadaiyandipuram and Gobalapuram villages in Nilakottai Panchayat union of Dindigul district in Tamilnadu (700-1100 mm); and Chor Pipliya, Siyalwada and Padariya Kalan villages in Silwani block of Raisen district in Madhya Pradesh (>1100 mm were selected as benchmark sites); were selected as the appropriate sites for the model watersheds.

After series of meetings and consultations, the Watershed Committees in all the four model watersheds are formed with at least 50% women. Special efforts were made to ensure the adequate representations of poor farmers and other vulnerable section of the community. The watershed committees are registered and the necessary bank accounts opened. Necessary trainings and exposure visits were organized to improve the capacity of the watershed committee members in performing their responsibilities.

Detailed baseline surveys were conducted in all watersheds, which included biophysical and socio-economic aspects of watershed through PRA and RRA techniques. A detailed household survey instrument prepared by ICRISAT was pilot tested and used to cover. For 25% of the total households from the watershed villages using stratified random sampling method. The secondary data for the area were also collected from the different service providers. Digitized cadastral maps of the watershed area are used along with transect walk, PRA Primary and secondary data to prepare detailed project reports. The total and net treatable areas of the each watershed were calculated. The watershed boundary, open wells, villages and other key features have been geo-referenced using the GPS. Total station has been used to carry out more detailed topographic surveys. The DEM maps have been prepared and the groundwater contour map has been prepared with lineaments (water carrier) and dyke (water barrier) lines have been marked.

Soil sampling and soil health assessment as knowledge-based entry point activity (KBEPA) was taken up in all the watersheds in place of conventional cash based EPA to rapport with the watershed communities. Participatory stratified sampling procedure was followed through PRA the soils in all the four watersheds were found deficient both in the major and micronutrients viz. boron, zinc and sulphur. For example at Dolasane model watershed in Ahmednagar, the analysis showed severe nutrient deficiency in the farmers' fields (OC was 53%, available P was 56%, sulphur was 69%, zinc was 71% and boron was 89%). Based on findings, site specific nutrient recommendations have been prepared.

As planned several development works on soil and water conservation, runoff water harvesting, groundwater recharging and gully control have been taken up at all the watersheds. These includes construction of farm ponds, earthen check dams, loose bolder structures, field bunding and development of pasture lands. To enhance high quality community participation by ensuirng tangible economic benefits to individual small farmers produciity enhancment activiites through in-situ rainwater and soil conservation measures were promoted through participatory research for development (PR4D). For example at the Raisen model watershed in Madhya Pradesh the first soil and water conservation activity, which was taken field-based land and water management system viz. broadbed and furrow (BBF) system. This system provides *in-situ* soil and water management and is highly effective in alleviating water logging, controlling runoff and soil loss and improving crop yields. Similarly, soil and water conservation measures such as construction of loose bolder structures, construction of farm ponds and earthern check dams were undertaken. Similar development works relevant to local needs were taken up in other three watersheds also.

Enhancing the agricultural productivity in the watersheds was given very high priority. Participatory demonstrations cum research trails on improved agricultural practices were conducted on the farmers' fields; using improved crops/ varieties (soybean JS 9305, groundnut ICGV 91114, black gram T-9, green gram PS 16, pigeonpea ICPL 871119, maize 9220, chickpea JG11 and wheat HI 1531), balanced nutrition including application of micronutrients, broad bed and furrow land management system and other improved practices resulting in increased crop yields by 23 to 88 per cent over the normal farmers' management practices, such tangible economic benefits to farmers not only improve community participation but also lays a strong foundation for collective community action which is critical for sustainability of watershed interventions.

The monitoring and evaluation was given very high priority at all the watersheds. One automatic weather station has been installed at each model watershed. Also one digital runoff recorder and automatic sediment sampler have been installed. Project staff are trained for day to day handling of the equipments. At each model watershed 12-16 open wells (representing upstream, middle and downstream parts of the watershed) are numbered, geo-referenced and monitored for using groundwater meters.

The capacity building initiatives included (10 to 18) CBOs, farmers and field staff thru hands-on trainings, exposure visits to other watersheds, training materials. Need-based specialized trainings were also conducted at all the watersheds. At watersheds the Women's Day, "Mahila Mela" were conducted to enhance and encourage women participation in the

watershed activities and other rural development activities. Some of key capacity building activities undertaken includes: orientation programs for the wateshed committee members, orientation programs for the SHG members, training on role and responsibilities of the watershed committee members, training to field staff and community members on groundwater meter, training to field staff on the collection of rainfall data from rainguages, training on the broad bed and furrow cultivation system, training on day to day maintenance of runoff and soil loss measuring equipments, training of farmers on Nadep/vermicompost preparation, training of farmers on agriculture productivity enhancement technologies and the exposure visit to other watershed programs. Farmers day and farmers mela were also organized at the model watersheds, which were attended by farmers, scientists, development workers and government officials.

In summary, overall good progress is there in all the four model watersheds. The watershed development, productivity enhancement and income generating activities are expected to increase substantially in the coming years to benefit large numbers of farmers. The monitoring and evaluation will be further strengthened through specific impact assessment and monitoring studies for different aspects. In incoming years we are on the way to transform four model watersheds as sites of learning and live examples of improved livelihoods in different ecoregions through integrated watershed management and build the resilience against climate change.

Background

The results of the recently completed global Comprehensive Assessment of Water for Food and Water for Life showed that a vast scope exists for doubling the productivity of rainfed agriculture in India and other Asian countries, with available technologies. More investments in developing countries are needed in rainfed areas, as there is little scope to expand large-scale irrigation in India and other Asian countries considering economic viability and environmental concerns. The policy shift towards rainfed lands is also necessitated on social grounds too, as a large majority of the rural community is at subsistence level, with a sizeable component of people below the poverty line. In India, the needed increase in food production to meet increasing demand has to come largely from 94 million ha of rainfed areas under cultivation. Rainfed areas are also the hot spots of poverty, land degradation and frequent droughts. Water is a vital lifeline and also a finite and scarce resource that needs to be managed and used in a sustainable manner and with efficient enhanced.

The rainfall in the tropics is seasonal with erratic distribution and generally comes as torrential downpours, resulting in large runoff and severe soil erosion. Groundwater levels are depleting in the region and most regions are facing water scarcity and drinking water shortages in the summer season. The productivity in these areas is low. The water scarcity is largely due to improper management of water resources and not so much due to low water quantity *per se*. Water use efficiency in the rainfed areas is low (35 to 45%) and through improved management options the productivity of rainfed agriculture could be doubled with enhanced water resources use efficiencies. While land degradation has taken place over decades, the pace of degradation has greatly increased in recent times due to burgeoning population and the enhanced means of exploiting natural resources. The process of land degradation is seriously undermining the livelihood security of the vast majority of rural populations, leading to poverty, starvation and migration.

The Government of India (GoI) has recognized the importance of rainfed agriculture in the country and has established a National Rainfed Area Authority (NRAA) to accelerate the growth rate as well as improve the livelihoods of rural poor. The GoI has adopted a community watershed management approach to improve rainfed agriculture and it could as well be the entry point to improve livelihood opportunities in the rainfed areas through increased rainfed food and feed production through sustainable use of the natural resource base, which is the lifeline for rural enterprises. This approach can be a principal component of integrated rural development efforts to alleviate poverty in rural India.

Recently Ministry of Rural Development and Agriculture, Government of India supported Comprehensive Assessment of watershed programs' impact in India through a consortium led by the ICRISAT. The CA of watersheds in India indicated that watersheds are silently revolutionalising the dryland areas in the country and can become growth engine of sustainable and inclusive development. The CA also showed that the watershed programs are benefiting the community economically (B:C ration of 2.01) as judged by, internal rate of return (IRR of 27%), generating rural employment of (151 person days/ha/yr), enhancing agricultural productivity by 3.6 to 189 per cent and protecting environment through reduced runoff (45%) and soil loss by 1.1 t/ha/yr. However, watershed program could further become growth engine of sustainable development of rainfed areas by improving the performance of 65% of the watershed projects, which are performing below average. However, the watershed programs particularly in low rainfall areas, have not yielded the desired results in terms of enhancing productivity in rainfed areas, improving rural livelihoods, and protecting the environment, largely due to lack of application of

appropriate technologies in different agro-ecoregions, and by not following a holistic approach.

Further, considering the vast spread of rainfed areas in the country covering different agro-ecoregions, nature of watershed interventions in different rainfall zones (<700mm, 700-1100mm and >1100mm) will vary. Moreover, in order to build the capacity of different stakeholders in the area of community watershed management, there is an urgent need to establish sites of learning in three different rainfall zones spread through different states to cover the country. Such facilities for training in specific eco-regions will go a long way in building the capacity of NGOs, lead farmers and concerned government line department staff. The Ministry of Rural Development, Government of India has provided assistance to establish four model watersheds in the low (<700mm) medium (700-1100mm) and high (>1100mm) rainfall regions of India with following objectives.

Objectives

The overall objectives of this initiative is to improve the livelihoods of rural poor in fragile dryland areas on a sustainable basis by enhancing the impact of integrated watershed management programs in Rajasthan, Maharashtra, Tamil Nadu and Madhya Pradesh states and similar agro-eco regions in the country through capacity-building initiatives using sites of learning in low, medium and high rainfall regions.

The specific objectives are:

1. To *improve rural livelihoods* through participatory watershed development program with consortium approach through application of cost- effective integrated genetic and natural resource management practices appropriate to socio economic conditions of farmers and natural resources of the ecosystems;
2. *To establish* four community model watershed sites of Learning in three target rainfall zones (<700 mm and 700 to 1100 mm, and > 1100 mm rainfall per annum) for demonstrating the potential of rainfed areas by adopting integrated water resource management approach; and
3. *To build capacity of different stakeholders* in the areas of integrated watershed management for enhancing impact of watershed programs.

Dolasane-Bambalewadi Model Watershed
Ahemednagar district, Maharashtra

Background

The Dolasane-Bambalewadi model watershed, Ahemednagar, Maharashtra comprises two villages namely: Dolasane and Bambalewadi, which are located about 22 km from Sangamner taluk headquarters with good accessibility on Pune-Nashik highway NH 50. The total area of these two villages is 1563 ha, out of which 783 ha is cultivable land, 105 ha waste land, 464 ha is forest, 179 ha is gairan and gothana and 37 ha is under river, nala and roads etc. Only 50 ha has seasonal irrigation facility and most of the cultivable area is rainfed (Table 1). The major crops grown in the watershed villages are pearl millet, groundnut, soybean, pigeonpea, greengram in kharif and chickpea, sorghum & wheat during rabi, and vegetables like tomato, onion and acid lime. The present crop yields are very low (Table 2).

Table 1. Land use pattern in Dolasane-Bambalewadi model watershed, Ahemednagar

Name of the village	Irrigated (ha)	Rainfed (ha)	Fallow land (ha)	Horticulture (ha)	Forest (ha)	Common property resource (ha)	Total (ha)
Dolasane	20	549.18	81.63	2.10	463.59	90.16	1186.66
Bamblewadi	30	219.00	21.02	0.30	0.00	121.08	376.34
Total	50	768.18	102.65	2.40	463.59	211.24	1563.00

Table 2. Present crop productivity and the area grown in Dolasane-Bambalewadi model watershed, Ahemednagar

Sl. No.	Crop	Area (ha)		Productivity (t ha^{-1})	
		Dolasane	Bamblewadi	Dolasane	Bambalewadi
Kharif					
1	Pearl millet	411	45	1.5-2.25	1.5-2.25
2	Soybean	10	0	1.25-1.5	-
3	Groundnut	25	7	1.0-1.25	1.0-1.25
4	Onion	55	4	7.5-8.5	8.0-10.0
5	Tomato	28	3	12-15	12-16
Rabi					
1	Wheat	4	2	1.5-2.0	1.5-2.0
2	Chickpea	28	2	1.0-1.2	1.0-1.2
3	Sorghum	82	4	1.5-2.25	1.5-2.25

The farmers perceive that water scarcity is a serious problem for low crop yields. The population of these two villages is 1727 (male 901 and female 826) with an average family size of 4.47 with a population density of 1.15 per ha (Table 3). The total households in these villages are 386, out of which 53% belong to small, 34 % medium, 10% big and 4% are

landless households (Table 4). Topography of watershed is undulated degraded hilly terrain with predominantly shallow to medium deep black soils with good drainage density. The watershed area has hilly terrain with degraded lands on the upper ridge portion and the fertile lower portion area is under intensive cultivation with different crops like food, vegetable and horticultural crops (Fig 1). The soil type on upper ridge portion of toposequence is mostly red mixed brown soil, in the middle portion shallow to medium deep black soil and lower portion deep black soil. There are 129 wells (121 open wells, 5 tube wells for irrigation and 3 tube wells for drinking purpose) with water table depth in tube wells ranging from 250 – 350‘ and open wells with depth ranging from 50-60’ exist in the watershed (Table 5). Livestock status in the watershed is also given in Table 6.

Table 3. Caste-wise population information of watershed villages.

Name of the Village	No. of households				Total population		
	Scheduled caste	Scheduled Tribes	Others	Total	Male	Female	Total
Dolasane	16	34	231	281	630	587	1217
Bamblewadi	3	83	19	105	271	239	510
Total	19	117	250	386	901	826	1727

Table 4. Households categories information of watershed villages, Ahemednagar

Name of the Village	No. of households				Total
	Big	Medium	Small	Landless	
Dolasane	32	101	139	9	281
Bambalewadi	5	31	64	5	105
Total	37 (10) *	132 (34)	203 (53)	14 (4)	386

** Values in the parentheses are the % of total*

Table 5. Groundwater status in Dolasane-Bambalewadi model watershed, Ahemednagar

Name of the village	Cow (breed)	Buffalo	Bullock and Cow	Other (goat, sheep etc)	Hens
Dolasane	35	14	787	1328	1819
Bambalewadi	nil	nil	249	181	705
Total	35	14	1036	1509	2524

Table 6. Livestock status in Dolasane-Bambalewadi model watershed, Ahemednagar

Name of the village	Open well-irrigation		Tube well-irrigation		Drinking water-tube wells		Total
	Functioning	Completely Defunct	Functioning	Completely Defunct	Completely Defunct	Functioning	
Dolasane	94	1	4	1	nil	2	102
Bambalewadi	26	nil	nil	nil	nil	1	27
Total	120	1	4	1	nil	3	129

Figure 1. Different crops grown at Dolasane-Bambalewadi model watershed Ahmednagar district.

Selection of Watershed Site

Based on the key criteria set for the identification of model watershed location, the few appropriate sites were identified in Ahmednagar district, Maharashtra. Several potential sites in the district were visited with WOTR, ICRISAT and respective of villages gram panchayat members and agriculture department staff. At each site, farmers meetings were conducted and detailed discussions were held with government officials, local institutions and community members. With the help of topo sheets and cadastral map, and based on the experiences of NGO partner (WOTR) discussions and the observation collected, Dolasane-Bambalewadi watershed was identified as site for the model watershed (Figs. 2 & 3).

Some of the important points for the selection of this particular watershed for model watershed project were: it has good accessibility; landscape is suitable for watershed development with different interventions and has good potential to develop as model watershed; good scope for water conservation and productivity enhancement measures as water scarcity is one of the serious problem; good response of farmers observed; farmers are initiative and innovative in tackling the constraints (e.g. One farmer has made a provision of conveying water for about a kilometer with two pumps to irrigate his field). The location

identified has good potential for holistic development of various watershed interventions as a model watershed applicable for the replicating the technology in the similar agro eco zone in Maharashtra.

Figure 2. Gram sabha was conducted with farmers to brief the objective of project.

Figure 3. Process of site selection and general view of Dolasane-Bambalewadi model watershed, Ahemednagar

Consortium Partners

- Watershed Trust (WOTR), Ahemednagar
- District Administration, Ahemednagar
- Department of Agriculture, Ahemednagar
- Mahatma Phule Krishi Vidya Peeth (MPKV), Rahuri and Pune Campus
- Dolasane-Bambalewadi model watershed committee
- ICRISAT

Baseline Data Collection

The detailed baseline survey for 25% of households has been conducted and the data analysis is in progress covering all the categories of households using detailed pre-tested instrument. Data on bio-physical (such as agro-climatic characterization based on long term rainfall data, soils, drainage pattern, land use system, water resource, major crops and their productivity, livestock) and socio economic (such as family details, landholding category,

income and infrastructural facilities) and GPS data of watershed has been collected for the preparation of DPR. A separate publication is also planned for baseline report after completing the detailed data analysis.

Formation of Watershed Committees

The formation of various committees viz. watershed committee, user groups and SHGs have been formed. A seventeen members watershed committee has been for comprising 8 women members and other members as per the standard norms set. Eight self-help groups have been formed.

Implementation of Interventions

Entry point activities: Knowledge-based entry point activities like detailed stratified soil sampling has been taken up. Sixty two soil samples have been collected from farmers' fields covering entire watershed as per the standard procedure set. The analyses of these soil samples are shown in Table 7. The results revealed that the soils in the watersheds are deficient in OC (53%), Av. P (56%), Av S (69%), Av Zn (71%) and Av. B (89% of farmer's fields). This clearly indicates that the major constraint for the low yield is poor soils along with other constraints like scarcity of water, erratic rainfall, poor economic conditions etc.

Table 7. Initial soil analysis report, Dolasane - Bambalawade Model Watershed.

pH	**OC %**	**Av P ppm**	**Av K ppm**	**Av S ppm**	**Av Zn pm**	**Av B ppm**
7.6	0.49	6.7	148	8.5	0.73	0.40
Range						
6.8-8.3	0.11-0.94	1.3-30.1	39-750	1.9-21.3	0.28-.70	0.10-0.76
% deficient	53	56	6	69	71	89

Recommended dose of fertilizers (kg ha^{-1}) for Pearl millet

N	P_2O_5	K_2O	S	Zn	B
60	30	20	30	10	0.5

Soil test based fertilizer recommendation

Urea	DAP	MOP	Gypsum	Zinc sulphate	Agribor or Borax	
105	65	17	200	50	2.5	5

Recommended dose of fertilizers (kg ha^{-1}) for groundnut

N	P_2O_5	K_2O	S	Zn	B
20	50	20	30	10	0.5

Recommended dose of fertilizers (kg ha^{-1}) for Pearl millet

Urea	DAP	MOP	Gypsum	Zinc sulphate	Agribor or Borax	
1	109	17	200	50	2.5	5

Productivity Enhancement Trials

The participatory field trials cum demonstration of improved practices have been initiated in 16 ha involving 41 farmers. Improved cultivars of seeds (groundnut 300 kg, pearl millet 42 kg, green gram 20 kg, pigeonpea 100 kg), and balanced nutrition with secondary and micro nutrients (zinc sulfate 400 kg and agribor 40 kg) along with conservation furrows opened at 5-7 m interval for moisture conservation have been implemented in the demo fields (Figs. 4, 5, 6 and 7) in 2010-11. Similarly the field demonstration of improved management was conducted in 2011-12. The results were quite impressive (Table 8). The pearl millet with improved management has increased grain yield by 49% over conventional farmer's practice, while in case of groundnut the increase in yield was 84%.

Figure 4. Distribution of improved seeds to farmers and Dr SP Wani discussing with farmers aboutimproved practices adopted by farmers.

Figure 5. Pearl millet and pigeonpea with farmers practice (left) and with boron and zinc amendment (right), Dolasane-Bambalewadi Model watershed.

Figure 6. Groundnut crop with farmers practice (left) and with boron and zinc amendment (right), Dolasane-Bambalewadi Model watershed.

Figure 7. Pigeonpea crop with boron and zinc amendment, olasane-ambalewadi Model watershed.

Table 8a. Crop yield in improved practice over farmers practice, Dolasane-Bambalewade model watershed, Ahmednagar, Maharashtra, 2010-11 and 2011-12.

Crops	2010-11 Grain/pod yield (kg ha^{-1})	
	Farmers Practice	**Improved management**
Pearl millet	290	440 (49)*
Groundnut	620	1140 (84)
	2011-12	
Pearl millet	478	673 (41)*
Groundnut	415	611 (47)
Pigeonpea	120	339 (182)

* *Values in parentheses are percent increase over farmers practice*

An improved multipurpose tool carrier called “Tropicultor”, which facilitates several field operations like plowing, harrowing, seed cum fertilizer drill and intercultivation, was provided and training to farmers on the usage of the equipment was organized on 18 November 2010 (Fig. 8). *Thematic GIS maps prepared:* Different thematic maps (viz. cadastral, soil depth and groundwater status maps) of watershed have been digitized (Figs. 9 and 10).

Figure 8. Tropicultor training to farmers at Dolasane-Bambalewadi Model watershed

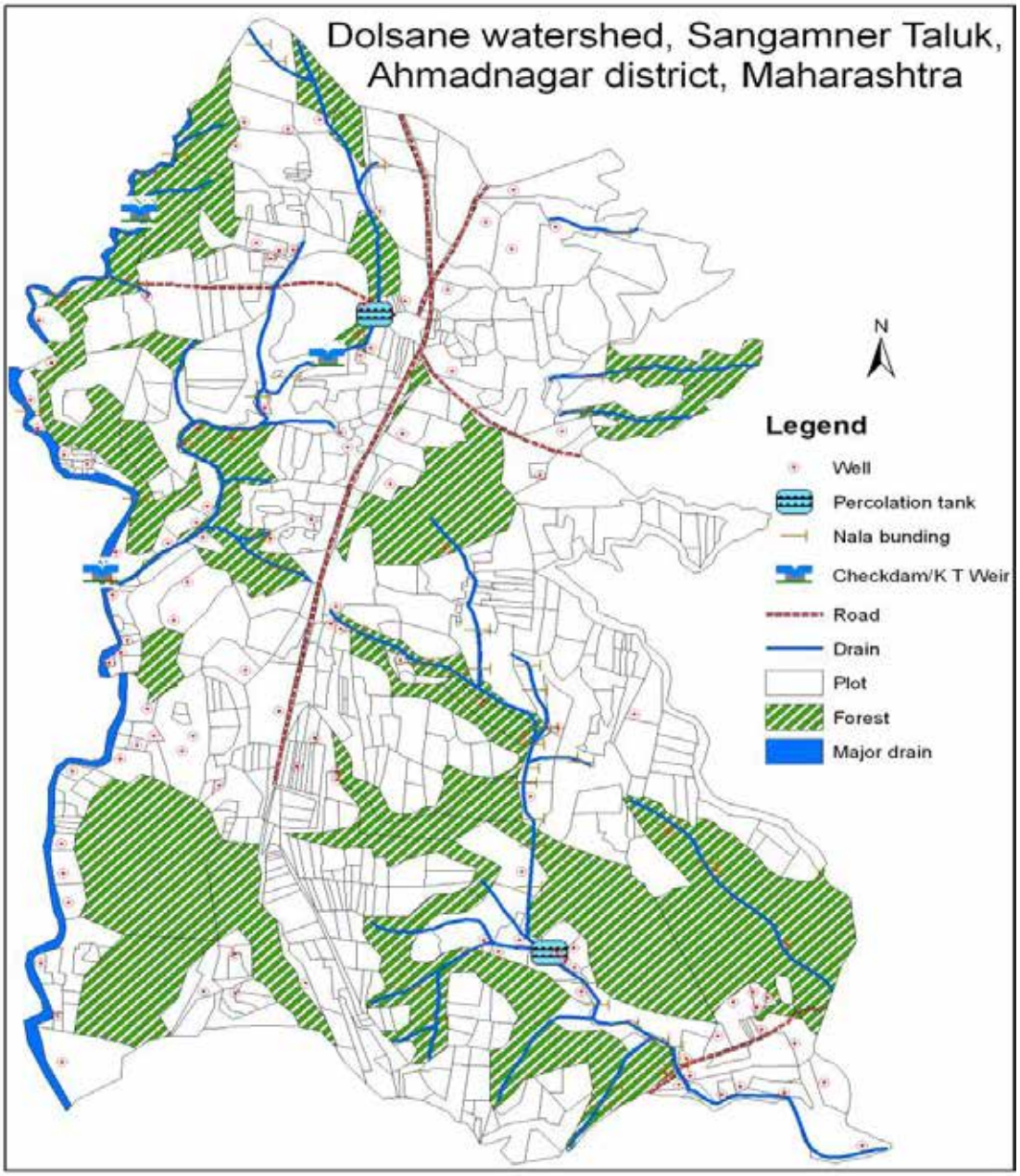


Figure 9. Cadastral map with existing physical features of Dolasane-Bhimbalewade model watershed, Ahemednagar, Maharashtra.

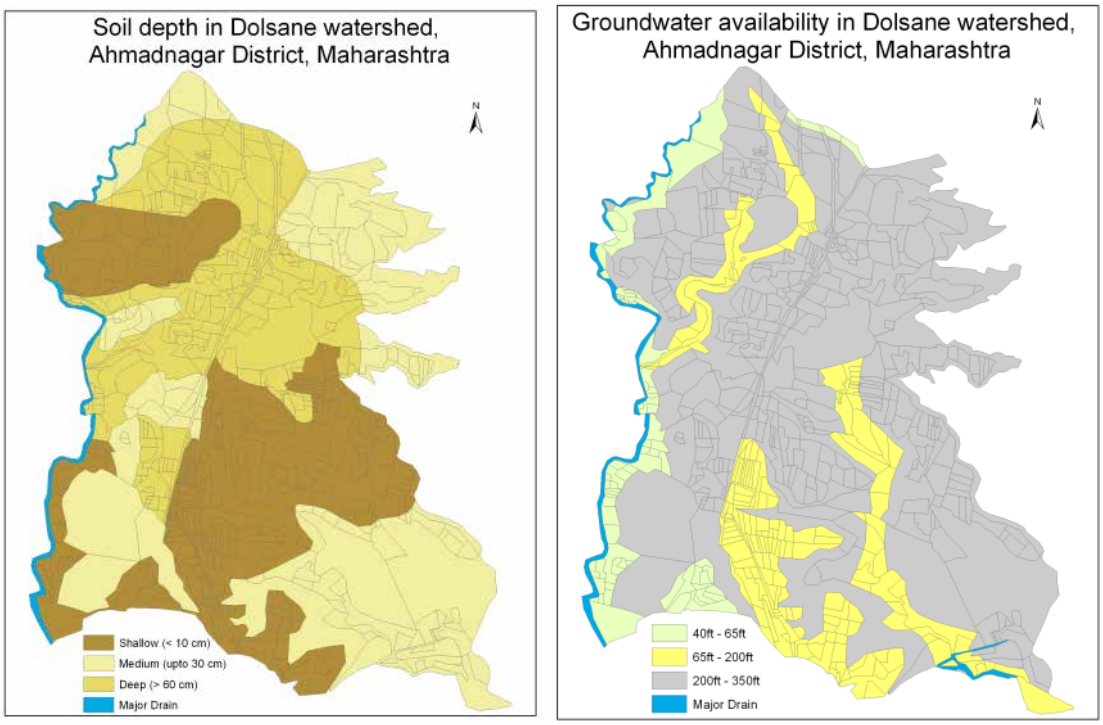


Figure 10. Soil depth and groundwater status maps of Dolasane-Bhimbalewade model watershed, Ahemednagar.

Soil and Water Conservation and Other Interventions

Various soil and water conservation activities (viz. nala/gully plugs, check dams, percolation tanks, farm ponds, rock filled dams, and check walls) have been planned and field bunding and gully plus have been started (Fig. 11) for the year 2010 with common consensus of the farmers, which will be taken up after the rainy season. The activities related to the horticultural and vegetable crops developments, afforestation and vermin-composting would be initiated.

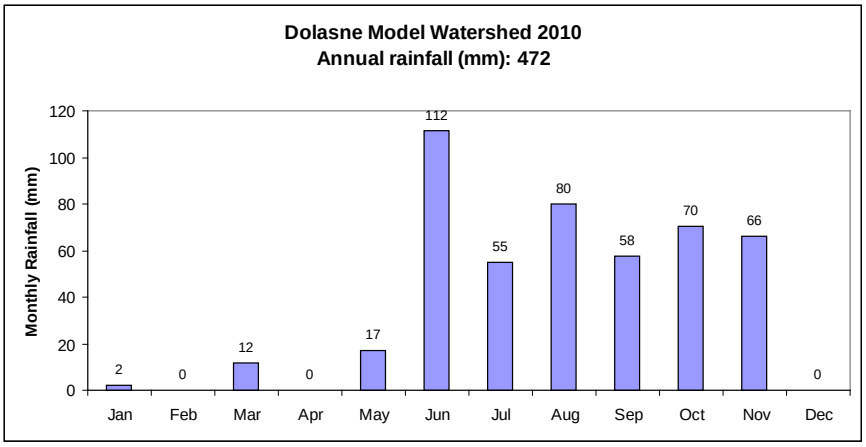
Figure 11. Field bunding at Model watershed, Ahmednagar

Table 8b. Activity Detail				
S.No.	**Activity**	**Project**	**Linkage**	**Remark**
1	Farm Bunding	120 ha		Some area is proposed under NREGA
2	Loose Bolder Structures	46		Completed
3	Gabion Structure	1		In progress
4	Masonry Check Dam		1	Agri Department
5	Farm Pond	4	9	Agri Department
6	Earthern Nala Bund	1		In progress
7	Horticultural		2 ha	Agri Department

Weather and Hydrological Monitoring

A raingauge with HOBO data logger and an automatic weather and hydrological monitoring station been established in the watershed for continuous monitoring of data (Fig. 12). The rainfall during 2010 was 472 mm (Fig. 13). Automatic Hydrological monitoring station for runoff and soil loss measurement has been established. Groundwater level data is collected on fortnightly (Figs 14 and 15). Figure 16 shows the groundwater contours with lineaments (water carriers) and dyke (water barriers), which will be used to plan interventions. The groundwater data collected in the model watershed shown in Figure 17.

Figure 12. Automatic weather and Hydrological gauging station with micro processor based integrated runoff recorder and sediment sampling unit installed at Dolasne-Bambalwadi Model watershed.



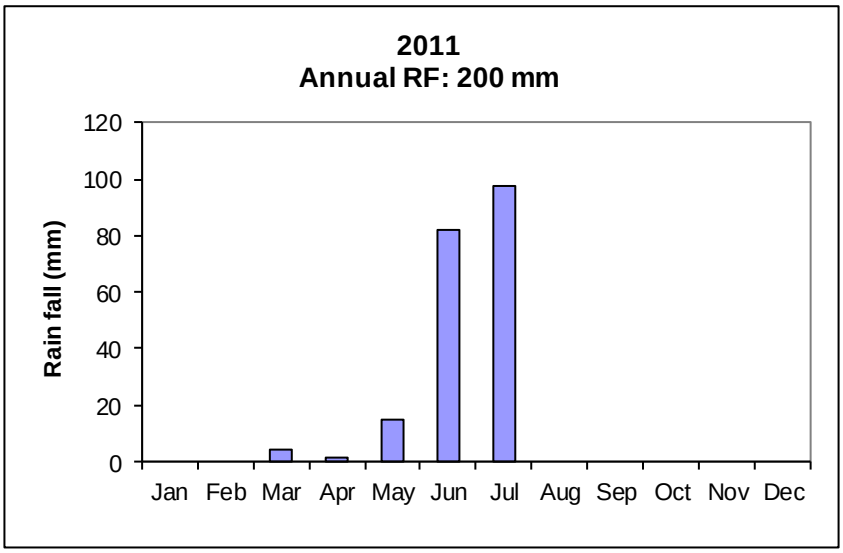


Figure 13. Monthly rainfall during 2010-2012 at Dolasane Model Watershed.

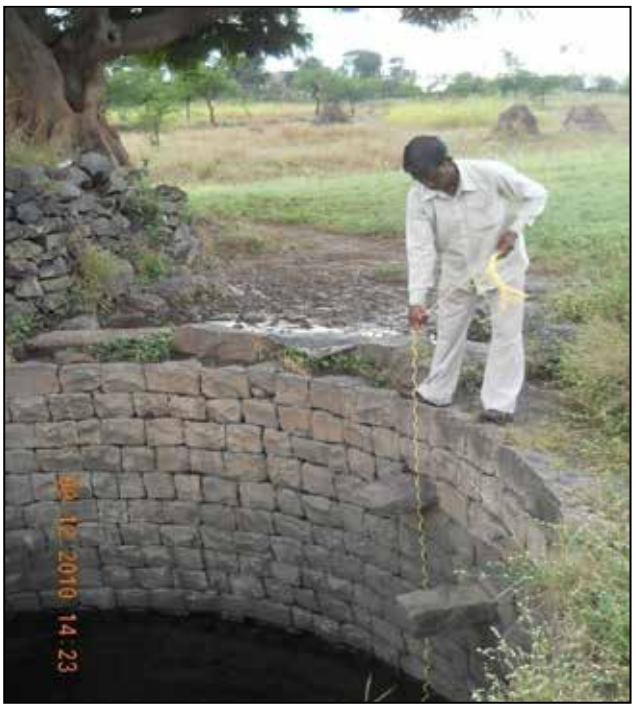


Figure 14. Trained farmers measuring groundwater level.

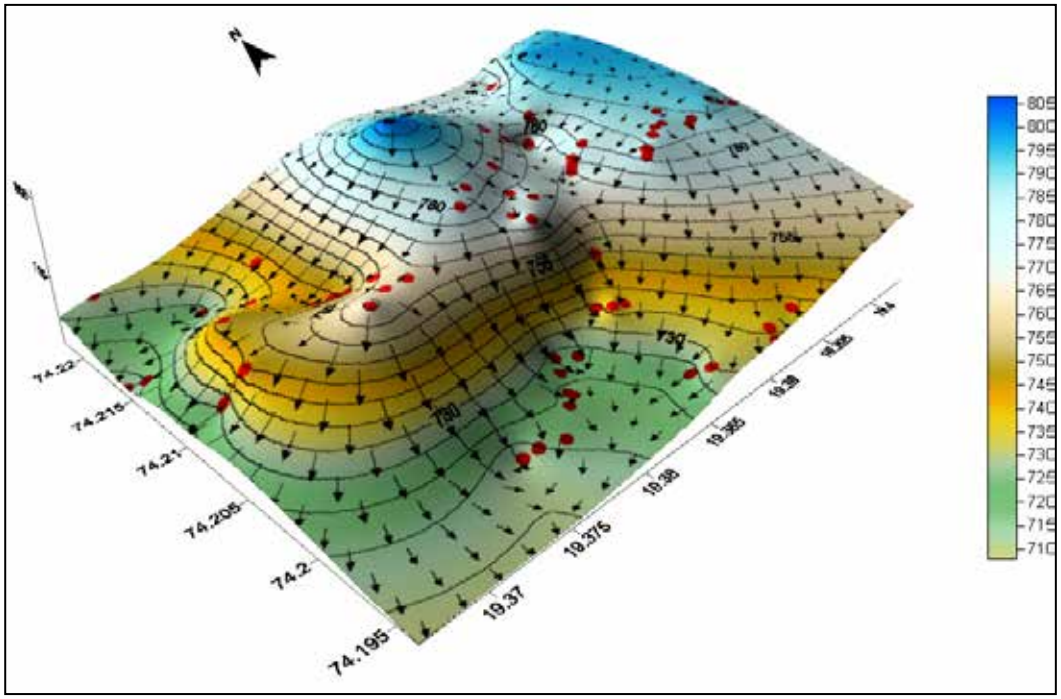


Figure 15. Groundwater contours have been plotted in Jan 2011.

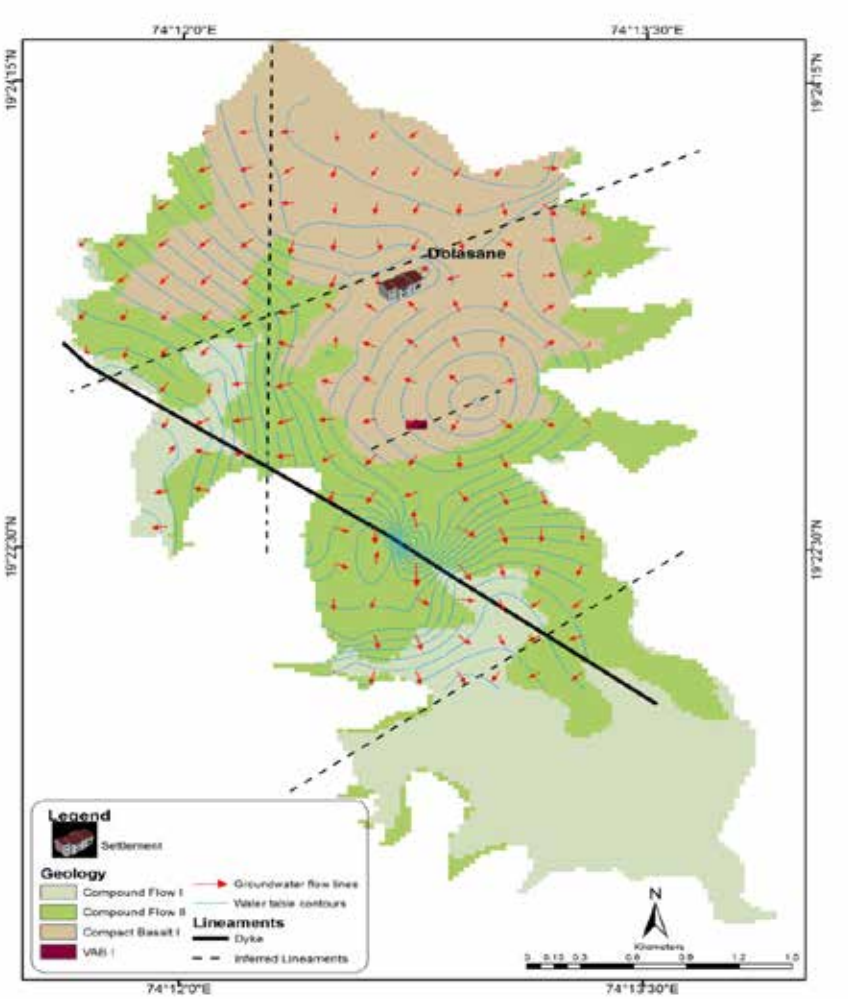


Figure 16. Map showing groundwater contours with Lineaments(water carriers) and dyke(water barriers), Dolasane Model watershed

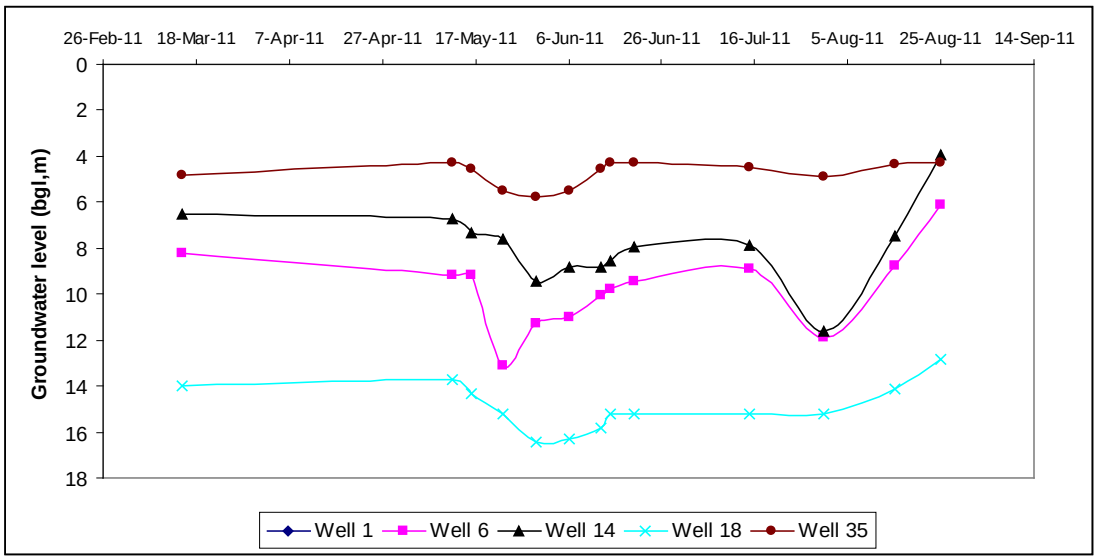


Figure 17. Groundwater level at Dolasne Model watershed, 2011.

Participatory Net Planning (PNP)

PNP activity is being carried out with each family participating in the process of planning of soil and water conservation work to be done in each gat (Survey) no. of the village. In this planning exercise detailed data collection is being done and parameters like land slope, soil depth, soil texture and erosion is calculated and then soil and water conservation measures are proposed. In this exercise we classify land as cultivable and waste land and prepare plan for soil and water conservation work accordingly. PNP is being carried out with the help of GPS equipment with an aim to improve efficiency, reduce time involved in the process, increase accuracy and hence better output and productivity.

Student Internship: Mr. Somnath Amle, a final year B. Tech. Student from MPKV, Rahuri is currently associated with the project as an intern, and he is some support to the field team in FSR preparation and awareness building.

GPS Training

Training was organized for WOTR personnel in using GPS equipment for Participatory Net Planning (PNP) (Fig. 18). GPS equipment helps in clear demarcation of land according to gat number, proposing soil and water conservation structures in the area with accurate

measurements and reduced time to complete the exercise. In this training 6 field staff were involved.

Figure 18. GPS Training to students and NGO staff, Dolasane Model watershed.

Other Activities

Several meetings, awareness and capacity building programs were conducted at Dolasane-Bambalewadi model watershed, Maharashtra (Table 9).

Awareness and Mobilization

At the beginning of the project, various awareness building and capacity building programs were conducted among the community as a whole and among men, women, children, farmers in particular. There were different tools, techniques and methodology adopted to create the awareness. Field team, expert from ICRISAT and WOTR's Regional Resource Centre were involved for bringing the awareness among the village community. Following are the major awareness methodologies adopted.

Table 9. Farmers meetings and awareness programs in Model watershed, Ahemednagar during 2010.

Sl. No.	Activity	No. of events	Activity details
A	**Awareness**		
1	Gram sabha	2	Orientation of the program and selection of farmer for Kharif Demo. 35 and 48 farmers attended.
2	Women Meeting	2	Awareness generation for SHG formation. 12 and 22 members attended
3	Farmers Meeting	2	Awareness building for Participatory Net planning and Socio Economic Survey. About 28 and 32 attended.
4	Farmers *Mela*	1	Organized by State Agricultural Department where State Agriculture Minister attended
B	**Demo cum field trials**		
1	Kharif Demo fields	1	Selection, Meeting to brief on field Demonstration. All 41 participants attended.

2	Fertilizers Distribution	1	Selection, Meeting, On filed Demonstration. All 41 participants attended.
	Farmer Meeting	5	Ongoing support for demo fields. Most of the participating farmers attended.
C	**Monitoring**		
1	Monitoring	2	On Filed Monitoring for documentation

Figure 19. Gram Sabha

Gram Sabha (Village gathering of all the adult members of the community)

Gram sabhas were conducted at different time for different purposes (Fig. 19). The major events through gram sabhas includes-awareness generation among the community, information sharing regarding the model watershed project, identification of farmers for kharif and rabi season for conducting agri crop demos, selection of area for Soil and watershed conservation work, input on women's empowerment and participation of women in the project. Apart from this gram sabhas were also held during regular field visits and monitoring visits.

Farmers' Meeting

Such meetings were carried out for selection of farmers for conducting crop demo plots and also for the purpose of giving inputs agronomical practices as advised by experts from ICRISAT. In this project the focus is on modified and advanced agricultural practices related to seed selection, seed sowing, spraying of nutrients, observation and harvesting of the crop. The seeds and fertilizers were made available by ICRISAT. The technology support is also provided by ICRISAT. On filed support to farmers by WOTR agri team. Farmers have got a good production from demo plots after following the instructions. Total 41 farmers participated in demo plots with inputs from ICRISAT.

Strengthening of Existing SHGs

Women meeting were carried out for motivating and awareness generation among women regarding the project and expected benefits and impacts of the project. Formation of SHGs has been started; benefits of financial savings and linkage building with bank have been discussed with women groups (Table 10).

S.No.	Name of SHG	No. of Members	Total Saving
1	Mahalaxmi SHG	10	35948
2	Dhanalaxmi SHG	10	10336
3	Prerana SHG	10	61142
4	Om Sai SHG	10	40509
5	Mata Jogeshwari	10	17797
6	Mahadev SHG	17	29520
7	Kamdhenu SHG	12	8729
8	Jijamata SHG	13	11101
9	Santoshimata SHG	13	11702
10	Kalamjai SHG	10	4900
11	Bholanath SHG	10	36857
12	Bharatiy Adivasi SHG	10	85899
13	Renuka Mata SHG	14	3000
	Total	**129**	**357440**

Mahila Melava

On the occasion of Women's day on 8th March 2011 Watershed Organization Trust organized a Mahila Melava at Malegaon Pathar and the women from Dolasane participated in this function (Fig. 20). In this melawa, in order to give an opportunity for all the participating women, different theme wise group of women were formed and discussions were held. Following were the major themes around which discussions were held 19 women were participated in this event.

- Women Health
- Women and watershed
- Rural Livelihood
- Food Security in watershed
- Women and Panchyati Raj
- Biodiversity

Women from Dolasane village actively participated in this function and shared their experience regarding the project being implemented in their village.

Figure 20. Mahila Melava at Malegaon Pathar, Dolasane-Bambalewadi model watershed Ahemednagar, Maharashtra

Proposed Work Plan

The activities proposed / completed during 2010 are presented in the Table 11.

Table 11. Proposed work plan of Dolasane-Bambalewadi model watershed, Ahemednagar, Maharashtra, 2010-11.

Sl. No	Activities
1.	**Management component**
	Baseline survey, data analysis and report
	DPR preparation
	Knowledge-based entry point activity (soil samples analysis)
	Formation of watershed committees, registration and opening of bank accounts
	Workshops, annual planning meeting and progress report
2	**Soil, water conservation and water harvesting structures**
	Nala / gully plugs (20 nos)
	Well recharging pits (10 nos)
	Field bund plantation / Avenue plantation (2000 rmt)
	Field bunds (2500 cum)
	Farm ponds (4 nos)
	Masonry check wall (1 nos)
	Earthen check dams (2 nos)
	Rock filled dams (1 nos)
	Renovation of old WHS (2 nos)
3	**Productivity enhancement and micro enterprises**
	Improved crop variety (100 ha)
	Micronutrients and balanced nutrition (100 ha)
	Improved Land and water management (50 ha)
	Afforestation, fodder development (2 ha)
	Crop diversification and horticulture development (10 ha)
	Vermicomposting (5 nos)
	Nursery (1 nos)
4	**Capacity-building**
	Community mobilization
	Trainings (on improved technologies, tropicultor use, hydrological & rain gauge equipments, WC etc) (6 nos)
	Field days (2 nos)
	Exposure visits (2 nos)
	Preparation of Training materials
5	**Monitoring and evaluation**
	Raingauge with HOBO data logger and Automatic weather station (1 nos each)
	Runoff and soil loss monitoring station (1 nos)
	Groundwater level meters (2 nos)
	Monitoring of various data

Table : Activity Detail

S.No.	Activity	Project	Linkage	Remark
1	Farm Bunding	120 ha		Some area is proposed under NREGA
2	Loose Bolder Structures	46		Completed
3	Gabion Structure	1		In progress
4	Masonry Check Dam		1	Agri Department
5	Farm Pond	4	9	Agri Department
6	Earthern Nala Bund	1		In progress
7	Horticultural		2 ha	Agri Department

Dob - Nevaj Model Watershed
Udaipur District, Rajasthan

Background

The Dob-Nevaj watershed-macro No. 17 (Micro 1, 2, 3, 4) is in Jhadol tehsil of Udaipur District, Rajasthan. It is located in the valley portion of Aravali hill range and covers two Gram Panchyats Nevaj and Birothi. The area of watershed spreads in three revenue villages namely- Nevaj, Dob and Atwal. The distance of the watershed from the district headquarter is approximately100 km towards south west. The watershed is predominantly inhabited by bhil tribe, which practices mainly rainfed agriculture on a degraded natural resource base. Since people are poor and not able to make their living out of agriculture, they migrate to neighboring state of Gujarat to earn their livelihoods. The long term average of annual rainfall of this area is about 650 mm. According to the land holdings, 80 per cent of the farm families belong to the category of marginal land owners (less than 1 ha), 15 per cent families are small farmers (1 to 2.5 ha) and rest five per cent are big farm families (more than 5 ha).There is no landless family in these villages. Most of the farmers in the area grow maize, pigeonpea and black gram in kharif (rainy) season and wheat, chickpea and barley are grown in rabi (winter season) by the farmers who have access to irrigation. Since access to irrigation is limited, most of the area in the rabi season remains fallow. Some of the key biophysical characteristics of the model watershed site are given in Table 1.

Selection of the watershed site

The success of the watershed program and its impact are greatly influenced by the selection of an appropriate site. Several criteria were considered in the selection of the site for the model watershed. These included representative benchmark site in terms of soils, landscape, rainfall, crops and socio-economic conditions; problem of water scarcity; high poverty level; willingness of the farmers to cooperate; good potential for increasing agricultural productivity, and major area under rainfed agriculture. Multi- institutional team visited several sites in the Udaipur district (Fig. 1). At each site, farmers meetings were conducted and detailed discussions were held with government officials, local institutions and community members. Based on these discussions and the observation collected, Dob, Nevaj and Atwal villages (024° 36’ 64.8” N and 073° 40’ 67.8” E) in Jhadol block was identified as the site for the model watershed in the Udaipur district.

Table 1. Some of the key characteristics of the Dob- Navaj model watershed, Udaipur, Rajasthan	
Revenue Village	3 villages-Navaj, Dob and Atwal
Panchayat	Nabaj and Birothi
Tehsil	Jhadol
District	Udaipur
Location	South part of Rajasthan (Agro Climate zone IV B Udaipur)
Total Area of revenue villages (ha)	1114
Total irrigated area (ha)	24
Highly degraded land (ha)	136
Forest land (ha)	481
Agro Climate	Rainfed; Dry SAT
Key soil chemical properties	
Soil pH	5.7 - 8.5
% organic carbon	0.22 - 0.82
Ols P (ppm)	1.9 - 91.0
Exch.K (ppm)	58 - 575
Availa S (ppm)	3.7 - 47.7
Availa Zn (ppm)	0.3 - 2.82
Availa B (ppm)	0.12 - 1.22

Figure 1. Visit of the multi-institutional team to Dob-Navaj watershed for the selection of watershed site in the Udaipur district, Rajasthan

Consortium partners

- Seva Mandir, Udaipur
- Mahatma Phule University of Agriculture and Technology, Udaipur
- Dob-Nevaj Watershed Committee

- Forest Department, Government of Rajasthan, Udaipur
- Department of Watershed Development, Udaipur
- Krishi Vigyan Kendra, Vidya Bhavan, Udaipur
- ICRISAT

Watershed Committee formation and its functions

Watershed committee was formed comprising the representatives from all the three watershed villages in April 2010. After the initial village level meetings, a general meeting of all households of three project villages was called to elect the members for watershed development committee (WDC). The assembled villagers were briefed about the structure, roles and responsibilities of the committee in the proposed watershed development. Members were selected from each village based on hamlets and social constitution such as caste, gender etc. Total 21 members were elected from the three watershed villages including 11 (>50%) women members. A president, vice-president, secretary and treasurer were also elected amongst the selected members. It was decided that 17th of the every month, the committee would meet to discuss the watershed development work.

- Structure of wateshed management and development committee
  - Representation from each hamlet
  - Three village development committees (one for each village)
  - Three sub committees
    - Planning and monitoring
    - Finance
    - Conflict resolution

The process of opening the bank accounts and registration of watershed committee has been completed. Training on orientation of watershed planning with selected members of watershed committee on the process of physical planning, based on net planning in watershed was organized in July 2010 (Fig.2).


Figure 2. Training to watershed committee members at Dob-Navaj watershed Udaipur

Self Help Group formation and trainings

First phase of Self Help Groups (SHGs) formation has been completed. This includes organizing meetings of the women for communicating with them about need of SHGs, importance of saving and lending, record keeping and management of funds, roles and responsibility of members etc. Eleven women members from Atwal village meet regularly on monthly basis. They have started saving with initial contribution of Rs. 21 / member / month. The first grading of this SHG was done in March 2011.

After a very useful SHG centric exposure visit to PEDO and Dungarpur model watershed, three more women groups of Dob and Nevaj are in process of formation. On campus training of SHGs was done on 7-8 June 2011 in Jhadol block office of Seva Mandir (Fig. 3). Forty women participated in the training from Dob, Nevaj and Atwal village where model watershed work is going on. The main objectives of the training program were:

- Purpose and objective of SHGs
- Strengthening of women groups
- Rules and regulations of SHGs
- Inter-loaning among groups for personal or group activities
- Operating income generating activities among groups
- Social as well as economic empowerment of SHGs
- Importance of SHGs in watershed committee and activities

The details of different self-help groups in 3 villages of the model watershed are given in table 2.

Table 2. Details of different SHGs in 3 villages of Dob-Navaj watershed

Village Name		Name of SHGs	Members	Supported by	Present saving (Rs)
Atwal	1	Vikas Self Help Group	11	Seva Mandir	1700
	2	Payal Self help group	9	ICDS	2800
	3	Dharati Mata SHGs	10	ICDS	19000
	4	Chamunda Mata SHGs	10	ICDS	16000
	5	Sarda SHGs	10	ICDS	3200
Dob	1	Dassa Mata SHGs	13	ICDS	5000
	2	Baba Ramdev SHGs	11	ICDS	NA
	3	Chetana SHGs	10	ICDS	NA

	4	Chamunda Mata	10	ICDS	NA
Nevaj	1	Jai Ambey SHGs	10	ICDS	NA

Fiaure 3. Trainina of watershed villaae SHGs at Seva mandir Jhadol office.

Baseline Data

Detailed baseline survey was taken up, which included biophysical and socio-economic aspects of watershed through PRA and RRA techniques. About 30% of the total households were covered using detailed pre-tested instrument. A detailed report will be prepared covering baseline characterization of the watershed. Some of the preliminary information from the baseline survey is discussed.

The Dob-Nevaj villages are revenue villages under the Nevaj panchayat and the adjacent Atwal is a revenue village under the Biroti panchayat of Jhadol block of the Udaipur district. These villages are inhabited mostly by Garasia (ST) and Rajput families and a few Meghwal (SC) families. There are 84 households with around 420 populations in Dob village, 240 families with around 1200 population in Nevaj and 120 households with around 600 populations in Atwal. The map of the watershed is shown in Figure 4.

The land holding pattern is small and fragmented. Among all these villages, 80% of the families are small farmers (less than 1 ha), 15% of the families are marginal farmers (1 to 2.5 ha) and rest 5% are big farmers (more than 5 ha). There are no landless families in the village.

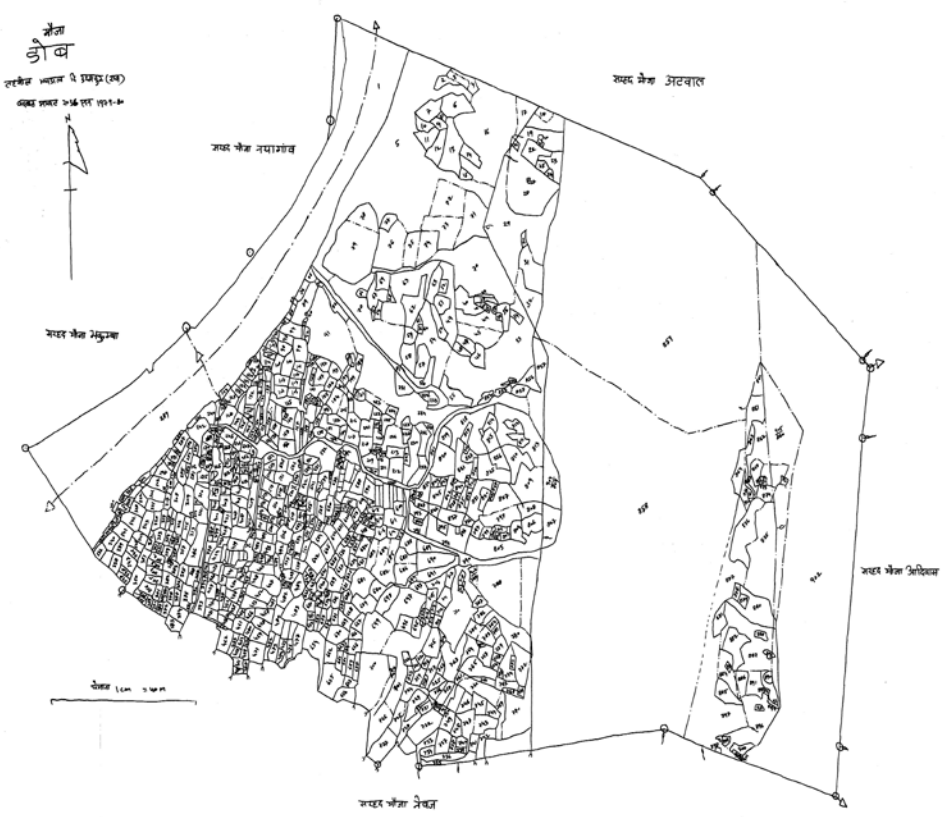


Figure 4. Cadastral map of Dob-Navaj watershed, Udaipur district.

Major crops and their productivity

Kharif is the major cropping season in these villages with maize and rice being the major crops grown covering 60 % of the net area sown during the season. Among these two crops, maize accounts for 75% and rice for 25% of the area under cultivation. The average maize productivity varies from 1.2 to 2.4 t ha^{-1}. Apart from these two crops, farmers also cultivate pigeonpea, black gram and sesame. The average productivity of pigeon pea is 0.7 t ha^{-1} and black gram 0.3 to 0.4 t ha^{-1}. Farmers practice mixed cropping of maize and pigeonpea. In the Rabi season, depending on the moisture availability, farmers cultivate chickpea and mustard. The average productivity of chickpea is 0.7 t ha^{-1} and of mustard 0.6 t ha^{-1}.

Village Infrastructure

A metal road passes through these villages, which connects them to tehsil headquarters and district headquarters. The villages Dob and Atwal have lower primary school and the Nevaj has one higher primary school. There is one sub-centre of PHC with one resident ANM in Dob and for the PHC service people have to commute to Panarva, which is 15 km away from these villages. There is Anganwadi (pre-school centre) in all these villages. A sub-

centre of Post Office is located in Nevaj and for banking purpose, they visit Mini bank at Piara, which is 15 km from the village.

Knowledge-based Entry Point Activity

Soil sampling and its characterization as knowledge-based entry point activity was taken up at the watershed. Participatory stratified sampling procedure was followed through PRA, and a total 60 soil samples were collected (Fig. 5) and analyzed for fertility parameters (Table 3). Based on finding, nutrient recommendations have been prepared. This will benefit the farmers in implementing balanced nutrient management to increase productivity, while saving money by judicious use of fertilizers and maintaining soil health.

Table 3. Soil health Status – Per cent farmers' fields deficient in various nutrients at Dob-Navaj model watershed, Udaipur.

	% deficient					
Village name	OC	Av P	Av K	Av S	Av Zn	Av B
Atwal	55	40	0	60	35	90
Dob	60	20	0	65	20	100
Nevaj	78	33	0	72	72	89
Total watershed	63	31	0	66	41	92

Figure 5. Farmers Collecting soil samples at the Dob-Nevaj watershed, Udaipur district

Weather and Hydrological monitoring

Following activities have been taken up:

- One automatic and one manual rainguage have been installed at the watershed (Fig. 6) on June 2010. The measured daily rainfall during 2010 rainy season is shown in Figure 7. During 2010 rainy season a total 986 mm of rainfall was received, which is about

40% higher than the long-term average of this area. One big rainfall event at 123 mm was received on 25th July 2010, which generated very high runoff and soil loss.

Figure 6. Rain gauge installed at the Dob-Nevaj model watershed, Udaipur district

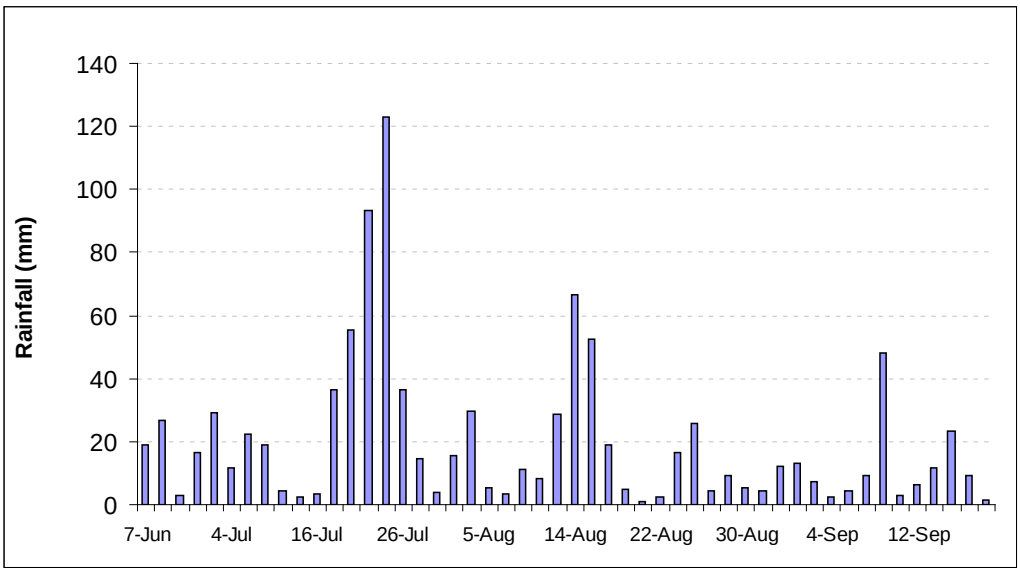


Figure 7. Daily rainfall at the Dob-Navaj watershed during 2010 rainy season

· Total 12 open wells (representing upstream, middle and downstream parts of the watershed) have been identified for monitoring the groundwater levels (Fig. 8). These wells have been numbered and geo-referenced. One groundwater meter has been provided to the watershed community for participatory monitoring of the groundwater levels. The project staff and community members are trained on use of

groundwater meter.The continuous monitoring of water levels in 12 open wells is done twice in a month to observe the change in the groundwater levels at watershed scale. The groundwater recorded during February to June 2011 is shown in Figure 9.

Figure 8. One of the open well idenfied for monitoring groundwater levels at the Dob-Nevaj model watershed, Udaipur district

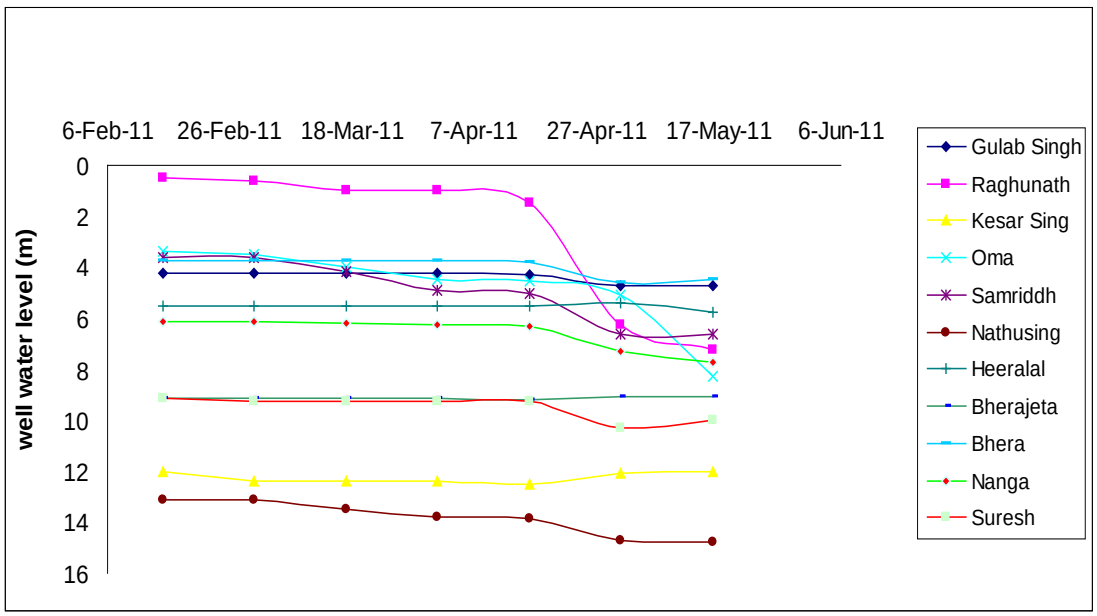


Figure 9. Groundwater levels (m) in different wells at Dob-Nevaj model watershed, Udaipur, Rajasthan

· One digital runoff recorder, and automatic sediment sampler is installed at the wateshed (Fig. 10). Training has been given to the local staff on day to day handling of the equipments. This equipment records runoff, soil loss as well as nutrient losses from the watershed.

Figure 10. Digital runoff recorder, automatic sediment sampler installed at the Dob-Nevaj model watershed, Udaipur district

Productivity enhancement activities

Enhancing agricultural productivity in the watershed area is of paramount importance. Discussions with the group of farmers were held to find out the ways for enhancing the yield of crops cultivated locally. In this connection, discussions began to introduce appropriate cultivation technologies including introduction of improved crop cultivar developed at ICRISAT or other institutions. In order to familiarize the farmers to improved technologies and practices like use of micro-nutrients and fertilizers, new crop cultivars etc., the farmers were given in field training by ICRISAT and Seva Mandir staff (Fig. 11). The local farmers actively participated in the interactive training programs. After the training, a list of interested farmers willing to participate in field trials was prepared. During sowing season too, project staff assisted farmers in implementing different treatments on the scientific lines. Details of the rainy and post rainy season trials conducted during 2010-11 are discussed.

Figure 11. Field training about the improved crop and nutrient management system during 2010

Rainy Season

Participatory productivity enhancement trials were conducted in the watershed. The farmers were supported well with improved variety of seeds of maize (Pratap composit), black gram (T-9) and pigeonpea and micro-nutrients such as Zinc sulphate, Agribore and Gypsum, but due to very poor early rains only few farmers could conduct the trials. The maize and black gram yields under the improved and traditional management systems (both grain and fodder) are shown in Figure 12.

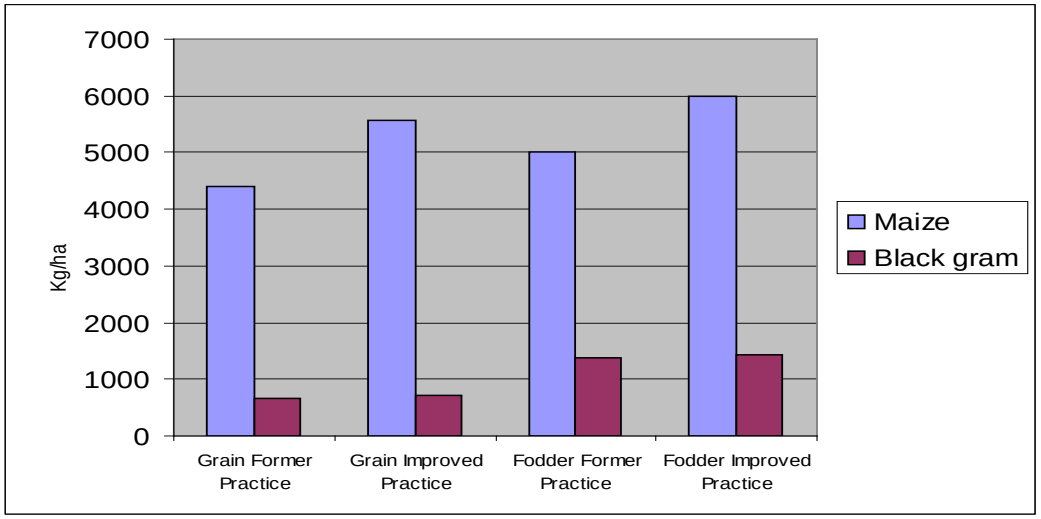


Figure 12. Maize and black gram yields under the farmers and improved management system during 2010 rainy season

Post rainy Season

(i) Participatory trials on improved and traditional management systems with chickpea:

Farmers participatory trials on chickpea with improved management system (balance nutrients and high yielding varieties) and traditional management system (local inputs with local varieties) were conducted in all the 3 villages of the watershed (Fig. 13). The chickpea grain and biomass yields from the trials are given in table 4. Data clearly shows the excellent performance of improved system compared to the local seed and FP. The chickpea yields due to improved system increased by 39-118% over the farmers' practice. The collected data were analyzed and shared with the farmers to upscale the improved practice of micro nutrients and improved varieties in the entire watershed area.

Figure 13. Chick pea demonstration at the Dob-Navaj watershed

Table 4. Chickpea grain and biomass yield in traditional and improved management system during 2011.

S. No.	Farmer's Name	Grain Yield (kg ha^{-1})		% increase over traditional system	Biomass (kg ha^{-1})		% increase over traditional system
		Traditional system *	Improved System**		Traditional system	Improved System	
1	Karan singh	1440	2000	39	1670	2330	40
2	Nathu singh	1110	1780	60	1610	2110	31
3	Himmat singh	890	1670	88	1330	1940	46
4	Balu singh	560	1220	118	1200	1440	20

** Local variety + traditional farmer's practice*
*** Improved system includes balance nutrients + improved chickpea variety of RGS 888*

(ii) Participatory varietals selection cum yield maximization of chickpea: Subsequently we selected the innovative farmers for the varietals trials for participatory selection of good variety of chickpea for the watershed area. These trials were designed with an objective of selecting a cultivar for better adaptation to biotic and abiotic stresses with capability of enhancing productivity. The related farmers were provided the soil deficient nutrient like zinc sulphate and gypsum and two improved variety of chickpea (RSG -888 and BG – 372) to cultivate The RSG – 888 and BG – 372 are the two high yielding chickpea varieties specially released for North West India. The chickpea grain and biomass yields under the improved management system are shown in Table 5.

Table 5. Performance of different chickpea varieties under improved nutrient management system during 2011.

S.No	Farmer's Name	Grain yield (kg ha^{-1})					Biomass yield (kg ha^{-1})		
		Balanced Nutrition+IV					Balanced Nutrition+IV		
		FS*	RSG- 888*	% Increase over FS	BG- 372**	% Increase over FS	FS	RSG-888	BG-372
1	Laxman	1220	1890	55	1780	46	2330	2110	2000
2	Raghunath singh	1220	1670	37	1670	37	1440	1890	2180
3	Nathu singh	1000	1780	78	1560	56	1560	2110	2060

** FS – Farmers seed (local variety)*
*** RSG-888 and BG-372 – Improved varieties*

Clearly under the improved nutrient management system both improved chickpea varieties gave much higher yields compared to local varieties. However the improved chickpea variety of RSG-888 has given highest yield compared to other improved and local variety.

(iii) Participatory trials on improving water productivity: It is important to conserve soil and water in the fields in the undulating area like Dob-Nevaj watershed. It is, therefore, necessary to follow agriculture practices which prevent soil erosion and improves water use

efficiency. Scientists of ICRISAT with Seva mandir staff and few innovative local farmers have designed and implemented trials in the watershed area to devise mechanisms which improves the soil-water-crop relationship. Total four farmers were involved in this experiment. Each farmer implemented following four treatments.

Drip irrigation system on BBF system

Drip irrigation system on flat **system**

Figure 14. Improved irrigation in different land and water management system during 2010-11 post rainy season.

1. Flat cultivation with drip irrigation
2. Flat cultivation with flood irrigation
3. Broad bed and furrow (BBF) with drip irrigation
4. Broad bed and furrow (BBF) with flood irrigation

In all the plots for sowing new machinery (tropicultor) was used to ensure accurate and uniform seeding and preparation of the BBF in field. The Drip system was laid out in the trials (Fig. 14) and the water meter was fixed for monitor the application of irrigation water in the field. Fiber tubes also installed in three places in each treatment for monitoring the soil moisture level in the field at different soil depths. The TDR meter was used in each plot to monitor soil moisture at different depths of soil for estimating the requirement of timely irrigation. Water was being lifted from the nearby river to all the fields. In all the plots, improved variety GW 773 of wheat had been used. As per the soil analysis balanced nutrients including micro-nutrients were applied.

The crop yield of wheat under different land form conditions and irrigation methods is shown in Figure 15. Column in given figures shows mean value of the given parameter and error bar shows its variation among all the four replications. Figure shows average grain yield of experimental plots in between 3.1 and 4.2 ton ha^{-1}. Water productivity of the wheat crop is found in range between 1.1 and 1.6 kg m^{-3} BBF plots with drip irrigation systems are

found superior among all the experimental plots as both yield and WP both are high; whereas crop yield and WP in flat-flood system is found relatively less

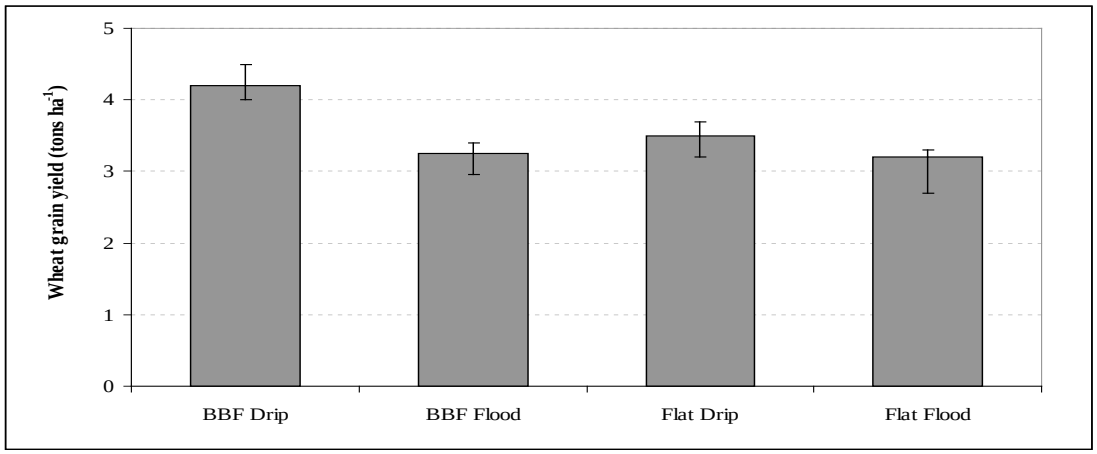


Figure 15. Crop yield of wheat crop under different land form conditions and irrigation methods in 2010 - Column in above figure shows mean value and error bar shows its variation among four replications

Impact of balanced fertiliser application on crop yield in 2011-12:-

A detailed soil sampling was undertaken to analyze soil health in the three watershed villages covering upper, middle and lower reaches of the watershed. Samples from the fields of 59 farmers were collected. Soil samples were analyzed at ICRISAT. Results showed that 63% farmers' fields were deficient in available nitrogen, 31% deficient in available phosphorus but all the fields were adequate in available potash. In terms of micro nutrients, 66% of the fields were found deficient in available sulfur, 41% and 92% fields were deficient in available zinc and boron, respectively. Application of balanced fertilizer application showed 10-20 % increase in crop yield during Rabi 2011-12 (Figure 15b and Table 6).

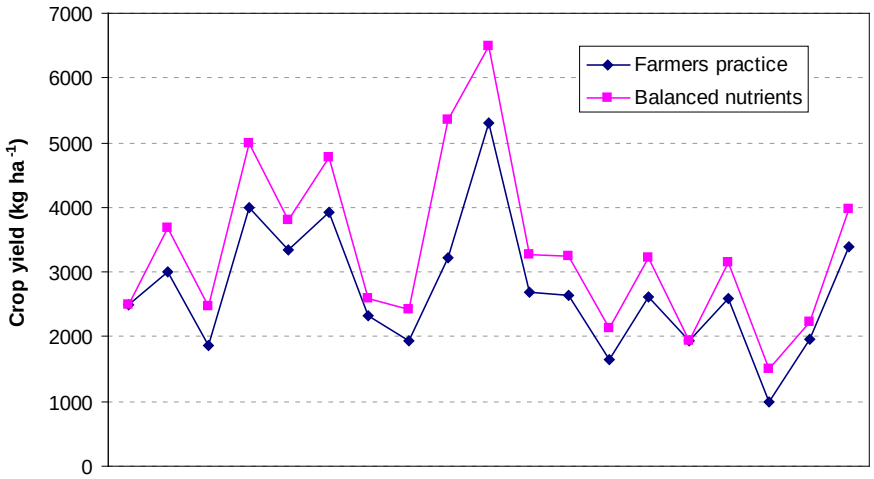


Figure 15b. A comparison of crop yield among farmers' practice and balanced application of nutrients (data from farmers participatory trials in watershed during 2011-12)

Table 6. Impact of micro-nutrient application on wheat growth and yield in year 2011-12 (Data are from 14 fields collected by farmers' participatory research)						
Parameters monitored	Farmers practice			Micro-nutrient application		
	Average	Min	Max	Average	Min	Max
No of tillers per plant	6	12	4	7	15	5
Average grain per ear head	47	63	14	49	68	15
Grain yield (kg / ha)	1503	3314	416	1778	3498	702
Straw yield (kg / ha)	2425	6094	1048	2682	6111	1151

Joint forest management (JFM)

An important aspect of watershed development intervention is to integrate common lands in the watersheds. In the proposed watershed, substantial area is under forest. The forest area is situated in the upstream of watershed. In any watershed program, treatment of upstream area is essential to reduce the flow of water and conserve soil and water resources. Seva Mandir along with other project partners and local community, prepared a development plan for the treatment of upstream (forest land) in Dob and Nevaj villages under Joint Forest Management (JFM) Programme in collaboration with the Forest Department. After getting the necessary approval from the Forest department, work on Dob (31 hac.) and Nevaj (51 ha.) JFM site was started. Protection of the site by open grazing was very essential. Therefore, in the initial phase, demarcation and construction of loose stone boundary wall has been completed and about 7832 rft of stone wall is constructed in Dob and 6371 rft in Nevaj (Fig 16). During the fencing there was lot of objection by some local dwellers who had encroached the land. However, this issue was resolved through negotiation by watershed committee members and forest protection committee. Several development works in the forest area are being taken up to improve the productivity some of the development activities taken up in JFM area are:

Figure 16. Construction of Joint forest management boundary wall work in Nevaj village

(i) **Construction of loose stone check dams (LSCD):** In the upstream area of JFM constructed 12 number of LSCD in Dob village and 149 numbers in Nevaj village for controlling the soil loss and reducing the runoff flow in the watershed.

(ii) **Construction of Trenches:** Trenches are very effective for *in-situ* runoff water management. We have completed in Dob village 6841rft trenches and 7485 rft in Nevaj village.

(iii) **Pit digging:** This year we plan to transplant about 8000 plants in Dob village JFM area and 13500 plants in Nevaj village JFM area and already 3000 pits has been completed in Dob village and 5500 pits in Nevaj village.

(iv) Farm bunding and LSCD: Watershed area are very undulated and lot of fields are facing the soil lose problems. In present years project has identified the individual farmer's field where field bunding could be made. Total 201.7 Cubic meter Dry stone cum earthen bunds, 2946.6 cubic meter earthen bund and 86 cubic meter dry stone check dam has constructed and thirteen farmers has benefited by the activities and covered approximate 60 hectare area in the village.

Income-generating activities

Annual Nursery: Last year total 10,000 nurseries of Neem, Mango, Kanranj (Pongamia), gliricidia and other plants species were prepared and all the plants were transplanted on the fields. This year, another 20,000 plants of gliricidia Neem, Kher, Acacia Pongamia, Black plum and Custard apple are being prepared for the watershed villages and JFM area (Fig. 17).

Figure 17. Nursery in Nevaj village

In year 2011-12 project has supported for local people to raise the local bread plants as well as Gliricidia plants for the pasture land and farm bunds for reduce the soil loss from the field and enhance the fertility status of soil. This year 6350 plants have prepared in the local nursery and transplanted in the joint forest as well as farmers field bunds. Details of the plants are given in Table 7.

Joint forest management: Tree plantation has taken place in project village at two sites and managed by the joint forest management committee. Total 18543 number of plants such as Jatropha, Neem, Bamboo, Jamun, Behara Karanj, Amaltas, Subabul,Mahua etc. are newly planted.

Table 7. Number of trees planted in watershed area			
S.No.	Village	Total No.of Plants	Species
1	Dob	900	Neem
2	Dob	3280	Bambo
3	Dob	445	Jamun
4	Dob	400	Mahua
5	Dob	80	Kikar
6	Dob	45	Sagwan
7	Dob	700	Glerecidia
Total		6350	

Vermicompost: The 4 chambers vermicompost model was shown to farmers during the exposure visit to Dungarpur watershed. Twenty six farmers of the watershed have shown interest for construction of vermicompost pit. Training for maintenance and use of vermicompost was provided to interested farmers on February 2011. Proposal had been taken though the watershed committee and initially 10 innovative farmers had been selected for this activity in this year and by May end 6 vermi pits have been completed (Fig. 18) and remaining four are under construction.

Figure 18. Vermicompost pit in Nevaj village

Several other activities for income generation especially for women and poor farmers are being discussed and planned.

Cattle health camp: Watershed is 100 km far from the Udaipur city and very little government facilities available for animal health checkups. One cattle heath camp has been organized in each of watershed villages during March 2012. Total 1291 animals has been checked and 1053 families has benefited.

Capacity Building Including Exposure Visits

Training cum exposure visit was organized for watershed committee members, farmers along with Seva Mandir staff (Fig. 19). The group visited the watershed being jointly developed by People's Education and Development Organization (PEDO) and ICRISAT in Dungarpur and WOTR and Bagar Jan Jagrati Sangathan Dungarpur. The main objective of the visit was to introduce and familiarize the newly elected members of the committee to a functioning watershed from which they could draw lessons on various aspects. The group interacted with the members of watershed development committee and leant about watershed planning and implementation, use of new technologies, improved methods of cultivation and maintenance of various records etc. PEDO Dungarpur is well known for its work on women`s empowerment and micro-finance programs. This exposure also provided an opportunity to the group to know more about the income generating activities, and formation of SHGs in watershed. Following key points were covered during the exposure visit.

Figure 19. Exposure visit to Dungarpur model watershed

- Cultivation and processing of aloe vera juice at household level by SHG members of watershed.
- Management of SHG member owned flour mill or *atta chakki* as income generating source
- Cultivation of improved cultivars of chickpea, wheat, mustard, turmeric and organic pest control measure
- Fennel seed cultivation and package of practices adapted by local farmers
- Dairy and poultry development and its management at village Kotera-Mewara.

In Summary the Participants greatly benefited from the exposure visit and gained enormously valuable knowledge which will help and motivate them towards adapting new technologies to improve their farming and livelihoods.

Some of the other key capacity building activities conducted at the watershed during 2010-11 were:

- Constitution and orientation training of the village development committee members: This project places institutions at the center stage of its development initiatives to

prepare them to take up and solve the local challenges through democratic dialogue process. For this purpose, village samuh (general village body) and village development committees (village executive body) are promoted and regularly trained for the institutions and development works. Village development committee members were imparted with two-day orientation training on the concept of village institutions, the roles and responsibilities of the members, and book keeping, etc. (Fig. 20).

- Training on the orientation on watershed planning: One-day orientation training was done for the selected members of watershed committee on the process of physical planning of the watershed based on net planning. The concept of net planning in the watershed, different watershed treatment activities based on landscaping, process of mapping the activities were discussed with the members.

Figure 20. Orientation training of the village development committee members at Dob-Nevaj model watershed, Udaipur district

- Visit of farmers to ICRISAT and the Kothapally Model watershed: An exposure visit was organized by ICRISAT to the model watershed of Kothapally, Andhra Pradesh in March 2010. Five farmers from the Dob and Nevaj villages along with the field level local workers of the Seva Mandir participated in this exposure visit. They were impressed by the different types of soil and water conservation activities and productivity enhancement initiatives. After their return from the visit, they discussed the learning of the visit with the other villagers in different meetings.

- Training to field staff and community members on how to operate and take the readings using the groundwater meter

- Training to field staff on the collection of rainfall data using the manual automatic rain gauges
- Training to field staff on the collection of runoff and soil loss data from the digital recorders and sediment samplers.

Convergence of other programs in watershed

- *Dob lift irrigation project sanctioned by the Forest Department*: A lift irrigation project has also been sanctioned by the Forest department. Survey work of the command area has been completed and process of construction of storage tanks will commence soon. Total 18 farmers are expected to be benefited from this activity.
- *Interventions on livestock*: Jointly with government departments two livestock vaccination cum treatment camps were organized in December 2010 and January 2011. In these camps, animals of local farmers were treated for seasonal and contagious diseases. Animals with minor ailments were also treated.

Padarlya-Siyalwada Model Watershed
Raisen District, Madhya Pradesh

Background

Padarlya-Siyalwada watershed or Garbhan Nadi Watershed is situated in Silwani block of the Raisen district in Madhya Pradesh. The watershed comprises six villages viz. Chor Pipliya, Rampura, Dungariya Khurd, Siyalwada, Gaganwada and Padariya Kalan. It is located about 55 km from the Raisen town. The total area of the watershed is about 1736 ha with net treatable area of about 1237 ha. The upstream parts of the watershed have forest areas. The mean annual rainfall is about 1050 mm. The watershed is characterized by an undulating topography with an average slope of 3.5%. At few places, there are small hillocks. The hill slopes range from 6 to 42% and the soils are subject to severe soil erosion and land degradation. In the watershed, the soils are predominantly black soils. The soil depth ranges from 10 to more than 300 cm; and the soils have medium to high water holding capacity. The total population in the Padarlya-Siyalwada watershed is 2821 belonging to about 511 households. Major crops grown in the watershed villages are soybean, maize, pigeonpea, chickpea and wheat.

Selection of the watershed site

This activity was given high importance, as the success of the watershed project and its impact are greatly influenced by the selection of appropriate site. Several criteria such as representativeness in terms of soils, landscape, rainfall, crops, and socio-economic conditions; willingness and cooperative nature of the farmers; good accessibility; good potential for increasing agricultural productivity and income and major area under rainfed agriculture.

Several other socio-economic factors such as prevalence of poverty, small and marginal farmers, high proportion of the vulnerable group members (BC, SC, OBC, etc.) were also considered. Considering these criteria, initially a few sites short listed for model watersheds were identified in Raisen district, Madhya Pradesh. Then multi-institutional team visited these sites in the district and identified appropriate site based on the available secondary data with government line department (Fig. 1). At each site, farmers meetings were conducted and detailed discussions were held with government officials, local institutions and community members. Based on these discussions and the observation collected, Chor Pipliya, Rampura, Dungariya khurd, Siyalwada, Gaganwada, and Padariya Kalan villages in

Silwani block were selected for the model watershed in the Raisen district. These villages met most of the criteria viz. villagers keen to participate, good possibility of improving water availability and increasing agricultural productivity and the site is easily accessible.

Figure 1. Multi institutional team visit to Padariya Kalan village for the selection of watershed site in Raisen district, Madhya Pradesh.

Consortium partners

- Bhopal Yuwa Paryavaran Shikshan and Samajik (BYPASS) Sansthan, Madhya Pradesh
- Garbhan Nadi model watershed development Samiti, Siyalwada, Raisen
- District Department of Agriculture, Raisen
- ICRISAT

PRA Exercise

At the initial stage of the watershed project, the PRA exercise was carried out at all the six villages. Following activities were taken up:

- Social / resource mappings
- Time line / context analysis
- Seasonality
- Services / problem analysis

The social mappings of all the watershed villages were done to understand the socio-cultural aspects of the village community. Also, the resource analysis was done in all villages with community. All the natural and other resources in the watershed were mapped (Fig. 2). This exercise facilitates community to analyze the available resources in their villages, which will help in future to plan for management of resources for livelihood improvements. The seasonality exercise was also done to learn about resource availability and community engagements in different socio-cultural issues. Also, it provides a clearer

picture about the availability of labor for physical activities in the area. The extension system in the villages was also analyzed. Due to remote location, the community is struggling hard to receive the services from government departments. Finally, the problem analysis exercise was carried out with community to sort out the reason behind problems which will help us in future to find out the possible solutions. The time line exercise was carried out with the community. Some of the interesting information came out of this analysis are:

- Human habitations in the area is about 150 years old
- Earlier their was dense forest of Sagon in the area
- Wild animals were present just till 15 years back in the area
- Electricity supply started in 2003
- Hand pumps were installed after 1990 in the area, earlier people used to dig pits in river beds during summer to get the drinking water

Figure 2. Social mapping and transit walk at the Padarlya-Siyalwada model watershed, Raisen district, Madhya Pradesh.

Watershed Committee formation and its functions

After a series of meetings and consultations, the watershed committee was formed and applied for registation with the district officials. About 50% of the wateshed committee members are women. The wateshed committee consistits of total 17 members with the following details:

- One male and one female village action group representatives from each village (12 members)
- Three active female members representing gram panchyat and SHGs
- One representative from BYPASS
- One secretary of the committee

One president, vice president, secretary and treasurer were also elected. Necessary trainings and exposure visits were organized to improve the capacity of the watershed committee members in performing their responsibilities. For each of the six villages, one action group of six members was formed with participation of community. This village level action group will facilitate planning, development and monitoring of various watershed activities.

Self Help Groups Development

SHG development is a proven method for empowering the marginalized/ vulnerable section of society. Under the project women from poor families residing in watershed area are motivated to organize in groups (Fig. 3). As a result of these efforts, in 3 villages 5 women SHGs have been formed, These 5 SHGs are in Gaganwada, Siyalwada and Dungariya villages. Total 72 Women are participating in these SHGs and in other villages also the women meetings are going on to organize more SHGs. Out of these SHGs 4 are from Tribal community. Till December 2010 the SHGs are having total saving of Rs. 13840.

Two days orientation of SHGs was done in following 3 villages

Village Siyalwada-3 SHGs (47 participants)

Village Gaganwada-1 SHG (12 participants)

Village Dungariya-1 SHG (13 participants)

Figure 3. Empowering women SHG in watershed village.

These sessions were organized during 20 to 30 August 2010. The orientation was done in interactive way; all the participants introduce their partner to the audience. The story on collective strength and mutual cooperation was discussed with the women and they were facilitated to learn the moral from the stories. Then the concept of SHG was discussed with participants. The examples of success through SHGs were narrated to the women, how the

small savings and confidence transform into strength. The quality of good SHGs like regularity, participation, mutual cooperation, equity, discipline, and collective decisions were discussed with the women. After two days rigorous exercise women were delighted that they spent time for useful learnings.

Besides saving and credit activities of SHGs, project regularly emphasize on searching and working on new avenues for employment and earning, thereby supplementing their household income. Taking the lead from their peers, Puja self-help group from Siyalawada village, decided to undertake a income generating activity. This SHG has in total 16 women members and all from tribal community. After deciding within group, members presented their idea to project staff. They planned to purchase pigeonpea from market and after grading they will preserve grade seed for sale in the next cropping cycle and preparing pulse from rest. After assessing the viability of the idea, a loan of Rs. 20000 was sanctioned to the group, out of this, group has purchased 400 kg of pigeonpea (Asha variety). A proposal has been also submitted to Agriculture Department for the supply of Seed Grader at subsidized cost. Department has already approved proposal and machine will be supplied to them very soon.

Baseline data collection and analysis

The secondary data for the area were collected from the different service providers. The cadastral maps of the watershed area were collected from the village patwari (Fig. 4) and were digitized at GIS lab at ICRISAT. The total area of the watershed is 1736 ha with net treatable area of 1237 ha. The watershed boundary, open wells, villages and other key features have been geo-referenced.

Detailed baseline survey was taken up, which included biophysical and socio-economic aspects of watershed through PRA and RRA techniques. A detailed household survey format prepared by ICRISAT was used for this purpose. For the baseline survey 20% of the total households (102 nos) from the watershed villages were selected. From the selected households very detailed information on following aspects were collected.

- Family information
- Land details
- Soil and water resources current status and its trend
- Current and past agricultural practices

- Input / output analysis for rainy, post rainy and summer crops and cropping system
- Harvest management
- Other sources of income
- Livestock management
- Infrastructure details
- Financial management

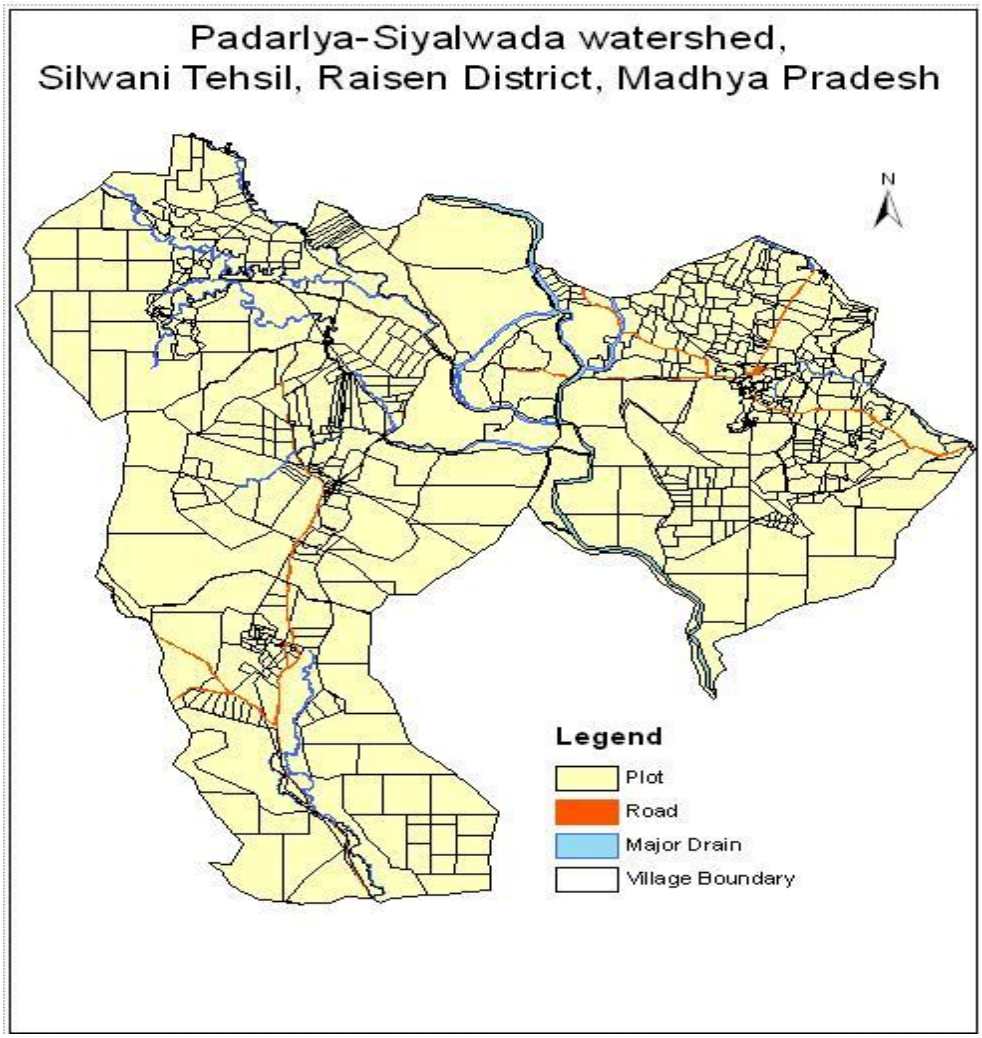


Figure 4. Cadastral map of Padarlya-Siyalwada model watershed, Silwani block, Raisen district, Madhya Pradesh

Data entry is already completed. Part of these baseline data on social profile of the community, farmers' classification, cattle population and land classification are given Tables 1, 2, 3, 4 and 5. A separate detailed report is being prepared on the baseline characterization of watershed villages.

Table 1. Social profile of the communities in different villages of Padarlya-Siyalwada model watershed, Raisen district.

Name of the Village	Households				Population		
	Scheduled caste	Scheduled Tribe	OBC & others	Total	Male	Female	Total population
Chor Pipliya	5	55	2	62	137	138	275
Rampura	3	3	30	36	102	88	190
Dungariya Khurd	3	50	5	58	165	144	309
Siyalwada	6	109	36	151	386	342	728
Gaganwada	1	16	22	39	116	99	215
Padariya Kalan	30	15	120	165	588	516	1104
Total	48	248	215	511	1494	1327	2821

Table 2. Social profile of the communities in different villages of Padarlya-Siyalwada model watershed, Raisen district.

Name of the Village	Population								
	Scheduled caste			Schedule tribe			Backward class & others		
	Male	Female	Total	Male	Female	Total	Male	Female	Total
Chor Pipliya	11	12	23	122	123	245	4	3	7
Rampura	8	5	13	9	9	18	88	71	159
Dungariya Khurd	6	6	12	148	123	271	16	10	26
Siyalwada	13	13	26	261	242	503	111	88	199
Gaganwada	1	1	2	46	35	81	72	60	132
Padariya Kalan	79	73	152	107	89	196	399	357	756
Total	118	110	228	693	621	1314	690	589	1279

Table 3. Farmers profile in Padarlya-Siyalwada watershed villages, Raisen district.

Name of the Village	No of households				Total farmers
	Big	Medium	Small	Land less	
Chor Pipliya	7	28	16	11	62
Rampura	3	18	8	7	36
Dungariya Khurd	7	8	30	13	58
Siyalwada	22	35	80	14	151
Gaganwada	5	10	17	7	39
Padariya Kalan	15	52	77	21	165
Total	59	151	228	73	511

Big farmer > 4 ha; Medium farmer 2-4 ha; Small farmer upto 2 ha.

Table 4. Livestock population in different villages of Padarlya-Siyalwada model watershed, Raisen district.					
Name of the village	Cow	Buffalo	Bullock	Other (goat, Sheep etc)	Total
Chor Pipliya	88	1	42	45	176
Rampura	110	12	70	30	222
Dungariya Khurd	102	10	60	80	252
Siyalwada	250	78	80	50	458
Gaganwada	110	42	77	70	299
Padariya Kalan	350	90	151	110	701
Total	1010	233	480	385	2108

Table 5. Land use pattern in different villages of Padarlya-Siyalwada model watershed, Raisen district.								
Name of the village	Irrigated (ha)	Rainfed (ha)	Monsoon Fallow land (ha)	Horti-culture (ha)	Total Agriculture land (ha)	Forest (ha)	Common land (ha)	Total (ha)
Chor Pipliya	0	90	19	0	90	0	0	90
Rampura	15	123	25	1	138	0	3	147
Dungariya Khurd	0	106	18	0	106	0	0	106
Siyalwada	60	202	34	0	262	0	3	274
Gaganwada	17	129	24	1	146	0	2	148
Padariya Kalan	120	375	36	0	495	422	18	971
Total	212	1025	156	2	1237	422	26	1736

Entry Point Activity

Soil sampling and its characterization as knowledge based entry point activity was taken up at the watershed. Participatory stratified sampling procedure was followed through PRA, and a total 60 soil samples were collected and analyzed for fertility parameters. Based on finding, nutrient recommendations have been prepared. This will benefit the farmers in implementing balanced nutrient management to increase productivity, while saving money by judicious use of fertilizers and maintaining soil health.

Weather and Hydrological monitoring

Following activities have been taken up during 2010-11.

One automatic and one manual rainguage have been installed at the watershed (Fig. 5) in June 2010. The measured daily rainfall during 2010-11 is shown in Figure 6.

Figure 5. Rain gauge installed at Padarlya-Siyalwada model watershed, Raisen district.

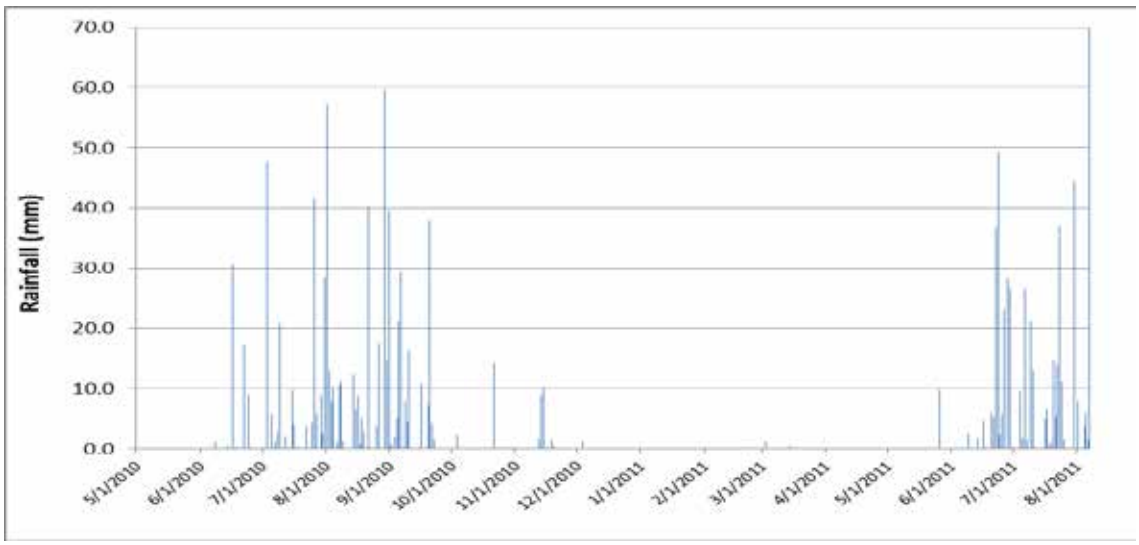


Figure 6. Daily rainfall between May 2010 and July 2011 at Padarlya-Siyalwada model watershed, Raisen district *(Total rainfall during period is 1206 mm).*

· Total 12 open wells (representing upstream, middle and downstream parts of the watershed) have been identified for monitoring the groundwater levels (Fig. 7). These wells have been numbered and geo-referenced. Two groundwater meters has been provided to the watershed community for monitoring the groundwater levels. Training has been given to the project staff and community members on use of groundwater meter.The monitoring of water levels in 12 open wells is being done. The reading is taken twice in a month to observe the change in the groundwater levels at watershed scale. The groundwater fluctuations in different open wells during 2010 are shown in Figure 8.

Figure 7. Groundwater level monitoring at Padarlya-Siyalwada model watershed, Raisen district.

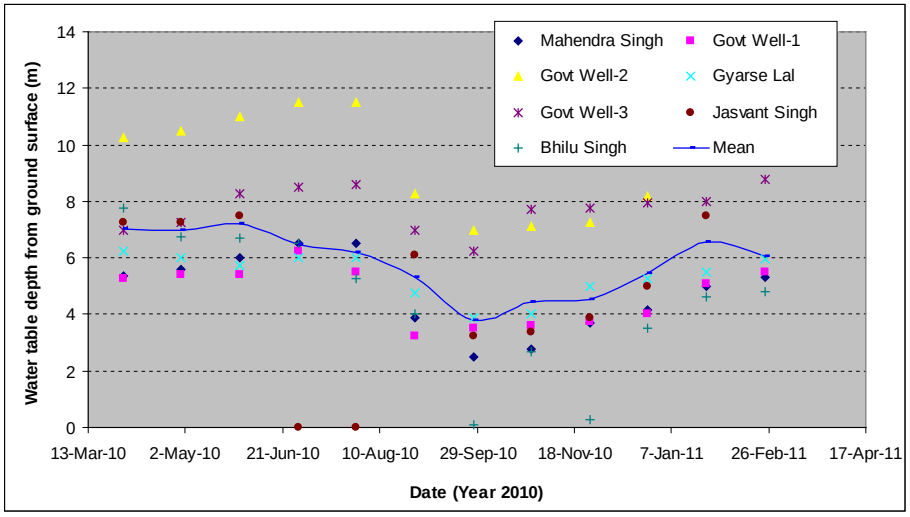


Figure 8. Groundwater levels (m) in different wells at Padarlya-Siyalwada model watershed, Raisen district

· One digital runoff recorder, and automatic sediment sampler have been installed at the wateshed (Fig. 9). Training has been given to the local staff on day to day handling of the equipments. This equipment will record runoff, soil loss as well as nutrient losses from the watershed.

Figure 9. Runoff and soil loss measuring structure and equipments at Padarlya-Siyalwada model watershed, Raisen district.

Soil and water conservation development activities

Several development works on soil and water conservation, runoff water harvesting, groundwater recharging and gully control have been taken up during 2010-11. These includes construction of farm ponds, earthen check dams, loose bolder structures, field bunding and development of pasture lands. Most of the development were done using the village labourers and small farmers. Four dugout ponds and two earthen check dams have been constructed in different villages (Fig. 10).

Figure 10. construction of ponds and earthen check dams at Siyalwada village, Raisen model watershed.

However, the first soil and water conservation activity, which was taken in the watershed was field based land and water management system viz. broadbed and furrow system. This system provides in-situr soil and water management and is highly effective in controlling runoff and soil loss and improving crop yields. Second activity under soil and water conservation was taken up was construction of loose bolder structures. The work started from the upstream parts of the watershed. So far 65 loose bolder structures have been constructed (Fig. 11).

Figure 11. Loose bolder structures for controlling runoff and soil loss at Padarlya-Siyalwada model watershed, Raisen district.

These structures is expected to protect about 55 ha lands from gully soil erosion. Before starting this activity several meetings of farmers were conducted in different villages. The farmers were selected whose lands are located in the upstream parts of the watershed. Most of the loose bolder structures were constucted with constribution from the beneficiary farmers. It is expected that these development works will significantly improve the water availability in the villages and will also control soil erosion.

Aforestation

During year 2012 rainy season for the cause of Soil conservation Bamboo plants has been planted near Nala Banks, Bunds of Farms and near Water storage structures. Bamboo roots are good soil binder, as the area is having more Soil erosion due to run off water comes from hilly ridge area, hence it was used to check it.

Productivity enhancement activities

Participatory demonstration cum research trials on improved agricultural practices are being conducted on farmers fields (Fig. 12). Improved crops varieties (soybean JS 9305, groundnut ICGV 91114, black gram T-9, green gram PS 16, pigeonpea ICPL 871119, maize 9220, chickpea JG11 and wheat HI 1531), balanced nutrition including application of micronutrients and other improved practices are being demonstrated on 45 farmers' fields (Tables 6, 7, and 8). Improved land and water management system of broad bed and furrow and flat cultivation with conservation furrow are also demonstrated. Improved implements for making broad bed and furrow and conservation furrow have been provided to farmers. So far, the responses to these improved technologies have been very good.

Figure 12. Productivity enhancement trials at Raisen model watershed.

· Activities for improved land and water management (BBF / Conservation Furrow):
  - Brain storming session with farmers
  - Motivational efforts
  - Make available pair of Furrow openers to farmers for making BBF system
  - Practical training on farm
  - Technical handholding during BBF formation and sowing.

· Activities for Integrated Nutrient Management
  - Brain storming session with farmers
  - Capacity building of farmers on soil health
  - Plot selection for demonstration and farmers training, application of recommended dose in 2000 Sq. m (Agribor – 0.75 to 0.5 kg, Zinc Sulphate – 10 to 15 kg, Gypsum – 40 to 60 kg,DAP – 14 kg, Urea – 30 kg)
  - Seed treatment – Tricoderma, Rhyzobium
  - Technical handholding during sowing and cropping season.

· Improved verities

Table 6. Improved crops varieties distributed during the 2010 rainy season

Crop	Variety	Quantity
Soybean	JS 9305	1500 kg
Groundnut	ICGV 91114	120 kg
Black gram	T -9	20 kg
Green gram	PS 16	12 kg
Pigeon pea	ICPL 871119	24 kg
Maize	Bio Seed 9220	20 kg

Table 7. Improved crops varieties distributed during the 2010-11 post rainy season

Crop	Variety	Quantity
Chickpea	JG 11	720 kg
Wheat	HI 1531	320 kg

Table 8. Trial details during rainy and post rainy seasons

Balanced nutrient – nucleus trials	15 No
Balanced nutrient – satelite trials	20 No
Fallow management trials	10 No

The crop growth and yields were found significantly higher under the improved management systems compared to farmers practice (Tables 9, 10, 11 and 12). The balanced nutrient system gave 16% higher soybean yield compared to farmers practice. Similar the BBF system gave 8% higher soybean yield compared to conservation furrow system. The

plant height, number of pods per plant, and number of nodules per plant were significantly higher in the improved management system. However, this year the response to improved management system was not so high due to very unfavorable rains during the rainy season.

Table 9. Effect of soil test based application of S, B and Zn on rainfed soybean in Raisen model watershed, rainy season, 2010.

District	No. of trials	Grain yield (kg ha^{-1})		% of increase over FP	Straw yield (kg ha^{-1})		% of increase over FP
		FP*	BN**		FP	BN	
Raisen model watershed villages	18	1280	1490	16	2170	3630	67

** FP – Farmers inputs; ** BN - Balanced nutrients*

Table 10. Effect of soil test based application of S, B and Zn on growth characteristics of rainfed soybean in Raisen model watershed, rainy season, 2010.

District	No. of trials	Plant height (cm)		% of increase over FP	Pod / plant (no.)		% of increase over FP
		FP	BN		FP	BN	
Raisen model watershed villages	18	56	69	23	38	67	76

Table 11. Effect of landform management (along with balanced nutrition and improved cultivar) on the soybean yield in Raisen model watershed, rainy season 2010.

District	No. of trials	Grain yield (kg ha^{-1})		% of increase over CF	Straw yield (kg ha^{-1})		% of increase over CF
		CF*	BBF**		CF	BBF	
Raisen model watershed villages	10	1330	1430	8	1940	2320	20

CF – Conservation furrow; BBF – Broadbed and furrow system.

Table 12. Effect of landform management (along with balanced nutrition and improved cultivar) on the growth characteristics of soybean in Raisen model watershed, rainy season 2010.

District	No. of trials	Plant height (cm)		% of increase over CF	Nodules / Plant (No.)		% of increase over CF	Pods / Plant (No.)		% of increase over CF
		CF	BBF		CF	BBF		CF	BBF	
Raisen model watershed villages	10	53	69	30	20	59	95	34	54	59

Table 13a. Participatory trials conducted with farmers - Kharif 2011	
Details of participatory trials	No of trials
Balanced Nutrient - Nucleus Trials	10
Balanced Nutrient - Satellite Trials	
Soybean	20
Maize	03
Black gram	05
Pigeonpea	5
Groundnut	02
Balanced Nutrient - Scale Up Trials	75
Fallow Management- Nucleus Trials-	10
Fallow Management- Satellite Trials	10
Wateruse efficiency	12
Balanced Nutrient – Residual Nucleus Trials	10
Balanced Nutrient – Residual satellite Trials	20
Special Trials on Agribor SBZ application on Paddy	24
Kitchen gardens	40 farmers / Women
Commercial vegetable cultivation	5 ha
Fodder development	2 ha

Table 13b. Participatory Trials with farmers in Rabi 2011	
Details of participatory trials	No of trials
Balanced Nutrient - Nucleus Trials	10
Balanced Nutrient - Satellite Trials	50
Balanced Nutrient - Scale Up Trials	74
Fallow Management- Nucleus Trials	12
Fallow Management- Satellite Trials	35
Water use efficiency	15
Summer vegetable cultivation	15
Summer vegetable cultivation	10 farmers (2.4 ha.)
treatment with Tricoderma	

Income-generating activities

Vermicomost : In all six watershed villages training was organized in September 2010 on vermicomposting. The farmers were explained about the short and long-term benefits of vermicompost and other organic fertilizers. Through the watershed project support and beneficiaries contribution, 12 vermicompost units have been construced (Fig.13) All the units are now fully functional. The farmers are also encouraged to sell this vermicompost especially to farmers who are growing vegetables and other commercial crops.

Commercial vegetables cultivation: In both rainy and post rainy seasons the commercial vegetables cultivation has been taken up in Rampura and Dungariya villages (Fig. 14). Necessary training, improved seeds and micronutrients were provided to few farmers. After good success this activity will be exanded to other 4 villages of the model watershed.

Figure 13. Vermicompost unit at the model watershed village

Figure 14. Onion cultivation in Rampura village of the model watershed during rainy season 2010.

Horticulture plantation: Farmers were engaged to grow horticulture plants to improve their income. About 1500 plants of Anwala, Guawa, Drum Stick and lemon were planted in the different villages of the watershed. The choice of plant was left mainly to farmers. This activity is expected to expand further in coming years.

Gliricidia nursery: Necessary training was given to one of the women SHG in raising the gliricidia nursery. In village Siyalwada the fliricidia nursury was taken by the women SHG group. About 2600 plants were produced, which were taken up by the farmes in 4 villages. Most of plants looks quite good and it is expected that in coming years this activity will be expanded to cover more farmers and villages (Fig. 15).

Figure 15. Gliricidia plants at the model wateshed, Raisen district.

Table 14. Cattle vaccination in the project villages during June-Dec 2011	
Service	No of animals
HSBQ / FMDvaccination	633
Cattle health Checkup	112

Income Generation activities and benefits gained by SHGs members

- 4 members from 2 SHGs are involved in "Grocessary Shop" and earning about Rs 50 to 150 per day.
- 8 members for 3 SHGs are doing "Goattery" activity and their worth of assets got doubled since inception.
- 2 members from 2 SHGs are involved in "Stitching Work" and both are earning Rs 50 to 60 per day.
- 3 members for 1 SHG are Jointly running "Flour Mill" in village and average daily earning is Rs 60 per day also all 3 members saves the expences done by their family for the same.
- 3 members from 3 SHGs are doing "COW rearing". All of them are selling one time milk in market and keeping other time milk for household consumption. Now from earning they are repaying the loan to project.
- 2 members for 1 SHG are respectively doing Poultry and Vegetable cultivation activities. Their worth got triple as compare to initiation.
- All these SHG women were provided training on "Personality Development" and "Health & Nutrition". The Resource person Manju Sharma provided 5 days trainng in 3 parts and about 76 SHG members and Adolescent girls got benefit of these trainings.
- Two members from Pooja SHG were participated in TRADE FARE during year 2011-12 which was organized by MP Council of Science and Technology in Bhopal and they were sold the products necessary for Nutrition of the family like- Soy Flour, Mix Flour (Soy+Gram+Wheat), Desi Gram and Pulses, Forest produce etc.
- The Minister of Science and technology, Govt of MP visited the stalls and see the products. The SHG women explain him the importance of these food products for health.

Capacity building

The capacity building initiatives included CBOs, farmers and field staff thru hands-on trainings, exposure visits to other watersheds, training materials. Need-based specialized training was also conducted. Some of key capacity building activities undertaken during 2010-11 includes:

- Orientation programs for the wateshed committee members: Two days orientation training (17-18 Aug 2010) was organized for members of model watershed management committee at Gaganwada village. Following issues discussed:
  - Detailed introduction with each other
  - Icre breaking session – discussion on present agriculture scenario in the villages.
  - Introduction of model watershed development proejct – why? What? How?
  - Community participation
  - Responsibility of each stake holder in development
  - Agriculture productivity enhancement aspect in watershed development.

All the members participated in the discussions on the various development issues. The participants were motivated to act as active volunteer in their village and facilitate other people to aopt positive attitude and help each other. Participants were alsol informed that in coming months all the technical know how related to model watershed deelopment programme will be shared with them.

- Training on role and responsibilities of the watershed committee members
- Orientation programs for the SHG members
- Training to field staff and community members on how to operate and take the readings with the groundwater meter
- Training to field staff on the collection of rainfall data using the manual and automatic rainguages.
- Training on the broad bed and furrow cultivation system with simple two furrow openers.
- Training on day to day maintenance of runoff and soil loss measuring equipments and the collection of data.
- Training on vegetable cultivation
- Exposure visit to nearby watershed programs
- Training of farmers on Nadep / vermicompost preparation
- Training of farmers on agriculture productivity enhancement technologies, viz., micronutrients, improved varieties, improved land and water management system etc.

Training for SHGs

In each of 4 villages 2 day Capacity building of SHGs done as follows: One day session was organized on "Health and Nutrition". The SHG women as well as adolescent Girls were facilitated to learn about the Nutrition requirement of our body and the sources to got it with minimum expences.There are so many nutritious food produce women can prepare with minimum efforts; all these were discussed linking with the indigenous knowledge of the women.

One day session was organized on Entrepreneurship development. Several options for enhancing the earning of families were discussed with women. After the rigorous discussions the Agriculture and allied sector came out as the major sector of livelihood of the community. Activities like Agriculture production, vegetable cultivation, Goatery, Poultry were came out as the large number of families can adopt.

Farmers' day at model watershed

Farmers' day was organized on 27th Sep. 2010 at Gaganwada village of the model watershed. Total 176 participants mostly farmers, ICRISAT scientists, BYPASS staff, State Government officials from the Agriculture and Veterinary departments and others participated in the event (Fig. 16).

Figure 16. Various events on farmers days on 27th September 2010 at Gaganwada village of Model Watershed, Raisen district.

In addition to field visits, following materials were displayed during the farmers day:

- Improved varieties of soybean, chickpea, pigeonpea, wheat and groundnut
- Major and micronutrients such as urea, potash, phosphate, zinc, boron and gypsum
- *Gliricidia* plants and seeds
- Photographs of various development activities in different villages
- Model of nadep and biogas
- Reading materials, pamphlets and charts on INM, green manure and organic farming.

The farmers' day was organized in very interactive manner. First the farmers who visited ICRISAT research farm and Kothapally watershed presented their experience and learnings during the exposure visit. After this the farmers were asked several questions on the problems which they are facing in their agriculture. Most of their questions were answered by experts from ICRISAT, bypass, government departments and lead farmers. The resource persons from ICRISAT, government departments, bypass and KVK center gave lectures covering the various aspects on soil health management, soil and water conservation and management, integrated watershed management, integrated nutrient management, integrated pest management, organic farming, crop rotations, women role in agriculture and improving livelihoods, livestock development, fodder production, BBF system, horticulture plants and others. Farmers' day went quite well. Most of the farmers who participated in the event appear to be fully satisfied. The event was also covered in the local newspapers.

Convergence of other schemes at model watershed

- Dispelling the darkness of villagers: One of the project village Dungariya have been facing hardship of dark nights, ever since its existence, due to inability of Madhya Pradesh State Electricity Board (MPSEB) to provide grid connectivity to it until 2025. This not only restricting their social life, but also adversely affecting education of children and indoor ambiance, which normally filled with toxic fumes generated from burning of kerosene. Realizing the problems which villagers were facing, we raised this matter with M P Urja Vikas Nigam, Bhopal, in an effort to find out alternative solution and solve the lighting problem of the village. The government department intimated us that this village can be taken under a centrally sponsored scheme of solar lighting for the household as well as street lights. We took proactive role and helped in completing the various formalities including convincing people for their contribution and collection of Rs.100/family as beneficiary's contribution. The prepared proposal was submitted to government department and after acceptance of the proposal, order for purchase of SPV for household and street lighting was placed. Total 54 solar powered home lights (Fig. 17) and five street lights (Fig. 18) have been installed at the village. This marked a new beginning in the lives of villagers. Now there is lot of activities in the village even after dark as children are able to study extra time each day, women can do household chores including cooking in better illumination and social engagements at the common place where elderly and male folks discuss day to day happenings and other issues of common concern.

Figure 17. Solar powered home lights in Dungaria village of model watershed, Raisen district

Figure 18. Solar powered street lights in Dungaria village of model watershed, Raisen District, Madhya Pradesh

- **Sowing better to reap greater**: With support from the State government, department of agriculture, Madhya Pradesh, 1620 kg of improved chickpea seed (Vijay) was provided to 63 farmers of six villages of model watershed. This improved chickpea variety is highly suitable for the project area. Production from the post rainy season (2010-11) has improved the availability of quality chickpea seed for the next cropping seasons.

- **Shower of hope**: In the project area, the farmers mostly using traditional practices including for irrigation, which is done through flooding method. This results in considerable loss of water due to undulating topography and high evaporation losses. Since in the project area moisture stress is quite common particularly during the post rainy season, it is important to promote judicious use of available water, thereby improving the water use efficiency and crop yields. The State Agriculture Department has provided sprinkler system to three farmers of Siyalwada and Gaganwada villages. The systems were installed during the post-rainy season and it is expected to bring more awareness among the farmers about the improved irrigation system.

- **Animal health camps:** At all the six villages, animal health camps were organized in Nov. 2010. this was done with the help of State Government Veterinary Department (Fig.

19). In all total 620 cattles were immunized (FMD vaccine). The artificial insemination of cattles has been started with the help of the veterinary department. One special camp was organized in Jan. 2011 at Padariya village. In this camp total 380 cattles got the treatment for different diseases. Artificial insemination and deworming were also done during the camp.

Figure 19. Animal health camp at Padariya village of model watershed, Raisen district

Ammainaickanur Model watershed
Dindigul District, Tamilnadu

Background

In consultation with at District Watershed Development Agency (DWDA), a watershed near Nilakottai Panchayat union in Dindigul district is selected (Fig.1). Ammainaickanur model watershed' is located in the foot hills of Sirumalai reserve forest. The watershed area and the villages covered under it are administratively under Nilakottai taluk and block (called panchayat union in Tamilnadu) and is located within geo-co-ordinates latitude-10^{0}7'58.8 '' north to 10^{0}12 '43.2'' north and longitude- 77^0 54'7.2'' east to 77^0 58' 1.2'' east. The villages are about 10 km from Nilakottai town, 6-14 km from *tehsil* head quarter and 22-26 km from Dindigul town. There are 4 revenue villages covered under the watershed. Micro-watershed codes, village names, geographical area of the watershed, treatable and untreatable area are given in Table 1.

Figure 1. Watershed visit for selection of Ammainaickanur model watershed

There are 6 villages/hamlets namely Kannimanagar, Pottikulam, Nakkampatti, Sadaiyandipuram, Rajathanikottai and Gobalapuram covered by the Ammainaickanur watershed (Fig.2) under 4 revenue villages and 4 panchayats including Ammainaickanur town panchayat. The details of revenue villages, panchayat and villages/hamlet covered under these revenue villages are as under (Table 2). Cadastral maps were collected for all revenue villages. Figure 2 shows the micro watershed boundaries, village boundaries, survey numbers, drains and some topographical (contour lines) details.

Table 1. Untreatable and treatable area in Ammainaickanur model watershed.						
S. No	**Micro Watershed Code number**	**Micro watershed geographical area, ha**	**Untreatable area land use, ha**	**Untreatable area, ha**	**Villages Name**	**Treatable Area, ha**
1	4A2A4b4c1d2a	417.0	Road	121.12	Rajathanikottai	324.01
2	4A2A4b4c1d1	272.0	Natham / Village area	5.89	Sadaiyandi-puram	363.78
3	4A2A4b4b3c	290.00	Cart Road	20.7905	Nakkampatti	332.52
4	4A2A4b4b3b	250.0	Pond	22.9605	Pottikulam	214.2405
5	4A2A4b4b3a	500.0			Kannimanagar	201.42
6	4A2A4b4a4	767.0	Railway	32.05	Gobalapuram	137.93
			Quarry	0.20		
			SIPCOT Industrial area	135.4005		
			Forest area	583.67		
	Total	2496.0		922.0905		1573.9005 **(1594)**

Table 2. Details of revenue villages, panchayats and villages /hamlets of the watershed			
S.no	**Revenue village name**	**Panchayat name**	**Village / hamlet name**
1	Oruthattu	Ammainaickanur Town panchayat	Rajathanikottai Sadaiyandipuram Nakkampatti
2	Malaiyagoundanpatti	Malaiyagoundanpatti panchayat	Pottikulam
3	Kullalagondu	Kullalagundu panchayat	Kannimanagar
4	Pallapatti	Pallapatti panchayat	Gobalapuram

There are 66 schedule tribes households out of total 730 households in six villages and total population is 2918 persons, having sex ratio of 925 females per 1000 males (Table 3 and 4). Majority of the houses are tile roofed, few are thatched roof and a very limited houses have been built under government schemes (Table 5).

Table 3. Details of Ammainaickanur model watershed population							
			Population details				
S.no	Village name	No of Households	Male	female	Male Children Up to 14 years	Female Children Up to 14 years	Total Population
1	Kannimanagar	31	45	36	19	11	111
2	Pottikulam	62	82	83	43	25	233
3	Nakkampatti	103	117	134	78	86	415
4	Sadaiyandipuram	41	64	67	38	42	211
5	Rajathanikottai	460	653	614	320	253	1840
6	Gobalapuram	33	49	34	8	17	108
	Total	730	1010	968	506	434	2918

Table 4. Details of Ammainaickanur model watershed household classes					
		Household classes			
S.No.	Village name	SC households	ST households	OBC households	Others households
1	Kannimanagar	Nil	Nil	31	Nil
2	Pottikulam	Nil	Nil	62	Nil
3	Nakkampatti	56	Nil	47	Nil
4	Sadaiyandipuram	10	Nil	41	Nil
5	Rajathanikottai	Nil	Nil	460	Nil
6	Gobalapuram	Nil	Nil	33	Nil
	Total	66	Nil	664	Nil

Table 5. Details of Ammainaickanur model watershed houses types						
		Type of houses				
S. No	Village name	Asbestos roof houses	Tiled-roof houses	Thatch roof houses	Houses built under govt. schemes	Concrete houses
1	Kannimanagar	21	7	2	1	Nil
2	Pottikulam	7	35	12	Nil	8
3	Nakkampatti	20	55	10	10	8
4	Sadaiyandipuram	12	24	2	Nil	3
5	Rajathanikottai	75	285	5	Nil	95
6	Gobalapuram	5	19	3	Nil	6
	Total	140	425	34	11	120

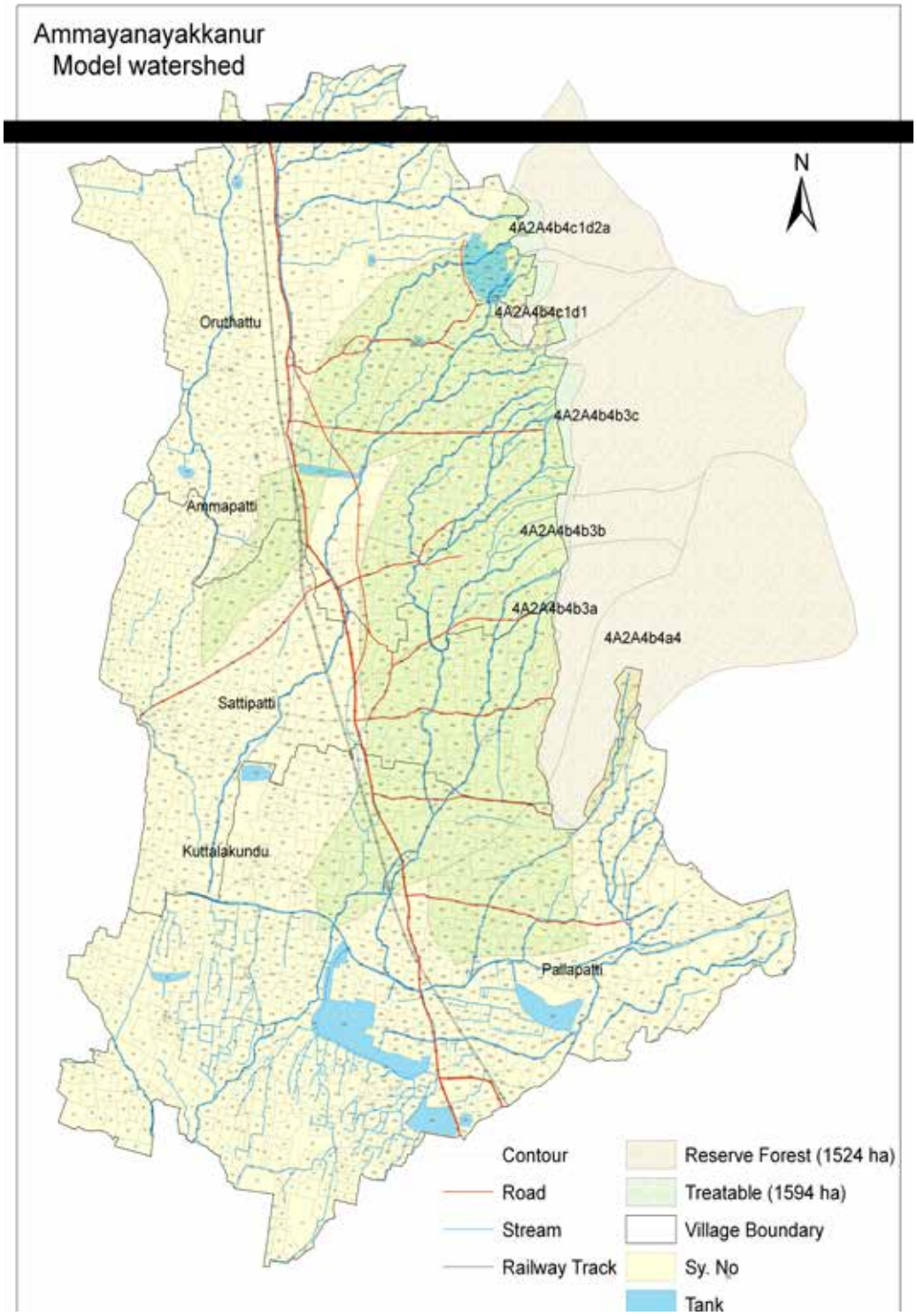


Figure 2. Cadastral map of Ammainaickanur model watershed

Livestock

The villages covered under the watershed have no bullocks and buffaloes and only 210 cows. The watershed community has large number of sheep and goats (Fig. 3) and some

poultry birds (Table 6). Large percentage of the farmer income is generated from the sale of cow milk and goat for meat.

Figure 3. Sheep and goats are preferred livestock in Ammainaickanur model watershed

Table 6. Description of cattle and birds in Ammainaickanur model watershed

S.no	Village name	Types of cattle and birds				
		cows	bullocks	buffaloes	sheep/goats	Poultry birds
1	Kannimanagar	22	Nil	Nil	162	50
2	Pottikulam	12	Nil	Nil	80	25
3	Nakkampatti	25	Nil	Nil	65	35
4	Sadaiyandipuram	35	Nil	Nil	125	35
5	Rajathanikottai	110	Nil	Nil	180	125
6	Gobalapuram	6	Nil	Nil	50	100
	Total	210	Nil	Nil	662	370

Land Holdings

There are only 569 households owning the lands, 161 households are landless, 53 migrate for employment else where and 5 households are handicapped (Table 7).

Table 7. Landed, landless and migrating and handicapped households in Ammainaickanur model watershed

S.no	Village name	Landholding details			
		Landless households	Landed households	Migrating households	Handicapped households
1	Kannimanagar	17	14	1	1
2	Pottikulam	50	12	15	2
3	Nakkampatti	25	78	15	Nil
4	Sadaiyandipuram	19	22	2	Nil
5	Rajathanikottai	20	440	20	2
6	Gobalapuram	30	3	Nil	Nil

	Total	161	569	53	5

Awareness and Participatory Rural Appraisal

Awareness and participatory rural Appraisal was conducted in all the villages. The demography and other details of land, water resources, crops, education, cattle, milk production, infrastructure, sanitation, etc of all villages were collected (Fig. 4).

Figure 4. Awareness and participatory rural appraisal meetings in Ammainaickanur model watershed

Water Resources

A survey of water resources (tanks, ponds, open wells, bore wells etc) was made (Table 8). Out of 323 open wells 193 are dry (Fig. 5). Similarly 38 bore wells are dry out of 158 bore wells. The irrigated area is low in the range of 10-20 % and water yield of the open wells is also low. Most bore wells are more than 100-150 m deep. The productivity of crops is also low. Irrigation is mostly done using open and bore wells. Also many open and bore wells are dry and non-functional.

Information on open well & bore well details in the project area were collected**.** We have identified 40 functioning open wells for monitoring water table depth on periodic interval (Fig. 6). Location of open wells and bore wells are shown in Fig. 7 and Fig. 8 respectively.

Figure 5. A dry open well in the watershed

Figure 6. Groundwater level monitoring in a open well

Figure 7. Open wells in the watershed

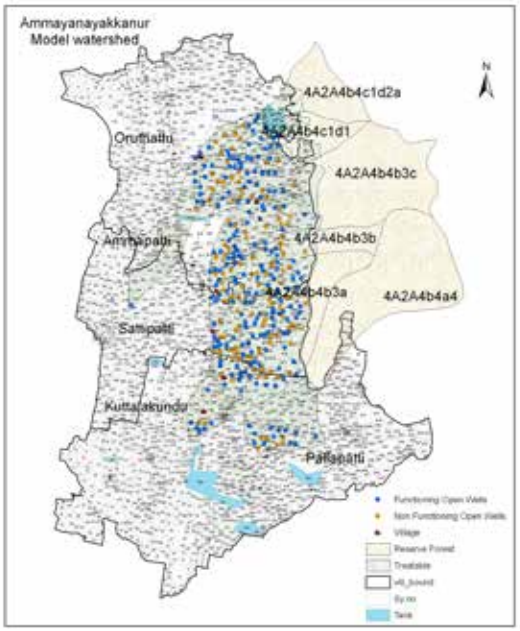


Figure 8. Bore wells in the watershed

Table 8. Water Resources in Ammainaickanur model watershed							
Parameters	**Rajathani kottai**	**Sadaiyan dipuram**	**Nakkam Patti**	**Pottik ulam**	**Kannim anagar**	**Gopala puram**	**Total**
Total open well	55	61	71	75	31	30	323
Functioning	37	35	45	39	19	18	193
Completely Defunct	18	26	26	36	12	12	130
Total Tube wells	36	33	37	33	4	15	158
Functioning	29	26	27	27	2	9	120
Completely Defunct	7	7	10	6	2	6	38
Total Drinking water	7	1	3	3	3	1	
Functioning	7	1	2	1	1	1	13
Completely Defunct	0	0	1	2	1		
Ground water level,ft	350	292	350	303	301	250	
Pond/Farm Pond	3	1	1	1			6
Approx. Bed area,ha	13.2	6.38	21.1505	1.3			42.0

Existing Soil Conservation Structures

There are existing 6 masonry check dams (Fig. 9) and 8 weir structures (Fig. 10) and 6 ponds in watershed villages (Table 9). Location of these structures in the watershed is shown in Fig. 11.

Table 9. Existing soil conservation structures in Ammainaickanur model watershed.							
Types of SWC structures	**Rajathani kottai**	**Sadaiyandi puram**	**Nakka mpatti**	**Pottik ulam**	**Kannima nagar**	**Gopala puram**	**Total**
Masonry Check dam	1	3	1	0	0	1	6
Weir	2	0	0	0	0	6	8
Ponds	3	1	1	1	0	1	6

Figure 9. An existing masonry check dam in the watershed

Figure 10. Existing weir structure in the watershed

Figure 11. Location of existing soil conservation structures in Ammainaickanur model watershed

Formation of Watershed Committee

Six area groups representing six villages were formed in Ammainaickanur model watershed. The watershed community selected, democratically, the committee members representing area groups, panchayats, self help groups, schedule caste / tribe community, and landless. There are 13 women and 11 men in the 24 member committee (Fig. 12). The committee has been registered as a society with the Registrar of Societies, Dindigul. The watershed committee has opened its bank account in nearby nationalized bank. Details given below are the category of the members (Table 10).

Table 10. Composition of the watershed committee membership

S.no	Category	Male	Female	Total
1	Area groups representative	6	6	12
2	Panchayat representative	2		2
3	SHG representative		3	3
4	SC / ST representative	2	1	3
5	Landless representative		3	3
6	CIRHEP representative	1		1
	Total	11	13	24

Figure 12. Members of the watershed committee, Ammainaickanur model watershed.

Automatic Weather Station

Automatic weather station is installed at Ammainaickanur watershed (Fig. 13). The rainfall was collected during 2010. There was no rain during January, Febuary and March. The cumulative rainfall during 2010 was 672 mm in 28 rainy days (Table 11).

Figure 13. Automatic weather station at Ammainaickanur model watershed.

Table 11. Rainfall in Ammainaickanur model watershed

Month	Rainfall (mm)	No of rainy days
April	16	1
May	120	1
June	0	0
July	37	1
August	1	16

September	69	6
October	106	4
November	243	10
December	65	4
Total	672	28

Long-term Average, Rainfall Probability and Water Balance

The long-term yearly rainfall in Nilakottai, where in long weather records are available average 782 mm. The cumulative rainfall between June and September (SW monsoon) is 235 mm and between October and December (NE monsoon) is 349 mm. (Table 12). Approximately 198 mm rainfall is received between January and May. The probability of weekly distribution of rainfall is presented in Figure14.

The preliminary water balance analysis for Nilakottai is shown in Figure 15. The water surplus is limited to approximately 32 mm and might occur between mid October to mid November. There are very low chances of crop productivity in south monsoon season (June to September). However, probability of reasonably productivity of short duration annual crops (70- 90 days) is fairly good in NE monsoon (October – December).

Table 12. Normal rainfall of Nilakottai, Dindigul district, Tamilnadu.

Week ending on	Rainfall (mm)	Week ending on	Rainfall (mm)
07-Jan	5.0	8-Jul	6.7
14-Jan	6.6	15-Jul	7.0
21-Jan	1.2	22-Jul	7.4
28-Jan	3.9	29-Jul	8.2
04-Feb	4.3	5-Aug	7.5
11-Feb	2.3	12-Aug	13.8
18-Feb	1.5	19-Aug	13.9
25-Feb	6.8	26-Aug	14.6
04-Mar	7.0	2-Sep	17.1
11-Mar	3.5	9-Sep	18.2
18-Mar	7.5	16-Sep	29.3
25-Mar	2.2	23-Sep	29.5
01-Apr	7.6	30-Sep	28.2
08-Apr	10.7	7-Oct	36.2
15-Apr	20.1	14-Oct	43.8
22-Apr	15.1	21-Oct	40.7
29-Apr	17.5	28-Oct	39.4
06-May	16.1	4-Nov	40.9
13-May	17.6	11-Nov	40.8
20-May	23.4	18-Nov	31.1

27-May	17.7	25-Nov	24.2
03-Jun	13.8	2-Dec	15.6
10-Jun	7.6	9-Dec	12.2
17-Jun	5.4	16-Dec	9.0
24-Jun	2.9	23-Dec	6.3
01-Jul	4.1	31-Dec	8.5

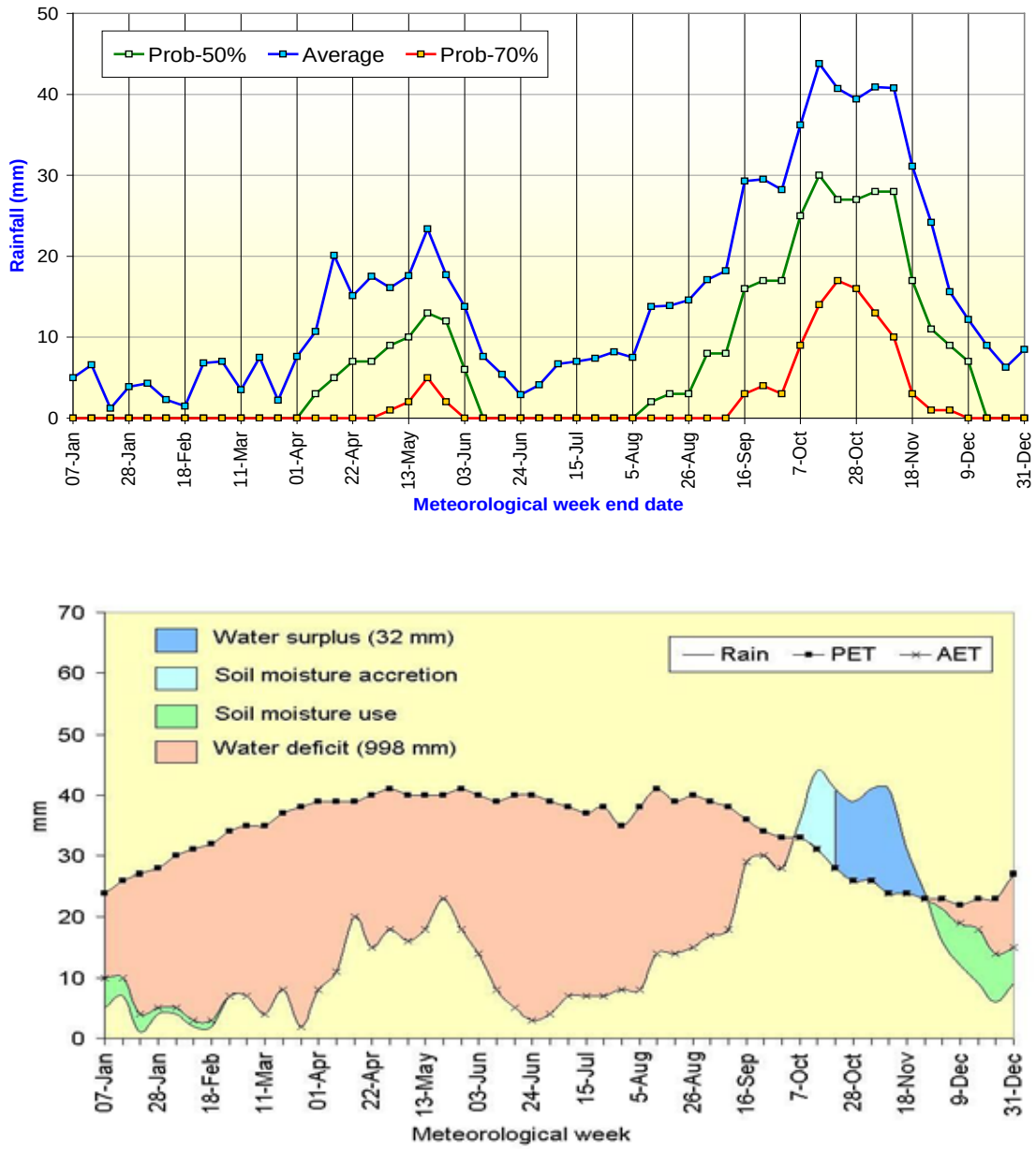


Figure 14. Weekly rainfall distribution at Nilakottai, Dindigul district, Tamil Nadu

Figure 15. Water balance, Nilakottai, Dindigul district, Tamilnadu

Soil Nutrients Analysis

Initially thirty nine soil samples were collected by adopting stratified sampling approach across all toposequence, farmers landholdings and cropping system in the watershed with the help of farmers (Fig. 16). The analysis indicated that there is no deficiency of potassium, only some fields are deficient in phosphorus and organic carbon is deficient in 77% of farmers' fields. The majority of the farmers' fields are deficient in zinc (59%), boron (72%) and sulphur (90%) (Table 13). Eighty more soil samples from the Ammainaickanur watershed are collected and analyzed.

Figure 16. Collection of stratified soil samples in the Ammainaickanur watershed

Table 13. Soil nutrient deficiency (average percentage) in Ammainaickanur watershed.

Soil nutrient	% deficiency	Soil nutrient	% deficiency
Organic carbon	77	Available sulphur	90
Available Phosphorous	13	Available zinc	59
Available potassium	0	Available boron	72

Crop Productivity Trials

Predominant soils are in the watersheds are red soils with shallow to medium soil depth and the slope in the watersheds range from 1.0 to 1.5%. Groundnut, pigeonpea, pearl millet (Fig. 17), sorghum and some pulse crops such as green gram are major upland crops. Crop productivity is low (Table 14). Some farmers who own open wells grow flower crops for essence industry in Nilakottai town (Fig. 18).

Table 14. Crops and their productivity (kg/ha) in various watershed villages.

Village Name	Rajathaottai	Sadaiyandipuram	Nakkampatti	Pottikulam	Kannimanagar	Gopalapuram	Average yield (kg/ha)
Pear millet							
Kharif	450	500	500	450	450	450	470
Rabi	650	700	800	650	650	650	680
Sorghum							
Kharif	450	450	650	450	500	500	500
Rabi	600	650	700	600	600	600	625
Red Gram							
Rabi	200	200	200		200	250	210
Flowers							
Kharif	250	250	250			500	310
Rabi	300	350	300			400	340
Summer	150	200	200	500		350	280
Mango							
Rabi	2000						2000
Sappota							
Rabi	1500	1500	1500	1500	1500		1500
Summer	2500	2750	2000	2500	2000		2350
Coconut					1000		1000
Kharif	2000		1500	2000	1500	2000	1800
Rabi	3500		3000	3500	3000	3000	3200
Summer	800		1000	1000	1000	1000	960
Tomoto							
Kharif		1500		2000	2000		1830
Rabi		2500		3500	2500		2830
Drumstick							
Kharif					1000		1000
Rabi					1500		1500

Figure 17. Pearl millet cultivation in the summer season using open/bore well water in the watershed for irrigation

Figure 18. Flower cultivation by farmers who own open/bore wells in the watershed

Most farmers in watershed villages plant their crop at the start of the SW monsoon season, which often result in failure due to poor rainfall during the season, an obvious fact from analysis of long term rainfall of Nilakottai. The biomass of such failed crops is used as fodder for animals. However, preliminary rainfall probability analyses suggest that there is good potential for increasing productivity for crops sown in NE monsoon through various interventions. Farmers' participatory productivity enhancement trials (improved varieties of sorghum and pearl millet and balanced soil nutrients) were initiated in the beginning NE monsoon in 2010 on 18 farmers.

Vermicomposting

Twenty farmers were identified in six villages for vermicoposting. Three farmers in Rajathanikottai initiated vermicoposting in 1m x 1m rings. Soon the vermicoposting would be initialized with remaining farmers (Fig. 19).

Figure 19. Vermicomposting in rings, Rajathanikottai, Ammainaickanur model watershed

Self Help Groups

An important extended and integrated function of watershed project is the empowerment of women. A detailed survey of all the villages coming under the project was conducted with the purpose of forming women Self Help Groups to augment domestic income of individuals of such groups (Fig. 20). There are 18 SHGs existing in this project area (Table

15). Efforts are being made to revitalize all the groups and take up income generating activities / enterprises. Most of the members are interested in growing milch animals.

Table 15. Details of existing self help groups in the watershed

Description	Rajathni kottai	Sadaiyandi puram	Nakkam patti	Potti kulam	Kannima nagar	Gopala puram	Total
No. of Groups	3	6	7	2	NO	NO	18
Total Members	35	81	90	24	NO	NO	230
Activity	Savings &loan	Savings &loan	Savings &loan	Savings &loan	Nil	Nil	Nil
Total Savings (Rs)	46000	89500	58000	17000	Nil	Nil	210500
Monthly Savings	50	100	50	100	Nil	Nil	
Linkage with the bank savings	ICICI and SBI Banks Oakottai	Canara Bank Kodairoad	Pandiyan Bank Oakottai	Canara bank Kodairoad	NO Linkage	NO Linkage	

Figure 20. Meeting with self-help group, Ammainaickanur model watershed **Tropiculture**

Tropiculture Demonstration in the Watershed Field

A multipurpose farm equipment, Tropiculture was provided and demonstrated at Rajathanikottai and Nakkampatti villages in the watershed and hands on training of its use was given to the farmers for various operations such as land preparation, ridge, bed formation, fertilizer application, planting, and intercultural operation, etc. (Fig. 21).

Figure 21. Demonstration and hands on training for multipurpose farm equipment 'tropiculture'

Proposed Interventions

Figures 22 and 23 shows planned Agroforestry and soil conservation structures of watershed community in consultation with the committee members.

1. Agroforestry and Horticultural plantation - 400 ha
2. Loose boulder gully control structures - 40 nos
3. Loose stone Gully control structures - 52 nos
4. Earthen check dams - 10 nos
5. Masonry check dams - 26 nos
6. Percolation pond - 1 no
7. Farm ponds - 1 no

Figure 22. Proposed location of agroforesty and horticultural plantation

Figure 23. Proposed location of soil and and water conservation structures

Construction of Soil and Water Harvesting Structures

Nearly 1150 m of diversion drain below the Sirumalai forest hillock has been completed. Diversion drain helps in protecting flooding kind of situation during heavy rain events and protects surface erosion. Total 27 number of Loose Boulders were constructed across the drainage line in watershed. It helps in reducing reduce velocity and soil erosion at downstream areas. The wells located near the drainage line benefited by increasing groundwater recharge and subsequently water table.

Figure 24a. Gully control structures constructed at model watershed

Total 15 Earthen Check dams were constructed in the watershed area. It harvest surface runoff and found very helpful in enhancing groundwater recharge. Total 27 open and 19 bore wells located near the earthen check dams has benefited due to these interventions.

Total 10 Masonry check dams were also constructed in watershed. Total 35 open and 25 bore located near by the structures have benefited. Similarly dug out ponds and tanks are constructed for harvesting surface runoff in watershed. Moreover 15 well recharge pits were

constructed in the watershed near to the open wells. Surface runoff from the field is also diverted to open wells after passing through the filter units. About 2089 m (running meter) length of field funds were constructed in watershed area.

Figure 24b. Masonry check dams

Figure 24c. Recharging pits

Figure 24d. Field bunding

Agro Forestry interventions: About 4900 Agro Forestry seedlings have been planted in 20 hectares of lands and 45 farmers are benefited. Almost 4,400 Grafted horticulture tree plants such as mango, Guava, lemon, pommogranet, drumstick, sappota etc. are planted in 30 ha. of lands.

Figure 25. Various forestry, horticulture, floriculture activities at Ammaiyanickanur Model Watershed

Consortium Partners

- Centre for Improved Rural Health and Environment Protection (CIRHEP), Nilakoattai, Dindigul district, Tamil Nadu.
- Watershed committee , Ammainaickanur model watershed
- District Watershed Development agency (DWDA, Dindigul)
- ICRISAT

Ring type

Ring Type

Compartmental type

Figure 26. Ring type and compartmental type vermicompost units Rajathanikottai village

Figure 27. Diversion drain below foot hills of forest to divert runoff from Sirumalai forest

Loose boulder structure

Loose stone structure

Figure 28. Gully control structures at Ammainaickanur model watershed

Figure 29. Gliricidia nursery raising by Vinayaka women SHG at Rajathanikottai village in Ammainaickanur model watershed

About ICRISAT

The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) is a non-profit, non-political organization that does innovative agricultural research and capacity building for sustainable development with a wide array of partners across the globe. ICRISAT's mission is to help empower 644 million poor people to overcome hunger, poverty and a degraded environment in the dry tropics through better agriculture. ICRISAT belongs to the Alliance of Centers of the Consultative Group on International Agricultural Research (CGIAR).

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