



SOCIO-ECONOMIC AND NATURAL RESOURCES IMPACT OF SUJALA WATERSHED PROJECT IN KARNATAKA

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ABSTRACT

Nearly three fourths of the cultivable land in India is dependent on monsoon, which is contributing nearly 42% of the total production from agriculture. The productivity of any crop mainly depends on two natural resources- land and water in addition to management practices. Conservation, up gradation and utilization of these two natural resources on scientific principles is essential for the sustainability of rain fed agriculture. In Karnataka state a separate Watershed Development Department was started during the 2000 to make the watershed development a more professional and to implement the watershed programmes on a more co-ordinated and in an integrated manner. SUJALA, a world Bank assisted community driven watershed development project, was implemented from Sept'2001 in five districts of Karnataka state. The uniqueness of the project lies in the peoples participation in decision making on the nature of development they perceive to be relevant and their involvement in implementation of activities. Sujala is the people's project; they are the planners and implementers of the project activities. The project intends to empower the local people to build a sustainable future with their own hands. The project has mainly concentrating on four components namely participatory watershed development and protection, Farming system intensification, Income Generation Activities, Institutional Strengthening. It is evident from the mid-term impact assessment that, the impacts of watershed interventions on natural resource base and livelihoods are interrelated in an agrarian economy. The increased employment opportunities and overall increase in income and consumption levels reflect the potential of watershed development in enhancing the rural livelihoods. The project also helped in reducing inequalities in income across the households. There is a clear indication that migration has gone down. Crop yields increased by 6 to 15%, Increase in ground water level by 3 – 5 ft in bore wells; Milk yield increased by 15 to 20%. Similar is the case with fuel wood & fodder availability. The productivity in non-arable lands has increased by 5-10%. Increased area under plantations helped for maintaining the *in situ* moisture.

KEYWORDS: Socio economic, Sujala project, integrated manners etc.

INTRODUCTION

India is one of the major agricultural countries with more than 70% of the population depending on it. Indian agriculture is dependent on monsoon which is not uniform over the years. Nearly three fourths of the cultivable land in India is dependent on monsoon, which is contributing nearly 42% of the total production from agriculture. The productivity of any crop mainly depends on two natural resources- land and water in addition to management practices. Therefore the conservation, up gradation and utilization of these two natural resources on scientific principles is essential for the sustainability of rain fed agriculture. The watershed concept for development of rain fed agriculture is gaining importance over the years and it amply demonstrated that watershed developmental tools are very effective in meeting the objectives and mission.

Among the 28 states of India, Karnataka state has been given an important place for Watershed Development because 75% of the cropped area in Karnataka depends upon low and uncertain rainfall. The geographical area of the State is 190.50 lakh ha. of which 116.90 lakh ha. is

available for watershed development. Out of this area, 35.42 lakh ha is treated up to end of the year 2005-06. It is estimated that 81.48 lakh ha is still available for watershed development. In Karnataka state a separate Watershed Development Department was started during the 2000 to make the watershed development a more professional and to implement the watershed programmes on a more co-ordinated and in an integrated manner. The concept of people's participation was refined, redefined and strengthened by way restructuring the guidelines for implementation of National Watershed Development Programme for Rain fed Areas (NWDPR) and Area Development Programmes like Drought Prone Area Development Programme (DPAP) / Desert Development Programme (DDP) / Integrated Wasteland Development Programme (IWDP) by Govt. of India. The present paper intends to highlight the unique approaches & interventions of SUJALA watershed project and the resultant impact on the natural resource as well as on the socio-economic life of the farmers.

SUJALA – A multi-faceted innovative project

In Karnataka state the last three decades have witnessed a paradigm shift in conservation and natural resource management (NRM) away from costly state-centered control towards approaches in which local people play a much more active role. These reforms purportedly aim to increase resource user participation in NRM decisions and benefits by restructuring the power relations between central state and communities through the transfer of management authority to local-level organizations. SUJALA, a world Bank assisted community driven watershed development project, was implemented from Sept’2001 in five districts of Karnataka state viz., Kolar, Tumkur, Chitradurga, Haveri & Dharwad. The project intends to treat 5.20 lakh hectares of dry land with 564.76 crores budget by covering 2.25 lakh families. The project is being implemented in a phased manner i.e., 1st phase 71,410 ha, 2nd phase 1, 12,168 ha and in 3rd phase 3, 36,142 ha. In the 1st phase watersheds the targeted area of 71,410 ha has been successfully treated and in 2nd & 3rd phase watersheds nearly one lakh ha is treated & remaining treatment is under progress. As on 2005-06, a total area of 1.7 lakh hectares was treated by different soil and water conservation measures along with horticulture, forestry and pasture plantations by incurring Rupees 185 crores.

The uniqueness of the project lies in the peoples participation in decision making on the nature of development they perceive to be relevant and their involvement in implementation of activities. Sujala is the people’s project; they are the planners and implementers of the project activities. The project intends to empower the local people to build a sustainable future with their own hands. The project has mainly concentrating on four components namely Participatory watershed development and protection (79.83%), Farming system intensification (7.04%), Income Generation Activities (6.36%), Institutional Strengthening (6.76%).

Objectives of SUJALA

1. To improve the productive potentials of selected watersheds and their associated natural resource base.
2. Sustainable alleviation of Poverty.
3. Develop and strengthen community based institutional arrangements for sustainable natural resource management
4. Improved skills and employment opportunities for non-farm sectors
5. Involvement of village communities in participatory planning, implementation, social and environmental management, maintenance of assets and to operate in a more socially inclusive manner.

The approaches adopted to meet these objectives is as follows

1. Multi-disciplinary team with an integrated farming system approach to improve the productivity
2. Community demand driven approach with an involvement of Non-Governmental organizations (NGOs) at all levels of project formulation and implementation to promote people’s participation
3. Adoption of farmer participatory consortium model for efficient management of natural resources emerged from the lessons learnt from long term watershed-based research led by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and university of Agricultural Sciences (UAS) & Indian Institute of Horticultural research (IIHR).
4. Refinement of technologies and on-farm strategic research experimentation by farmers with technical support from the consortium partners.
5. Increased individuals’ participation is ensured by providing tangible economic benefits. The emphasis on *in situ* conservation of rainwater is translated into increased soil water availability that is in turn translated into increased productivity through Farmers Field school approach.
6. A holistic system approach for watershed management for livelihood improvement is adopted, instead of solely soil and water conservation. Locale-specific, low-cost income generation activities (IGAs) are promoted to improve the socio-economic condition of vulnerable and landless families through Self help group (SHG) concept.
7. Adoption of Remote Sensing & Geographic Information System (GIS) tools in generation of Resource maps, draft treatment plans & for impact assessment.
8. Adoption of Environment & social assessment (ESA) technique in planning of watershed activities like Entry point activities, land treatment activities & income generation activities.
9. Adoption of participatory and independent monitoring and evaluation tools to provide timely, accurate, reliable & relevant information to reflect the true picture of the project.
10. Ensured transparency & accountability in the project, through Wall paintings, Photographing, Payment through pay to order cheque & through Public open house meetings.
11. Ensuring equity to small and marginal farmers

To ensure equity, the per hectare cost (in Rs) fixed for different size of land owners is as follows

Hectares	1 to 5	6	7	8	9	10	11	12	13	14	15
Per ha. Cost	7,000	6,666	6,428	6,250	6,111	6,000	5,727	5,500	5,307	5,142	5,000
Maximum cost limit	35,00	40,00	45,00	50,00	55,00	60,00	63,00	66,00	69,00	72,000	75,000
	0	0	0	0	0	0	0	0	0	0	0

1. Adoption of ‘community centered’ withdrawal strategy and establishing better linkages with line departments & marketing channels for long-term sustainability of watershed assets.

2. Scaling up and technology dissemination is facilitated by using bench mark sites as training sites for partners and farmers, and for sensitizing policy makers.

METHODOLOGY

Baseline survey

A detailed baseline survey of the watershed was conducted by **Tata Energy research Institute (TERI)** to study major socio-economic and biophysical constraints to sustainable crop production.

The results of the survey indicated that in Project villages:

- (i) Dry land areas were more extensive than irrigated land
- (ii) Irrigation tanks constructed long ago, are in poor condition due to heavy siltation and poor maintenance
- (iii) Most of the dug wells have dried up and are replaced by bore wells. In certain areas, even shallow bore wells have become dry.
- (iv) The project districts have a very poor forest cover, just 5% of the area.
- (v) Low productivity of crops & Scarcity of fodder
- (vi) Low per capita income

Using the baseline survey and a detailed reconnaissance survey of the watershed, the watershed committee with the technical support of Watershed development team (WDT) had prepared detailed action plans at the micro-watershed level. These plans are popularly called as **SUJALA watershed action plans (SWAPs)**. The components of SWAPs include soil & water conservation, horticulture, forestry, livestock and demonstrations. Whether it is SWAP for land based activities or sub-plans for IGAs, the plans are implemented by the beneficiaries themselves. The physical and financial progress of various interventions is regularly analyzed using computerized Management of Information System (MIS). It creates systematic database to query and analyze periodic field data and generate reports at watershed, district & state levels. To assess the sectoral interventions to enhance productivity & income, the SWAPs along with MIS reports were thoroughly analyzed. To assess the impact of project interventions on the beneficiary households and to evaluate the resultant changes in their socio-economic conditions. The independent M & E agency has selected 10% samples through a combination of purposive and random sampling methods.

RESULTS AND DISCUSSION

1. Sectoral interventions to enhance productivity & income

1.1 Soil & water conservation measures

Using the baseline survey of the village and a detailed reconnaissance survey of the watersheds, the technical team along with watershed committee identified sites for soil and water conservation structures and other measures. The Department & University has provided technical support for cost-efficient water storage and soil conservation structures. The measures are categorized as community- and individual farmer-based.

Community-based interventions

These measures were implemented on common resources, viz. water courses, *nala* and wastelands.

Farmer-based interventions

Farmer-based soil and water conservation measures are implemented in individual fields.

Lessons derived from past experiences are technically integrated in to *sujala* programme with a shift in paradigm to insitu conservation of rainfall and store the excess after considering down stream catchments by developing water vision. Out of 3,11,38,975 Cu.m of expected runoff, it is planned to conserve 93,26,725 Cu.m after meeting the requirements of existing storage of 90,96,137 Cum.m leaving 13,25,735 Cu.m in to the down stream across the districts in 1st phase watersheds.

The major soil and water conservation measures taken up in the project area are bunding, farm pond, recharge pits, rubble checks, etc. In addition, drainage line treatment carried out includes check dams, *nala* bunds, *nala* revetments, ravine reclamation structures, mini percolation tanks, etc,

Table 1: Impact on water Resources due to Project Interventions in Phase-1

District	%Nalas rejuvenated	% Bore wells rejuvenated	% Open wells rejuvenated
Dharwad	44	52	25
Kolar	38	93	5
Chitradurga	81	75	79
Tumkur	51	76	39
Haveri	25	70	39
Average	48	73	37

The results in the table 1 reveals that, the five districts put together, 73 % of bore wells & 37 % of open wells were rejuvenated in the 1st phase watersheds. Further, the 48 % of *nalas* rejuvenated in the in same phase watersheds. A users group was formed for each water storage structure, and the water collected in the storage structures was exclusively used for recharging the groundwater.

1.2 Horticulture interventions

Importance was given mainly for Agro-Horticulture systems on private lands. In some areas silvi-horticulture systems were also established.

1.3 Wasteland development and tree plantation (Forestry)

Common wasteland treatment involved by planting saplings of useful species along the roads, field bunds, tank foreshores, *nalas* & in Gomalas has been taken up by the project. The different models adopted are agro-forestry, farm forestry etc.

1.4 Live stock interventions

Approximately 76,585 farmers have benefited through the implementation of various livestock activities like, Farming system Research demonstrations, Agro Service Centers, Cattle Shelters, Feeding troughs, Chaff cutters, Urea treatment, Urea molasses block distribution, Hay & silage making, Mini kits distribution, Crop border plantations, Fodder nurseries & village based trainings. To

meet the first-aid livestock health services, local youths have been inducted into livestock activity as Gopal Mitras, Apart from this, approximately 4.6 lakh animals have been benefited from Animal health camps. Around 413 hectares have been covered under fodder cultivation through mini kit distribution. 822 hectares have been covered for fodder cultivation under crop border plantation.

1.5 Farmers field school concept to empower farmers on crop production technology

To facilitate the farmers to learn, discover, evaluate and to find out the solution to the crop production/protection problems, FFS concept has been initiated in Dharwad, Haveri & Chitradurga districts. 25 farmers in each school are covered and over all around 1150 farmers were directly benefited by this approach. 52 trained, experienced, interested and volunteered farmer-facilitators were identified. One week refreshing training programme was organized to farmer-facilitators. One day Training on Production of NPV and trico-cards locally by farmers was organized. Post harvest technology and quality management in cotton was addressed first time in FFS.

1.6 International Crops Research Institute for semi-arid Tropics (ICRISATs) research & demonstration units under sujala

ICRISAT an international organization is collaborating in establishing research & demonstration units in project areas. Initially the activities are started in selected watersheds by conducting various trials and capacity building programmes to farmers on technical matters. The demonstration activities undertaken during last kharif 2005 are:

- ✓ Land & water management trials in Ragi (Finger millet) & Ground nut
- ✓ Varietal-cum-yield maximization trials
- ✓ Micro-nutrient amendments & Integrated nutrient management (INM) trials
- ✓ Integrated pest management (IPM) trials
- ✓ Use of Tropiculators

ICRISAT has established five silt monitoring posts & rainguage stations in SUJALA watersheds. The monitoring of samples and data analysis is being done by ICRISAT. The results are being used for the study of impact of the land treatments.

Results of ICRISATs demonstrations

a) Evaluation of Integrated nutrient management (INM) trials in Chitradurga district

- ✓ Advantage of applying N, P fertilizer to sunflower in the region is conspicuous with a gain in yield nearing 100%, as well as to application of deficient micronutrients along with N, P, reflected in quite significant response ranging between 100-150% gains in seed yield of sunflower. This study indicating the usefulness of soil diagnostic studies and corrective application of inputs.

b) Farmers' participatory varietal selection of Sunflower cultivars in Chitradurga district

- ✓ Intervention with an improved hybrid itself contributing to a yield increase between 40 to 100% increase.
- ✓ Optimum use of required nutrients (BEST BET) certainly increased yields by more than 100% with improved sunflower hybrids

- ✓ Farmers expressed interest on KBSH-41, and KBSH-44 based on their performance during the season.

c) Yield maximization of Maize cultivars in Dharwad district

- ✓ Pro-Agro Hybrid of maize responded to optimum input management by giving more than 100% increase in grain yields. Increase in fodder production was also nearing 100%.

d) Yield of Ragi (finger millet) under Integrated Nutrient Management field trials in Kolar district

- ✓ Ragi crop responded well to integrated nutrient management, and with the application of nitrogen, phosphorus and micro-nutrients, the grain yield increased up to a considerable range of 55-65% over the farmers' input management.

1.7 Fish Production in watersheds

In the watersheds, water storage structures like Check dams, Nala bunds, Farm ponds, Mini percolation ponds etc. have become an integral part supporting agricultural activities, drinking water for animals, community usage. These resources also offer immense opportunities for promotion of aquaculture as potential agro-based micro-enterprise to meet family nutrition, complementary income & social benefits. In SUJALA watersheds, training on improved fish production is imparted to farmers & many of the resource users have already started fish rearing from the last two seasons.

On-farm research trials are established to develop integrated fish production technologies with the technical assistance of University of Agricultural Sciences, the first-cut result on the turbidity management in farm ponds reveals,

- ✓ Application of lime @ 600 kg/ ha.m, cow dung @ 3 tons/ ha.m, lime and cow dung @ 400 kg/ ha. m. and 200 kg/ ha.m, respectively, lime, cow dung and paddy straw, lime, cow dung and banana stem peel indicated better effects in terms of reducing water turbidity.
- ✓ For better pond productivity, water turbidity of >20 cm is suggested
- ✓ Participation in planning allowed resource owners to become more perceptive and responsible for their own resources.

1.8 Vermi-culture to boost income

Training on vermi-composting is imparted to self-help group (SHG) & Area group (AG) farmers. *Parthenium*, an obnoxious weed, agricultural waste, earthworms, rock phosphate and cow dung slurry are the ingredients for vermin-composting. In the watershed areas nearly 50 % of the farm households are benefited from vermi-composting demonstrations & a sizeable percentage of SHGs have taken up vermin-composting as a micro-enterprise to generate income.

1.9 Income Generation activities of SHGs

The main objective of IGA is to improve the socio-economic condition of the vulnerable families by supporting them to become successful entrepreneurs. Under SUJALA, totally 6726 SHGs are formed and strengthened out of these; nearly 50 % of the SHGs have established linkage with financial institutions for their sustainability. SHGs have a savings upto Rs.13 crores in sujala watershed project.

Income generation activities for SHGs		
Members covered under Entrepreneurship awareness programme	Members covered under Skill training	Members established their own micro-enterprise
26,000	2,500	11,000

Various micro-enterprises established by SHGs

✓ Animal husbandry, Petty shop, Tailoring, Repair of Radio/TV & other electronic equipments, Screen printing, Agarbatti making, Welding, Motor rewinding, Candle making, Leaf plate making, Paper bag making, Vermi-composting, Food processing etc.

2. Mid-term Impact Assessment

TABLE 2: Mid-term Impact of 1st phase watershed interventions on Natural resource base and livelihoods

Impact Indicators	Baseline				Mid-term Impacts			
1. Household income	Average household income Rs. 10,036/-				Average income of Midterm – Rs. 16,790/-			
	Size class	Baseline			Size class	Midterm		
	Landless	6009.59			Landless	9858.11		
	Marginal	9751.9			Marginal	12089.29		
	Small	14071			Small	20442.58		
	Big	20250			Big	38506.02		
2. Crop Yields (Total land productivity for arable crops)	Crops	NTZ	CDZ	EDZ	Crops	NTZ	CDZ	EDZ
	Ragi	3.4	4-6	4.7-6	Ragi	3.4 – 3.8	4.4 – 6.0	5.0 – 6.0
	Jowar	3-4	4-4.5	4.4-25	Jowar	4.0 - 5.8	4.5 – 5.0	4.5 - 4.7
	Maize	13.4	12.7	12.6	Maize	13.0 – 15.0	13.0 – 13.5	12.6 - 13
	Pulses	1.4-2	2 – 2.7	2 - 3.5	Pulses*	2.0 - 2.25	2.5 – 3.0	2.0 - 3.5
	G.Nut	3 - 4	3 - 4	3.5 - 4	G.Nut	3.5 - 4.5	4.5 – 5.0	4.0 - 4.75
	Cotton	3 - 5	2.5 - 3	2.5 - 3	Cotton	3.5 – 5.0	2.5 – 3.5	2.5 – 3.0
	Sunflower	1-2	3-4	3-4	Sunflower	2.0 – 3.0	3.75 – 5.0	3.5 - 4.5
	Paddy	5.2	11-14	11-14	Paddy	6.4	12.0 - 14.5	11.5-15.0
	(Figures in quintals per acre)				(Figures in quintals per acre)			
					Crop Yield increased by 6 to 15 %			
3. Groundwater recharge (Water levels of sample bore-wells)	Borewell – 400ft (drill depth) Dugwell - 45 ft				Borewell – Increase in level by 3 – 5 ft Dugwell – increase in level by 1.5 – 2.5 ft Discharge – increased by 250 - 275 gal / hr. Period of Availability – increased by 2 to 3 months			
4. Cropping Pattern	NTZ – Jowar, (22.6) Maize (17.7), Cotton (13.9), Oilseeds (12.3), Pulses (10) CDZ – Oilseeds (62), Pulses (6.9), Ragi (5), Cotton (4.9), Paddy (4.5) EDZ – Ragi (24.7), Oilseeds (21.3), Fruits (10), Pulses (8.7), Maize (8.2) (Figures are in Per cent cropped area)				Area under Food Crops – decreased by 8.2% (Jowar, Ragi) Cash Crops – increased by 2.79% (Milberry, Vegetables) Oil seeds – increased by 3.59% (G.nut, Soyabean, Sunflower) Pulses – increased by 1.83% (Redgram, Horsegram) Shift from Agri. to Agro.Horti./Forestry – 14.7 % (Avg.)			
5. Milk, fuel, fodder production (No. of families requiring externally sourced fuel wood and fodder, local milk output)	Fuelwood – 85-90% depend on external sources. Fodder – 50-85% depend on external sources.				Milk Yield – Increased by 15 to 20% Fuel wood and fodder – Dependence on external sources decreased by 5 – 10%			
6. Productivity of non-arable lands	Percentage of land in low productivity (10-15%)				Productivity in non-arable lands has increased by 5 - 10%.			

Note: 1. NTZ – Northern Transition Zone, CDZ- Central Dry Zone, EDZ – Eastern Dry Zone, 2.* (Pulses) – includes – Red gram, Green gram, Black gram & Horse gram

2.1 Improved ground water levels

2.1.1 Groundwater level

The groundwater level in the project area had reached as high as 1200 feet in some parts of Kolar district, this problem was further compounded due to continuous drought. The intervention made under SUJALA has

rejuvenated the ground water level in many parts of the project area. The mid term impact studies showed 1.5 to 2.5 feet increase in groundwater level in dug or open wells where as it was 3 to 5 feet in bore wells (Table 2).

2.1.2 Groundwater discharge

Since the groundwater levels were dipping, the discharge rate has also reduced over a period of time. With the completion of different soil and water conservation measures under sujala, the levels improved leading to an improvement in the discharge rate. It has recorded an increase by 250 to 275 gallons per hour

2.1.3 Groundwater availability and poverty

Over exploitation of groundwater leading to non availability of groundwater in many areas, even once potential zones turning into poor or nil groundwater available zones. This in turn reducing the success rate in bore well yield, contributing to poverty in the area. The water harvesting mechanisms adopted in SUJALA has improved the availability of water for irrigation purpose from 3 to 4 months to 4 to 6 months. As a result of more availability of water, area under irrigation has improved by 5 to 8 per cent in open or dug well and 10 to 20 per cent in bore wells. The drinking water availability is also substantially improved in the watershed villages; this is mainly attributed to the drinking water supply systems established by the project. Nearly 130 such drinking water supply systems were provided to the needy villages. This has reduced the poverty to some extent thorough employment generation in the agriculture and allied sectors.

2.2 Improved vegetative cover

The vegetation density assessment in watersheds shows that, 20-30% of fallow & common lands brought under vegetative cover through various forestry, horticulture & pasture interventions (Table 2).

2.3 Improved Productivity

2.3.1 Crop yield

Table 2 reveals that in the 1st phase watersheds, the overall crop yields increased by 6 to 15% when compared to the base year crop yields. Despite the poor rainfall during the last three years land productivity has increased considerably in all the watersheds. In the project areas major dry land crops are Ragi (finger millet), Jowar, Maize, Ground nut, Sunflower. The further analysis reveals that the Ragi yield increased from 4.5 q/acre to 4.7 q/acre, Jowar yield increased from 3.9 q/acre to 4.7 q/acre, Maize yield increased from 12.9 q/acre to 13.3 q/acre, Ground nut yield increased from 3.5 q/acre to 4.3 q/acre, Cotton yield increased from 3.1 q/acre to 3.8 q/acre, Sunflower yield increased from 2.8 q/acre to 3.6 q/acre.

2.3.2 Milk yield

Milk yield increased by 15 to 20%. The daily average milk yield before the project is 3.47 litres/animal but during the mid-term it is increased to 3.59 litres/ animal. It is mainly due to the project interventions like increased primary animal care, increased local veterinary Services like artificial insemination, local capacity building through village based trainings & improved green fodder availability. In the project area majority of the SHG (70%) members have taken up live stock based IGA activity to improve their livelihoods (Table 2).

2.3.3 Fuel wood & Fodder availability

The table 2 depicts that, before the project initiation, 85-90% and 50-85% dependence on external sources for fuel wood and fodder respectively. During the mid-term impact

assessment it is observed that the fuel wood & fodder dependence on external sources decreased by 5-10.

2.3.4 Productivity of non-arable lands

The productivity in non-arable lands has increased by 5-10% (table 2).

3. Cropping pattern

The cropping pattern is diversified to high value crops, the mid-term assessment clearly indicates, that the cash crops, oil seeds, pulses cultivation increased by 2.79%, 3.59%, 1.83% respectively. The food crops cultivation decreased by 8.2% and it is also observed that nearly 15% of agricultural land brought under agro-horti/forestry. The major species grown under agro-horti are mango, sapota, tamarind, orange and pomegranate & their survival rate is 70 to 80% (Table 2).

4. Impact on Household income

The average household income is increased from Rs.10, 036/- to Rs.16, 790/-. Further the class wise household income shows that the big farmers income increased from 20,250/- to 38,506/-, small farmers income increased from 14,071/- to 20,443/-, marginal farmers income increased from 9752/- to 12,089/- and landless farmers income increased from 6010/- to 9858/-. The results clearly indicate that the project interventions like soil and water conservation activities, horticulture and forestry plantations have been generated lot of employment opportunities to vulnerable section of the families (Table 2).

5. Employment generation & migration

The major employment generating activities taken up under SUJALA are bunding, farm pond, boulder/rubble check, horticulture & forestry activities apart from various income generation activities of vulnerable groups. These interventions have tremendously increased the employment opportunities, nearly 15,000-20,000 man days of employment created in each micro-watersheds (approx. 500 ha). Due to this the individual person's income is increased between Rs. 4000 to 6000. The increased employment opportunities have reduced the seasonal migration. In the watershed areas nearly 80 % of migrating populations were benefited from the various interventions of the project. The utilization of human labor (non-machinery) has created a total wage component of about Rs.125 crores for this period (calculated on an average of 70% of expenditure as labor component at the wage rate of Rs. 62.50 per day per person).

6. Changes in accessibility to livelihoods among women SHGs

Table 3: Changes in accessibility to livelihoods among women SHGs

Sl.no	Livelihoods	% change
1	Fuel wood	80
2	Fodder	75
3	Drinking water	41
4	Finance	66
5	Better Education	52

A cursory look at the table 3 indicates, a great majority (80 %) of women's have reported an increased fuel wood accessibility. With respect to fodder accessibility three-fourth of them reported as increased. In case of finance, 66 percent of women's have reported increased accessibility.

Little more than fifty percent (52 %) of women's have reported to be more accessible towards better education

facilities, while 41 percent of them have more accessible to drinking water.

Best Practices adopted in SUJALA watershed project

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- ✓ Weekly review through Audio Conference
 - ✓ Transparency in financial management matters
 - ✓ O.K card systems to ensure quality of physical interventions
 - ✓ Wide range of publications in local language for grassroots level stakeholders
 - ✓ M&E reporting structure enables concurrent corrections at all levels
 - ✓ Entry point activities Implemented through Grama panchayats
 - ✓ Fortnightly logical action plans to monitor the progress.
 - ✓ Monthly public open house meetings at each micro-watershed level
 - ✓ Banning of machinery usage
 - ✓ Ensured Govt. wage rate to laborers
 - ✓ Photographic documentation of works- before, middle & after the treatment
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CONCLUSION

It is evident from the above findings that, the impacts of watershed interventions on natural resource base and livelihoods are interrelated in an agrarian economy. The increased employment opportunities and overall increase in income and consumption levels reflect the potential of watershed development in enhancing the rural livelihoods. More importantly watershed development has helped in reducing inequalities in income across the households. There is a clear indication that migration has gone down after the advent of watershed. Impact of watershed on environmental indicators, though crucial, is medium to long run in nature. Given the fact that the sample watersheds are not very old, as the implementation was initiated only during 2001-02, our data serves as an indicator in this regard. However, some of the medium-run impacts are clear. Impact on ground water has improved, though in a limited way. Similar is the case with fuel wood & fodder availability. These are long run impacts & hence may take some more time to translate in to tangible benefits. Given the long run nature of these impacts the ultimate benefit flows will depend on the sustainability of watersheds. In other words, maintenance of the watershed works is equally important as proper technical implementation of the watershed. For instance, the absence of proper maintenance of check dams, nala bunds and farm ponds, ground water table may not improve. More importantly, sustaining ground water tables depends critically on reviving the traditional water harvesting systems like tanks. These systems degenerated over years due to lack of maintenance. The integration of these systems with watershed development would result in

sustaining ground water development. Similarly, maintenance of plantations on waste lands is crucial for maintaining the *in situ* moisture and improving the pasture and grazing lands. This is not an easy task to achieve, as benefits are not immediate in terms of influencing the livelihoods of the households. This could be achieved only through bringing awareness and developing social capital among the communities. Therefore, sustainable management of watersheds in the long run is vital in realizing tangible and substantial benefits.

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