



**IMPACT ASSESSMENT OF
NATURAL RESOURCES MANAGEMENT PROJECT
FOR POVERTY ALLEVIATION IN A CHALLENGING
ARAVALI ECOSYSTEM**



A CASE STUDY OF GOTOLI VILLAGE OF ALWAR DISTRICT (RAJASTHAN)



**Society for Promotion and Conservation of
Environment, Chandigarh
March, 2013**

FOREWARD

CONTENTS

Executive Summary	1
Introduction.....	2
SRF Limited.....	3
Bio physical and Socio-economic conditions	4
Hydrology.....	8
Land development	11
Improvement in crop production.....	13
Fodder tree plantation.....	14
Fruit tree plantation.....	15
Ground water recharge.....	16
Livestock development.....	17
Assets created by sampled families.....	18
Assessment of Mahila Bachat Samitis	19
Community perception.....	20
Renovation of Village well.....	21
Way forward.....	21

EXECUTIVE SUMMARY

SRF Limited, a diversified business house took up a natural resource management project for poverty alleviation under corporate social responsibility portfolio near one of its plant in Tijara Block of Alwar District of Rajasthan, with the support from PRADAN a reputed NGO, which handed it over to Sir Syed Trust (SST) subsequently. Initially, SRF took up the program in 17 villages and expanded to 35 villages after successful implementation for 2 years of pilot phase. In view of extreme poverty, the *Meo-muslim* community was unable to reclaim privately owned wastelands. The fast depleting ground water was another serious problem. The program was tailored to harvest rainwater from barren *Aravali* hills by constructing earthen embankments across gullies locally called paals, reclamation of waste lands with farmer's cost sharing, plantation of fruit and fodder trees by organizing communities as self help and user groups. In the last seven years, 182 paals were constructed, 1151 ha of waste lands reclaimed and more than 2.49 lakh trees have been planted on the land of 5161 resource poor families. The total project investments made so far are around Rs. 8.1 crores. The project has set a model of partnership between corporate and NGO's.

The impact assessment of interventions was considered necessary to justify the investments in terms economic, social and environmental benefits. SPACE, a professional NGO was involved for this purpose. Such an assessment was conducted during 2010 for a typical village Gualda and its report provided positive indications of development but the results were vitiated by the benefits also drawn from the mining activity. The study was, therefore, repeated in village Gatoli where no mining activity was prevalent.

There are 322 families with 1026 male and 865 female, 957.87 ha of land out of which 352.8 ha is privately owned waste land. A total of Rs. 38.79 lakhs were spent between 2006-12 out of which 31% on paal construction, 28% on land development and 24% on plantation. During this period, 15 Paals were constructed to harvest rainwater from 884 ha catchment area. The rainfall varied from 538-1078 mm with an average of 738mm. 25.55 ha of waste lands have been reclaimed and in addition 80.43 ha area of

undulating land was leveled by 81 farmers. A total of 31262 fodder plants were raised but 14283 survived out of which 76% is Aruneem. Similarly, 10798 fruit plants were planted out of which 44% is Guava and 3412 survived having 42% citrus. The survival of fodder plants was only 20.27% in 2006 which increased to 77% in 2012. The number of tube-wells increased from 2 to 128 in last 30 years.

Well observations were recorded at fortnightly interval to study the impact of rainwater harvesting on ground water recharge. The ground water showed a decline between 1.05 to 2.02m in 5 years. In last 6 years, 150 ha m ground water was recharged. The community has perceived the benefits of Paals construction, land development and plantation in a very positive way. The availability of fodder, milk and food grains have increased leading to better quality of life. The data from 31 sampled families indicated that the overall livestock decreased from 286 to 174 but milk production increased from 282 to 363 litres day before and after the project. The number of buffalo increased from 70 to 109 but that of cows decreased from 131 to 45 and goats from 124 to 13 with the sampled families. The leveled land increased from 62.25 to 133.25 ha, the number of school going children increased from 37 to 74, number of tractors increased from 4 to 8, bikes from 3 to 23, TV/Refrigerator from 12 to 20 and number of pacca houses increased from 17 to 28 in a period of 6 years.

Six Self Help Groups (SHGs) were formed in the village with a total of 72 members and these have Rs. 117370/- as savings in their account. However, the activities of SHGs remained limited to inter-loaning only. A village development programme was also initiated where an old well with lot of filth around was renovated with Pacca floor, an over head water storage tank and Khel for livestock. The villagers have greatly appreciated this programme and contributed 40% of the total cost. The overall impact in the form of increased income to the families, improved livelihoods, better quality of life including food nutrition, better children education, more transport vehicles and overall improvement in the green cover over the village has been indicated by the study. Moreover, with the reduced number of cows and goats, the grazing pressure on the hills have reduced. The overall cost: benefit ratio is 1.8 and internal rate of return as 29%. The investments made are recoverable in a period of 3.5 years. These positive impacts fully justify the investments made and make a valid case for large scale replication of the programme over other similar areas.

INTRODUCTION

The Aravali Ecosystem



The *Aravali* hills are one of the oldest fold mountains which extend over approximately 450 kilometer length from north-east to south-west across Rajasthan state in western India. The northern end of the range continues as isolated rocky ridges in Haryana state, terminating near Delhi. These low hills are deeply imbedded and acted as a natural barrier to the spread of wind –blown sand dunes towards north –east and protected the alluvial plains against the march of *Thar* Desert .The *Aravalis* were once covered with dense forest and not only served the needs of fuel-wood and timber of the local community but also maintained the delicate ecological balance of the arid ecosystem. As the population pressure increased, the hills were denuded of the vegetation cover due to excessive fuel wood extraction and over grazing by herds of cattle, goats, and sheep resulting in severe land degradation with concomitant adverse environmental and socio-economic consequences impacting the quality of life of the inhabitants. The state forest department failed to bring back greenery on the barren hills and have practically written these off. Large chunks of land are community owned and are managed under an open access system .The survival of rural populace greatly depends on income generated from livestock rearing.

The ecosystem witnessed a phase of transformation in the last couple of decades. What was once a predominantly pastoral economy has transformed into a tract of arable farming with scant regard to low and erratic rainfall, impoverished sandy soils, harsh climate and limited ground water resources. The entire region is presently facing acute water shortage because of large scale extraction of ground water by ever increasing number of tube wells and loss of precious rain water as runoff from bare hills. As the water table is going down, the centrifugal pumps are being replaced by electricity driven submersible motors. The *Meo-muslim* community inhabiting the area has large family size, low literacy rate, women mostly illiterate and their drudgery is beyond description. Men are involved in illegal mining directly or indirectly.

PARTNERSHIP MODEL OF SRF



The SRF Limited, a diversified chemical business house established one of their plants near Bhiwadi in Tijara Block of Alwar District of Rajasthan State. In view of extreme poverty and backwardness in the surrounding Aravali area of the plant, SRF decided to venture in the field of poverty alleviation through natural resources management under its Corporate Social Responsibility portfolio. In the year 2006, 17 villages were selected initially with the help of PRADAN a reputed NGO and subsequently with Sir Sayed Trust to take up the program of community awareness, organizing them into groups and take up large scale rain water harvesting program by constructing earthen embankments locally called Paals. Reclamation of private wastelands, planting of trees and crop production improvement formed part of the package. The project was design to work in partnership.

A steering committee was constituted for monitoring and evaluation of the program. The impact assessment was considered the integral part of the program, so the Society for Promotion and Conservation of Environment (SPACE), a Chandigarh based professional NGO was involved for impact assessment in 2007. After successful implementation in first two years, the program was extended to 35villages at the expansion phase. The mid-term evaluation of the project was conducted during 2010 for learning lessons of experience and changes if needed in the implementation strategy. It was decided to select one project village where maximum works were completed for evaluation. Eventually, village Gualda was selected for impact evaluation.

The SPACE carried out this evaluation study and published a comprehensive report covering the period from 2006 to March 2011. This report clearly brought out positive social, economic and environmental benefits of the project and made several recommendations for future improvements in the implementation strategy.

It was noted that in a short span of two years, the mining activity in the vicinity of *Gualda* villages increased mani-fold and provided such an attractive option of gainful employment to the youth that their attention was diverted from agriculture to wage earning/custom hiring in mining activity. Being an illegal activity, the work was done stealthily during night or during odd hours thus more wages from the contractors. *Gualda* village was swarmed by trucks and tractors engaged in illegal mining. The income thus gained was ploughed back to improve land, install tube-wells, make Pacca houses and purchase of buffaloes. It became difficult to segregate the monetary benefits from the project viz a viz benefits derived from the mining business. It was, therefore, decided that another village be selected for impact assessment where there is no mining activity. Village *Gotoli* was selected after careful consideration. This report sums up the results of impact assessment study taking village *Gotoli* as a test case.

BIO PHYSICAL AND SOCIO-ECONOMIC CONDITIONS

Geographical location

Gotoli village falls in Tijara block of Alwar district of Rajasthan state. It is situated north-east of Tapukara town at a distance of 15 km and connected by metalled road. Tapukara town is situated on Bhiwadi-Alwar highway.

Demographic status

Gotoli village has a population of 1891 which is distributed over 322 families with 1026 men and 865 women or 843 women for every 1000 men (Table). SC and ST families constitute one third of the population. This ratio is particularly wide in ST population comprising of Meena community.

Table: Demographic details of Gotoli village

Caste	No. of Families	Male	Female	Total	Sex Ratio
General and OBC	183	649	557	1206	1000:858
SC	88	241	201	442	1000:834
ST	51	136	107	243	1000:786
Total	322	1026	865	1891	1000:843

*Source: Census 2011

Land use pattern

Out of total land of 957.87 ha, 466.62 ha (48.7%) is privately owned with average land holding of 1.45 ha. While forest, hills and Panchayat land constitute roughly 12% of the total but waste lands cover a significant 352.8 ha of total area (Table).

Table: Land use pattern of Gotoli village

Particular	Ownership	Area (ha)	Percentage
Cultivated private Land	Farmers	466.62	48.70
Hilly Forest Land	Forest Department	77.74	8.11
Panchyat Land	Community.	40.84	4.26
Uncultivated waste Land	Mostly private.	352.80	36.82
Roads and paths	Govt.	14.18	1.43
Village settlement	Community.	5.69	0.68
Total		957.87	100.00

Almost 50 % of land comprising uncultivated waste land, forest and Panchayat land are in one contiguous block under open access system used mostly for grazing livestock and as such not providing much economic gains to the community. There is vast scope for improving such lands and put them to productive use. Almost 50 % of private cultivated lands are also uneven and undulating and need leveling for efficient rain water conservation and production improvement.

Infrastructural facility

The village lacks basic facilities and people have to travel long distances to get the agro-services and farm inputs (Table).

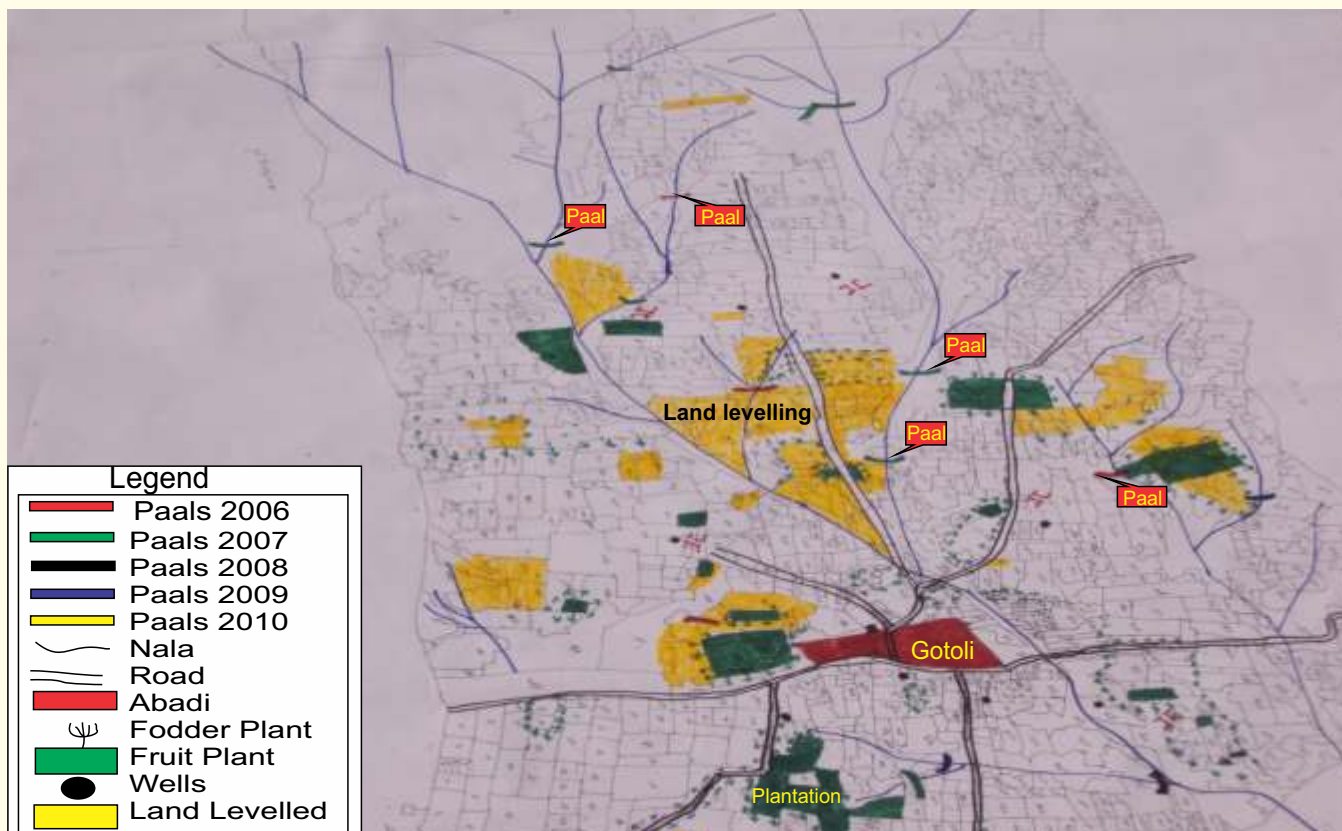
The villagers have to go to Tapukhera and Tijara for bank, petrol, grain market, electricity and other common needs. The district head quarter is 70 km away.

Table: Infrastructural facilities available and their distances from Gotoli

Service Centres	Location	Distance from Gotoli(Km)
Electricity office	Tapukara	15
Pesticide shop	Tapukara	15
Fertilizer store	Patan Kala	2
Co-operative society office	Patan Kala	2
Agro-industry centre	Alwar	70
Grain market	Tijara	18
Bank	Tapukara	15
Petrol pump	Tapukara	15
Agriculture Officer	Tijara	18
Post Office	Local	0
Primary Health Centre	Local	0
Gram Panchyat	Khiderpur	2
Krishi Govt. School Vigyan Kendera	Alwar	70

Drainage pattern and detail of executed works

Gotoli village is drained by a net work of gullies emerging from the *Aravali* hills and first pass through the waste lands below the hills, then the farm lands and cause damage to infrastructure. The slope is steep near the hills, becomes rolling in the lower portion of the landscape. Paals have been constructed at strategic locations across the gullies to harvest rainwater. The location of Paals, pocket of land leveled and plantation work is shown in the map.



Cropping pattern

The survey revealed that Bajra (Pearl millet) is the most dominant crop of Kharif season occupying 65 % of cropped area. Mustard was another dominant crop of Rabi season covering 51 % of cropped land. Wheat was the second most preferred crop of Rabi season covering 46.7 % of the area and mainly occupied the lands earlier kept fallow during Kharif season. There appears a logic behind this practice. In case farmers raise pearl millet during Kharif on such lands, the moisture would be used by Kharif crop and it would not be possible to raise wheat crop on residual moisture. Keeping such lands fallow during rainy season is to ensure sufficient storage of moisture in the soil profile on which wheat crop can be raised successfully.

Postoral economy

The survival of rural populace of Aravalis in general and Gotoli in particular greatly depends on income from livestock rearing which constitute buffalo, cow, sheep, and goat. Except buffaloes, most of the livestock depends on grazing in open access system in village common grazing lands and forest land. The plants of almost all types are browsed and new seedlings are trampled. The forestry initiatives are not yielding any good result. Some trees may grow being out of reach but are cut for fuel wood and leaves are fed to goats. Large number of goats and cattle create grazing pressure on Aravali hills leading to deforestation and denudation.

Soil fertility and water quality analysis

Soil samples were collected from representative sites from the village and analysed. The results indicated that the soils were poor in nitrogen whereas phosphorus was low to medium and potassium medium to high. In general, soils of the village are Alkali in nature and salt content is nearly normal allowing cultivation of all crops with precautionary measures. Water samples from all the observation wells were collected and got analysed from CCS Haryana Agricultural University Regional Research Station, Bawal. About 60 percent samples of water were not safe for application to crops as such and need to apply required amount of gypsum.

Source of irrigation and groundwater exploitation

Tube wells, either diesel operated or electricity driven are the main source of irrigation. The bigger land holders have their own tube wells, whereas small farmers get the irrigation facilities on rent basis. The exploitation of ground water has increased over time thus depleting the ground water reserves. As a result, water table is going down day by day. An idea about the ground water situation can be had from the following information.

- Water table is falling at a rapid rate varying from 4-5 feet every year. This fall increases to 8-10 feet in drought years. But because of recharge from monsoon rains, part of loss is recouped but not the total.
- Water table is 40 feet deep in tube-wells located in lower reaches and around 80 feet deep in the tube-wells located in upper reaches near the hill. This is because of elevation difference.
- Thirty two percent tube-wells are diesel engine operated and 68 % are electricity operated.
- Fifty percent tube-wells have been converted to submersible during the last 5-6 years.
- Number of submersible tube-wells is increasing very fast. In the coming 4-5 years, all the tube-wells will be converted to submersible, if depletion in water table is not controlled.
- On an average, roughly 2.0 ha cultivated area is irrigated by each tube-well.
- Maximum fall in water table occurs during peak period of withdrawal from December to February when wheat and mustard crops are irrigated.
- Most of the farmers are adopting sprinkler system because of saving in irrigation water.

Two issues mainly emerge from the information cited above

- There is large chunk of unproductive land not contributing to the economy of the people.
- Water crisis are emerging as ground water is being depleted at a faster rate. Farmers are investing on submersible motors to extract water from deeper layers.

Technological package

- Community awareness and sensitization, forming Self Help Groups, preparation of watershed based micro-plans, implementation in close partnership as per need, demand and technical feasibility.
- Since water scarcity mainly hinders economic development, harvest every drop of rainwater which runs off from barren hills during rains and form gullies in wind-blown sandy tract by constructing earthen embankments and check dams across drainage lines.
- Land leveling/field bunding of waste/under-utilized private lands of groups and put them under productive use by project supported package of practices.
- Plantation of fruit and fodder trees on reclaimed lands and promotion of improved packages of practices for sustainable crop production.
- Help develop market linkages for vegetable crops.
- Organizing community to undertake construction of earthen dams, land development in clusters, maintenance of plantations and joint marketing.

Financial outlay

Total financial investment made on project activities in village Gotoli from the year 2006 upto 31 March 2012 is Rs 38.79 lakh out of which 30.86 percent amount was spent on paals and spillway, 28.04 percent on land leveling and field bunds, 24.23 percent on plantation, 4.07 percent on crop demonstration and 9.16 percent on the development of irrigation sources and 3.61 percent on village development activity (Table).

Table: Project investments made in Gotoli on various components from 2006 to March 2012

S.No	Particular	Project investments in different years (Th. Rs.)							Total	% of total
		2006	2007	2008	2009	2010	2011	2012		
1	Paals	184.96	536.03	65.26	198.06	212.80	0	0	1197.13	30.86
2	LL and FB	277.43	108.20	22.35	40.59	279.71	222.71	136.69	1087.70	28.04
3	Plantation	17.33	154.00	114.47	249.43	71.52	208.84	124.51	940.13	24.23
4	Crop demo	0	17.01	7.07	84.14	46.36	3.60	0	158.19	4.07
5	Tube-wells	272.43	82.91	0	0	0	0	0	355.34	9.16
6	VDA	0	0	0	0	0	0	140.27	140.27	3.61
Total		752.15	898.15	209.15	572.22	610.39	435.15	401.47	3878.76	100%

Progress of Paal construction

The Paal construction work was started during the year 2006-2007 and total number of 15 Paals were constructed upto the year 2010-11 (Table)

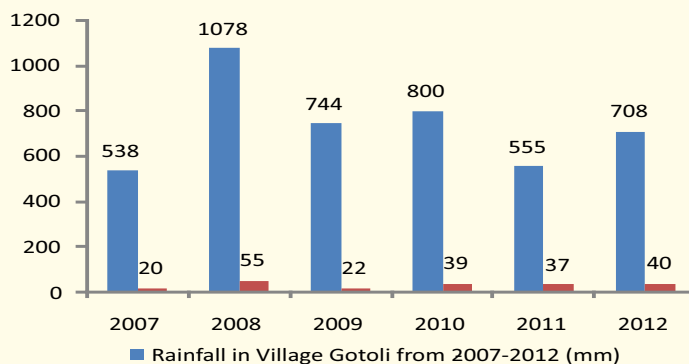
S.N.	Name of Paal	Year of Construction	Catchment Area (ha)	Land Ownership	SRF Contribution	Farmers Contribution	Total Cost (Th. Rs.)
1	Ram kishor ki paal	2006-07	8.5	Private	14.74	3.68	18.43
2	Leek wali	2006-07	38.5	Private	61.51	15.37	76.88
3	Kamal wali	2006-07	16.24	Private	46.82	15.60	62.43
4	Prakash wali	2006-07	4.0	Private	14.33	3.58	17.92
5	Esrail wali	2006-07	4.0	Private	14.97	4.99	19.96
6	Aaqup wali	2006-07	5.0	Private	32.57	13.81	46.38
7	Khati wali	2007-08	25.0	Private	89.46	8.94	98.40
8	Khadd wali	2007-08	210.0	Community	81.17	9.01	90.19
9	Cheekana teel	2007-08	357.0	Community	182.80	36.56	219.36
10	Dhundlee wali	2007-08	75.85	Private	119.70	11.97	131.67
11	Safeda wali	2007-08	9.8	Private	12.69	2.53	15.22
12	Balendi wali	2008-09	29.0	Private	31.10	6.22	37.32
13	Naya wali	2009-10	37.0	Private	39.22	9.80	49.02
14	Sharda wali	2009-10	10.0	Private	53.18	10.63	63.82
15	Jokha wali	2010-11	55.0	Community	159.53	17.72	177.26
Total			884.89		953.79	170.40	1124.26

Out of 15 Paals constructed, 3 are on community land and 12 are on private land. Two Paals on community land have large catchment area of 210 and 357 ha. Three Paals having 4 to 5 ha catchment area are gully plugs and land above them has been levelled and put to crops. Run off from 884.89 ha of area was harvested. Out of total cost of Rs. 11.24 lakh, 1.70 lakh (15%) was contributed by the farmers themselves and remaining Rs. 9.54 lakh by the project. The results of the study are now presented in different sections.

HYDROLOGY

Rainfall amount and distribution

Daily rainfall was recorded by ordinary rain gauge. The highest rainfall of 1078 mm was received during monsoon of 2008 in 55 rainfall storms. The lowest monsoon rainfall of 538 mm was received in 2007 in 20 rainfall events (Fig). The monsoon rainfall varied with high variability over place and time.



The monthly totals for monsoon rainfall for the last five years are given below in table:

Table: Monthly rainfall in village Gotoli during different years (mm)

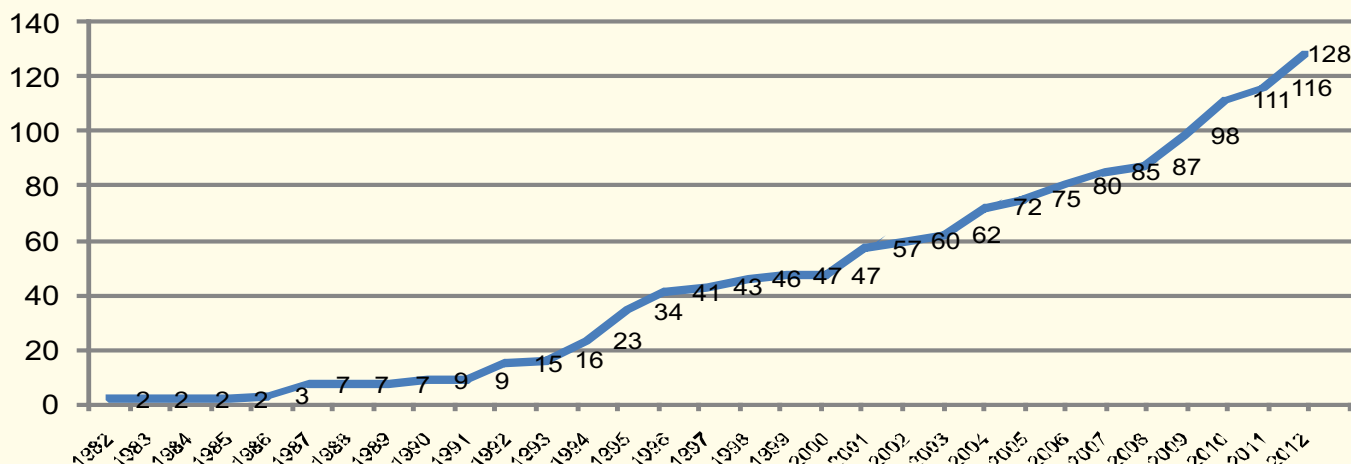
Year	2007	2008	2009	2010	2011	2012	Average
May	0	200	63	2	27	13	51
June	51	230	0	33	100	12	71
July	149	250	145	170	91	106	152
August	153	233	265	359	108	271	232
September	185	163	271	236	228	306	232
Total	538	1078	744	800	555	708	738
EVENTS	20	55	22	39	38	40	36

The highest rainfall of 359 mm was received in the month of August 2010. On 11 September 2009, one day highest rainfall was 173 mm and on 3/4th September 2012, 228 mm of rainfall was received in one day which breached several Paals and damaged infrastructure. Rainfall storms above 80 mm are common. This shows the possibility of runoff harvesting.

Analysis of ground water situation

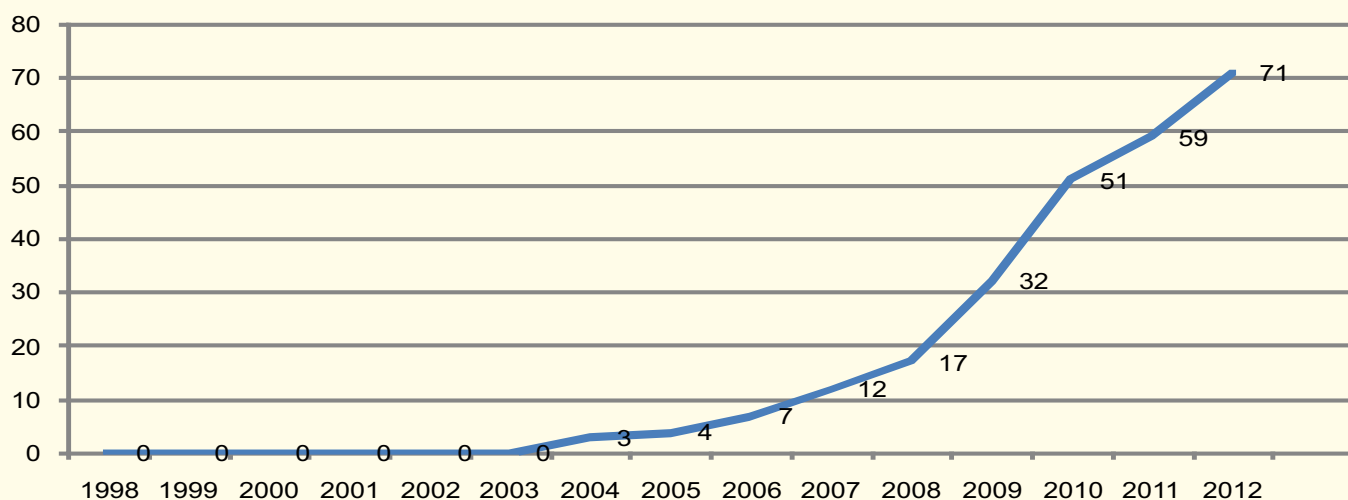
Between 1982 and 2012, the number of tube wells in Gotoli village jumped from just 2 to 128 and in the same period, the water table has gone down drastically (Figure). Almost 48 tube-wells were added in last 6 years.

Periodic increase in the number of tube wells



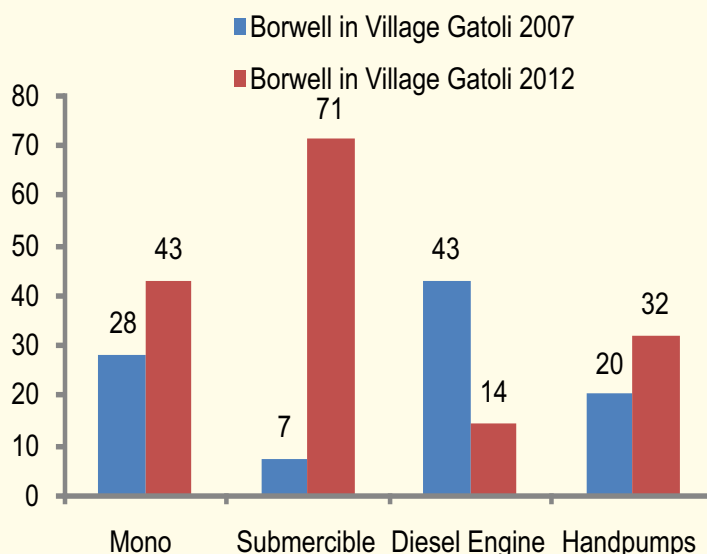
The shallow tube wells had to be converted to submersible motors whose number increased from 7 to 71 from 2006 to 2012 (figure).

Periodic increase in the number of submersible motors



But the number of diesel engines decreased from 43 to 14 (figure). Now there are 33.59 % mono-block bore wells, 10.93% diesel pumps and 55.46% submersible motors.

The need of submersible motors started from 2003-2004. The cost of conversion from diesel pump to submersible motor is Rs 1.25 Lakh. So, there was an investment of Rs 80 lakh on conversion of 64 (71-7) diesel engines to submersible motor due to lowering down of water table.



Paradoxically, the area does not receive sufficient rainfall to replenish the ground water depletion. Major part of monsoon rainfall ends in runoff from barren rocky hills. The trend justifies the need of rain water harvesting for ground water recharge. The farming community, therefore, attached high priority to the construction of Paals.

Rain water harvested and ground water recharge

Out of total 15 Paals constructed in village Gotoli, two were selected for detailed monitoring by installing gauges. The results were extrapolated for the total paals constructed in the village. The recharge varied according to the rainfall amount and distribution in different years. Over the last five years, the total groundwater recharge by all 15 Paals is 150.38 ha.m or 1503800 cubic meters (Table). Heavy storms contributed much more than small showers.

Table : Rainwater harvested and groundwater recharge for 2007 to 2012 in village Gotoli

Particulars	2007		2008		2009		2010		2011		2012	
	Study Paal	Total Paal	Study Paal	Total Paal	Study Paal	Total Paal	Study Paal	Total Paal	Study Paal	Total Paal	Study Paal	Total Paal
No. of Paals	2	11	2	12	2	14	2	15	2	15	2	15
Rainfall mm	538	538	1078	1078	744	744	800	800	555	555	708	708
RWH ha. m	2.84	15.6	5.36	32.2	5.69	39.83	2.95	22.12	0.219	1.64	6.08	45.65
GWR ha. m	2.82	15.5	5.29	31.7	5.13	35.91	2.89	21.67	0.214	1.6	5.87	44
Cumulative		15.5		47.2		83.11		104.78		106.38		150.38

RHW – Rainwater Harvested, GWR – Ground water Recharge

The runoff was zero from two Paals in the year 2011 because of land leveling and bunding in their catchment area. As the lands are leveled in upper areas, the runoff to the paals decreases. The recharge potential of 150 ha m is equivalent to one irrigation over 2000 hectare of cultivated land.

All the Paals in Gotoli were filled to capacity during a heavy rainfall storm on third September, 2012. The gauges were installed to work out the storage capacity.



LAND DEVELOPMENT

The land development component is divided into two categories:

- A) Reclamation of waste/gullied land above and below Paals
- B) Leveling of sloping but already cultivated land

A) Reclamation of waste/gullied land

A total of 25.55 ha of waste land above and below the Paals was levelled as detailed below involving 99 farmers of the village (Table).

Table: No. of farmers and area leveled above and below paals (ha)

S.No	Name of Paal	No.of farmers	Above Paals	Below Paals	Total
1	Kamal wali	8	1.3	1.49	2.79
2	Leek wali	16	3.25	1.49	4.74
3	Ram Kisore wali	5	1.12		1.12
4	Parkash wali	6	0.5	0.61	1.11
5	Israil wali	2	0.74		0.74
6	Akupwali wali	4	0.5	0.67	1.17
7	Safeda wali	4	0.3	0	0.3
8	Dhundhalia	10	0.5	1.84	2.34
9	Khadd wali	5	0	0.86	0.86
10	Khati wali	28	1.36	5.15	6.51
11	Baleri wali	6	2.25	0	2.25
12	Nai wali	2	0.31	0	0.31
13	Sarda wali	3	1.06	0.25	1.31
Total		99	13.19	12.36	25.55

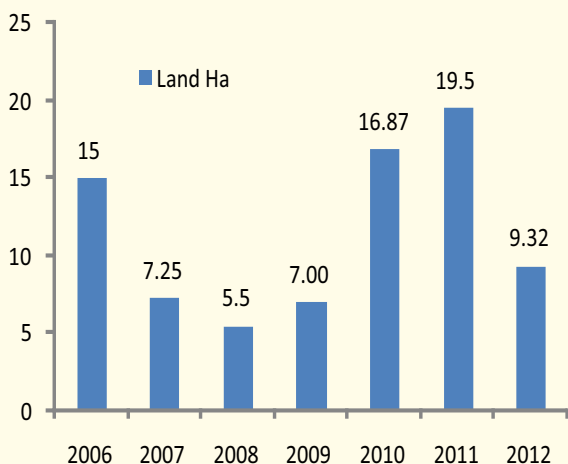
Cheekana and Jokha Paals are not included as these are located in common land.

A recently leveled block of land with plantation



B) Levelling of sloping cultivated land

The total area covered under leveling and field bunding of sloping cultivated land from 2006 to 2012 is 80.43 ha covering 81 farmers. Depending on the slope and topography, lands are divided into three categories and financial assistance is provided at variable rates as per the category. Almost 50% of the cost was shared by the farmers. The year wise progress of leveling such lands is given in figure.



The land leveling in first, second and third category was 29.62, 24.16 & 26.65 ha. A total of 218.5 ha is irrigated at present and support good crops (Photo). Aruneem has become a symbol of land development.

Irrigated crops on reclaimed lands



IMPROVEMENT IN CROP PRODUCTION

After land leveling, crop yields improved by 25 to 30 % in first, around 50% in second and about 90% in third/fourth category. Thus a total of 105.98 hectare (80.43+25.55) of land was leveled and terraced which lead to improved production potential. Yet, a sizeable area of waste land needs leveling.

31 sampled families raised 89.25 bigha of wheat, 91 bigha of mustard and 45.5 bigha of gram making a total area of 225.75 bigha. The production on an average was 12.52 q/bigha of wheat, 4.15 q/ bigha of mustard and 1.92 q/bigha of gram before the land leveling work. This increased to 31.31 q/bigha of wheat, 10.37 q/bigha of mustard and 4.8q/bigha of gram after land leveling, bunding and use of improved production technology promoted by the project (Table).

Table: Area under different crops and yield before and after land development (31families)

Name of crop	Area in Bigha	Crop yield (q/bigha)	
		Before leveling	After leveling
Wheat	89.25	12.52	31.31
Gram	45.5	1.92	4.80
Mustard	91.0	4.15	10.37
Total	225.75	18.59	46.48

After land improvement and limited irrigation, the crop yield improved by 2 to 3 times. Wheat was given 6 to 9 irrigations and mustard was given 2 irrigations only. In view of depleting ground water, mustard should be given preference because of less water requirement. Farm women contribute significantly in farm operations (photo).



FODDER TREE PLANTATION

Fodder plants were planted on the reclaimed lands and in the period from 2006 to 2012, some 31262 fodder plants were planted but 14283 plants survived and majority of these was Aruneem. The survived of plants was low during initial years but gradually improved. The overall plant survival was 45.68 percent. (table)

Table: No. of fodder plants planted from 2006-2012 in Village Gotoli

Name of fodder plants	2006	2007	2008	2009	2010	2011	2012	Total	Survival
Adruneem	350	3112	2538	2306	2363	6467	3541	20677	10897
Sagwan			100	187				287	52
Bakayan				50	157	642	760	1609	954
SIRIS		50	267	50	131	295	180	973	459
Neem		90	100		15	610	96	911	332
Seesam	280	30	768		40	674	150	1942	772
Safeda		40						40	-
Sahsut			50			140	125	315	190
Karanj					450			450	67
Jaitropha	2300							2300	378
Sahajna			378					378	48
Samal			100	470				570	65
Tunn				500				500	38
Total	2930	3322	4301	3563	3156	8828	4852	31262	14283
Survival Percentage	20.27	34.22	22.6	21.2	39.0	63.73	77.11	45.68	

One of the woman farmer harvested 270 Aruneem plants planted in 2006 and sold for Rs. 70000. She cleared the long outstanding debt and also married two of her sons.

Several trees planted during the year 2006-2007 have crossed girth diameter above 60cm and are fit for harvesting (See Photo). The farmers are expecting good income from trees farming.



FRUIT TREE PLANTATION

10798 fruit plants were planted out of which only 3412 (32%) are surviving Guava and citrus is maximum. (Table)

Table: No. of Plants growing in Gotoli from those planted from 2006 to 2012

Years	Guava	Mango	Citrus	Bilpathar	Jamun	Karonja	Aonla	Kathal	Cheeku	Ber	Total
2006	0		460	281	0	485	505				1731
2007	1045	350	2394				79	15		230	4113
2008	264	400	1165		50		20		20		1919
2009	811			353							1164
2010	425										425
2011	784		152		10						946
2012	293	19	188								500
Total	3622	169	4359	634	60	485	604	15	20	230	10798
Surviving	1501	65	1419	147	23	84	138	2	5	28	3412
Survival%	41.4	8.5	32.5	23.2	39.3	17.3	22.8	13.3	25.0	12.2	32.0

The overall survival of plants was low from 2006 to 2010 it but improved during 2011 and 2012. This was due to selection of healthy plants, identification of only interested farmers and training of staff & farmers. The fruit plants have come into bearing and several farmers have started getting income from fruit plants (see photo).



GROUND WATER RECHARGE

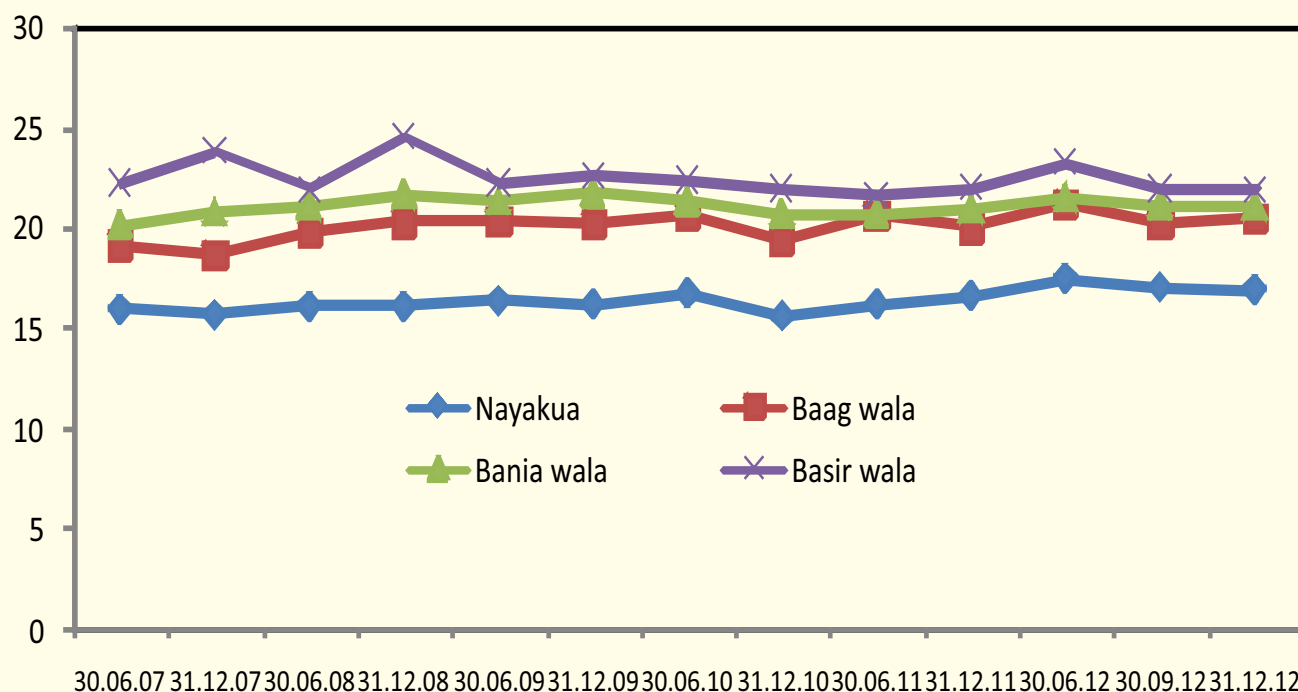
The ground water observations were recorded from 8 observations wells starting from 30.06.2007 and continued up to 31.12.2012 and data are reported in table and figure given below.

Table: Water level in observation wells from 2007 to 2012

Name of wells	30.6.07	31.12.07	30.6.08	31.12.08	30.6.09	31.12.09	30.6.10	31.12.10	30.6.11	31.12.11	30.6.12	30.9.12	31.12.12
Naya kua	15.96	15.7	16.1	16.1	16.4	16.2	16.7	15.58	16.18	16.62	17.5	17.06	16.96
Baag wala	19.18	18.7	19.8	20.3	20.35	20.23	20.65	19.4	20.65	20.04	21.2	20.22	20.55
Bania wala	20.17	20.8	21.1	21.7	21.35	21.78	21.32	20.72	20.75	20.93	21.52	21.14	21.07
Basir wala	22.2	23.84	21.9	24.5	22.2	22.6	22.35	21.95	21.63	21.98	23.25	21.97	21.88

When compared the levels between 30.06.2007 to 30.06.2012, there is general drop in the ground water level from 1.05 to 2.02 m. Ground water levels rise after the monsoon season and then gradually drop during February/March when crops are irrigated.

In spite of Paals construction and land leveling the water table is going down primarily due to increase in number of tube wells coming up in the reclaimed lands. More land reclamation is leading to more ground water exploitation- a dilemma.



LIVESTOCK DEVELOPMENT

Since livestock sector also plays an important role in socio-economic development of the project area, SPACE Team analysed the development of livestock sector in terms of population and production in Gotoli village. Interviews were conducted to gather information about the livestock development since 2006, benchmarking between before and after of the project was also done in terms of population and production of livestock development (Table).

Table: Livestock pattern and milk production of selected 31 families in village Gotoli

Name of animal	No. before	No. After
Buffalows	72	109
Cows	131	45
Goats	124	13
Camel	8	0
Total	335	167
Milk production per day	386	440

The number of buffalo increased from 72 to 109, but numbers of cows decreased from 131 to 45, goats from 124 to 13, camel from 8 to 0 and total number of animal from 335 to 167 before and after the project. The milk production increased from 386 to 440 litres per day. It was estimated that 54 litres of milk increased per day which is being sold to the local market. The erstwhile waste lands have been leveled, children started going to school instead of taking animal for grazing.

As the livestock composition has changed; cows and goats were reduced and buffaloes have increased which eventually increased milk production. With availability of fodder, farmers are able to provide good quality and quantity of fodder to buffaloes and are rearing them with interest. Recently, one farmer sold two buffaloes for Rs 1.08 lakh, which is indeed a big achievement in the village. It was also recorded that there was one co-operative milk dairy operating at the beginning but with the increase in milk production, one more private dairy has also started operating. In addition to this, many families have started selling milk outside at their own will.



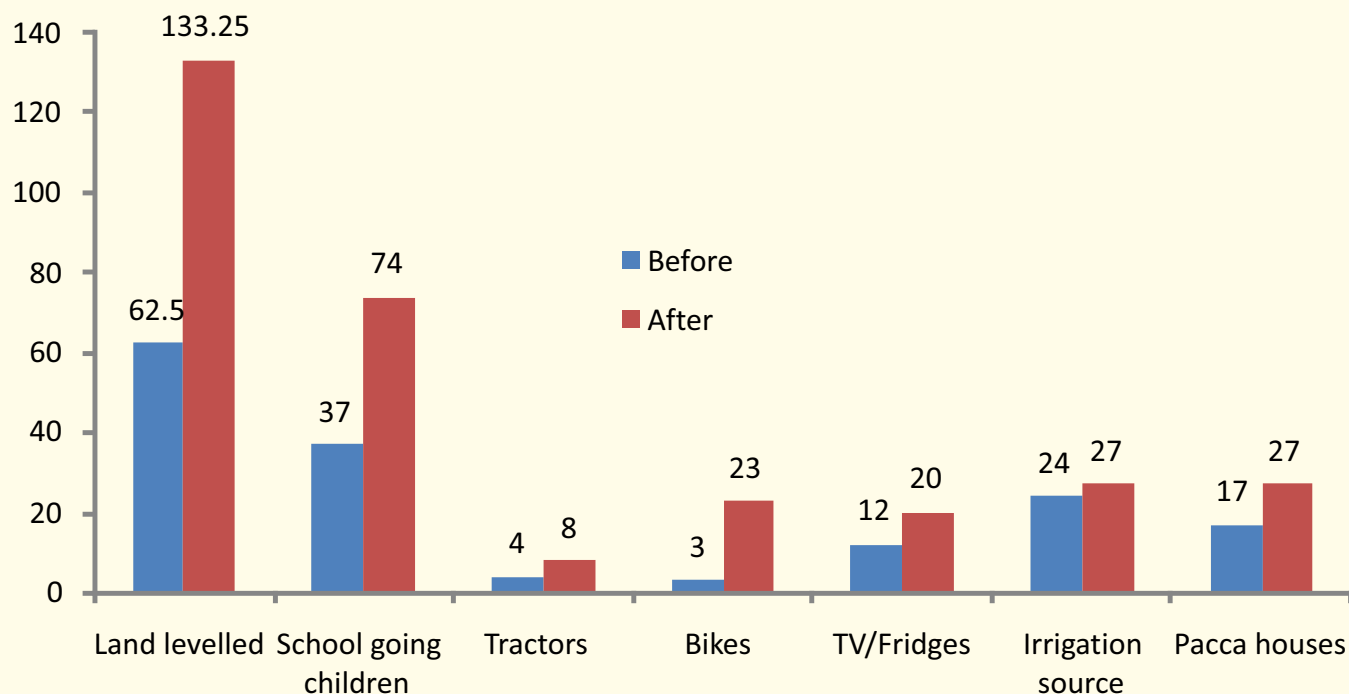
Interaction of experts with farmers



Buffalo are adding income to farmers

ASSETS CREATED BY SAMPLED FAMILIES

Leveled land with sampled families increased from 62.25 to 133.25 ha, number of school going children went up from 37 to 74, tractors from 4 to 8, bikes from 3 to 23, TV and Refrigerator from 12 to 20, bore wells from 24 to 27, pucca houses from 17 to 27 in a period of six years as shown in figure.



Gotoli on way to prosperity



Roadside plantation of Aruneem on link road to Gotoli

ASSESSMENT OF MAHILA BACHAT SAMITIS

All the 6 Self Help Groups formed in the village are functioning with 72 members. The Laxmi Mahila Bachat Samiti (MBS), a new SHG was formed in the year 2012. The old Jai Bhawani MBS alone has a saving of Rs.39050 and number of meeting held were 355. No group was linked to the bank. The total amount of savings is Rs. 117370. There are problems in the long term sustainability of MBS. The Group could not move beyond inter-lending. The loans taken by members are faithfully returned. The salient details of these SHGs is given below.

Table: Salient details of Mahila Bachat Samitis

S.N.	Name of SHG	Formation date	Total members	Meetings held	Saving Rs	Meeting days	Status
1	Jai bhavani	1/1/2007	11	355	39050	Thursday	Good
2	Nai Ummeed	2/8/2010	10	111	12210	Saturday	Good
3	Jagrati	21/12/2009	11	139	15290	Monday	Good
4	Khushi	21.12.2009	12	121	14520	Monday	Good
5	Jyoti	31/5/2010	13	122	15860	Thursday	Good
6	Laxmi	17/5/2012	15	34	5100	Thursday	Good
Total			72		117370		

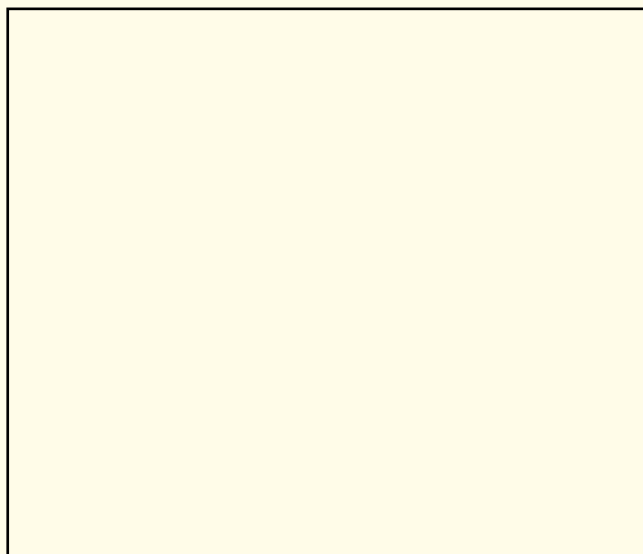
There are 4 watershed committees in the village having membership varying from 8 to 11.

Out of 322 families of the village, 149 were benefitted (46%) with the project. The caste distribution is wide spread, but almost 99% of ST Meena community received benefits (Table).

Caste	No. of Families	Benefitted with INRM project	Percentage
Meo Community	75	28	37.33
SC (Harijan)	73	35	47.94
SC (Sweeper)	15	0	0
ST (Meena)	51	46	90.19
Mahijan(Banyia)	14	6	42.85
Yadav (Aheer)	11	3	27.27
Parjaapita (Kumhar)	83	31	37.34
Total	322	149	46.27



COMMUNITY PERCEPTION



A senior consultant from SPACE Chandigarh and SPACE team interacted with number of beneficiaries individually and in groups to know about their views about the project. The information gathered is summarized as under:

- Constructions of Paals for rain water harvesting have brought dramatic changes in the village. The beneficiaries counted lot of tangible as well as intangible benefits of these Paals like availability of water for communities and livestock, ground water recharge, in situ moisture conservation in fields, increment in the production, change in crop pattern, better connectivity to settlements.
- Beneficiaries admitted that after the start of the project, the number of tube wells increased from 98 to 154 but construction of Paals resulted in increased availability of water for irrigation and domestic purposes.
- The crop pattern and crop production has changed after the intervention of the water resource development and land leveling. The crops like metha and vegetables were cultivated only after the start of the project.
- The rain water with fertile soil which used to runoff is now stored in the Paals and recharging ground water.
- With availability of fodder from the planted fodder tree species and more forage availability from farm lands, the livestock composition has changed. The number of cows and goats has reduced whereas buffaloes have increased which eventually increased milk production.
- Income generating activities like vegetable cultivation and selling of milk have increased the income of beneficiaries, hence improvement in the quality of life.
- The project interventions have brought prosperity in the village. The fact was admitted by the villagers during discussion.

RENOVATION OF VILLAGE WELL

Condition of village well before the project

Whenever we visited Gotoli village for impact assessment study, the slush and filth around the common village well, mosquitoes and flies attracted our attention. Women and children bring buffaloes for water and were given bath by pouring buckets of water on them which made the slush. Do something for this dirty place was the request made by poor villagers with folded hands.

Several meetings were held in the village by SST/SPACE staff and finally it was agreed to renovate and raise the old water tank, make pucca khel for livestock drinking and entire floor be made pucca by laying concrete. The well should be covered with an iron mesh.

Condition of village well after the project

The plan was implemented with financial support from the Project with community contribution in the ratio of 60:40 respectively. Now the used water after buffalo washing goes to the nearby pond. This work has generated a lot of good will for the SRF/SST. The work has been completed to the entire satisfaction of the villagers. They have no words to thank the organizers. The above photo shows the Overhead tank, khel and Pucca floor near Baag Wala well in Gotoli village.



Condition of village well after the project

Intangible benefits of the Scheme

There are number of intangible benefits which are not easy to quantify. Some of these are as under:

- An electric motor replaced the manual pulling.
- An overhead tank stored enough water for livestock and human use.
- Concrete floor created neat and clean conditions. No fear of foot and mouth disease.
- Amanger type channel made easy access to water for livestock watering.
- Excess water goes to pond through pacca channel and do not stagnate to breed mosquito.
- An ordinary villager warns a women that she should not wash clothes near the well as splashes would pollute the well water used for drinking. The level of awareness increase.

WAY FORWARD

The overall impact in the form of increased income to the families, improvement in livelihoods, better quality of life including better nutrition, better children education, more transport vehicles and overall improvement in the green cover over the village. Moreover, with the reduced number of cows and goats, the pressure of grazing on the hills has reduced. The overall cost: benefit ratio is 1.8 and internal rate of return is 29%. The investments made are recovered in a period of 3.5 years. These positive impacts fully justify the investment made and make a valid case for large scale replication of the programme over other similar areas. Social audit of the programme is suggested.

SOCIETY FOR PROMOTION AND CONSERVATION OF ENVIRONMENT (SPACE)



SPACE is basically a consortium of experts registered as NGO having long and varied experience in the relevant field of participatory natural resources development and management. Most of the members have worked in the projects funded by the state, the central government and International funding agencies. Under the aegis of SPACE, this professional group attempts to draw attention to the cause, effect and consequences of depleting and degrading natural resources. This society help, assist and promote suitable mitigation measures, essential for resources conservation and poverty alleviation.

The SPACE Offers services on a wide range of field such as:

Assessment of resources through feasibility and case studies, base-line, demographic, topographic, soil and vegetarian surveys.

Projects appraisal, planning, formulation, monitoring, evaluation and impact assessment. This also include environment and social assessment (ESA), guidelines and monitoring framework.

Preparation of integrated watershed development and management plans.

Participatory Rural Appraisal (PRA), micro-planning, institution building and capacity building for implementing plans and projects. Help and assist PRI's in resource planning, project formulation, implementation and financial management.

Development and management of water resources, alternate source of energy and pollution control measures.

Development of monitoring systems for ongoing projects/programmes using well designed and verifiable indicators.

Organize workshop, seminars, conferences and exhibitions for experience sharing and technology transfer.

Organize training course on technical, social and environmental aspects and organize exposure visits.

For Further Information, Please Contact:

Dr. S.S. Grewal, President SPACE
Chandigarh
Mobile:9417655612
Email : drgrewal0114@yahoo.com
Website : thespace.org.in