Impact Assessment of Natural Resource Management Project in a Challenging Aravali Ecosystem - A Case Study of Gualda Village

Society for Promotion and Conservation of Environment
Chandigarh

September 2011

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 consequence of depleting and degrading natural resources. This society help, assist and promote suitable mitigation measures, essential for resource conservation and poverty alleviation.

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

- Assessment of resources though 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.
- Organise workshop, seminars, conferences and exhibitions for experience sharing and technology transfer.
- Organise training courses on technical, social and environmental aspects and organise exposure visits.

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Foreward

As a part of our Corporate Social Responsibility (CSR) portfolio, SRF Chemicals Business has embarked on a watershed based poverty alleviation and environment conservation program in 34 villages in Tijara Tehsil of Dist Alwar in Rajasthan situated in close proximity with our production facilities.

Gualda is one village where the local community came forward to seek our help to harness their land and water resources in order to improve their quality of life. The land and water related interventions are planned and executed by PRADAN and SST-the two NGO partners -involved in implementation of this program on behalf of SRF Limited.

We are very happy that SPACE(Society for Promotion and Conservation of Environment) has been associated with this project since 2007-08and have contributed significantly to the project in terms of their scientific approach to data collection and analysis.

I would like congratulate and thank Dr. S. S. Grewal and his team from SPACE for putting together this case study to understand the cost and benefit impacts (Socio, economic and environmental) of our interventions in this village. This document will guide us on our future steps and I am sure this will also be of help to others who seek to learn and replicate these interventions for the good of the rural poor and the environment.

Roop Salotra

Dr. S. S. Grewal
President

Society for Promotion and Conservation of Environment Chandigarh

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The Society for Promotion and Conservation of Environment Chandigarh is extremely thankful to the management of SRF Ltd in general and Sh. Roop Salhotra the CEO SRF Chemical Business in particular for imposing faith in the organization and involve in impact assessment of its NRM project. It was his suggestion to conduct a comprehensive study of one treated village to learn lessons from past experience and redesign future implantation strategies of this prestigious project. The unqualified support and keen interest taken by Sh. H.S. Dua Head HRD CSR is thankfully acknowledged. The basic issue of conducting this study emerged through the delebrations of the steering committee of the project and Dr. Sardana, Dr. Achintia Gosh, deserves appreciation to bring this idea of study on board. Mr. Mumtaz Masood Manager CSR and coordinator of this project made all out efforts to facilitate the process and provided all help and support at all stages. The society is indebited to him.

We wish to place on record our gratitude to Mr. Asif Ziaidi and staff of Sir Syad Trust for all possible help, assistance, and information sharing. Thanks are also due to men, women Sarpanch and prominent members of Gualda village who shared their views in discussions and provided all information during household surveys.

The previous Program Officers of the SPACE namely Sh. Inderjit Jadav and Dr. J.P. Yadav made earnest efforts to conduct field surveys, compiled data from various sources and prepared first draft of the report. Dr. Shabir Bhat the present program officer helped to fill in the gaps. All of them deserve appreciation.

At the end, I sincerely express my gratitude to my fellow colleques from SPACE namely Dr. J.S.Kanwar, Dr. Y. Agnihotri, and Sh. H.S Lohan for making valuable contributions in the compilation of this report. Thanks are also due to S. Gurdeep Singh for financial management and Sh. Kesar Singh for faithfully handling accounts of the project.

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Executive Summary

The SRF Limited, a leading chemical business house established one of their plants near Bhiwadi in Tijara block of Alwar District of Rajasthan. In view of extreme poverty and backwardness in the surrounding area of the plant, SRF decided to venture in the field of poverty alleviation through natural resource management under its corporate sector's social responsibility portfolio. The *meo-muslim* community inhibiting the area suffered from water scarcity, uncertain and low farm production and maintained herds of cattle destroying forests from adjoining Aravali hills. This house initially selected 17 villages with the help of PARDAN a reputed NGO to take up the programme of community awareness, organising them into groups and take up large scale rain water harvesting programmes by constructing earthen embankments across gullies emerging out of barren Aravali hills. This was coupled with reclamation of gullied privately owned wastelands by land leveling and bunding. The crop production programme including horticulture and forest tree planting was promoted as an integral part of the package. It was intended to reach out 6500 families in a period of 6-8 years and increase their annual income by atleast Rs. 10,000/- per year. Pardhan discontinued its operations in this area and Sir Syad Trust (SST) took over the responsibility of implementation. A professional NGO named Society for Promotion and Conservation of Environment (SPACE) was associated for impact assessment of the project and expert guidance. After some good response in 17 villages during first phase of three years, the programme was extended to 34 villages during the expansion phase.

The SPACE reported both positive and negative impacts of the programme and indicated questionable viability of investments on certain unproductive initiatives. As a consequence, the steering committee in its meeting of April 30, 2010, decided to conduct a mid-term review of the project to consolidate the achievements and experiences of the last four years and then modify the future implementation strategies. For this purpose, the management decided to take up a comprehensive social, economic and environmental study of one of the typical village, well treated with the package of practices. Ultimately, village Gualda situated on southern aspect of Aravali hills, where works started in the year 2006 and received maximum interventions upto 2010 was selected for the study. Gualda has a total population of 6691 spread over 1152 families and occupy 1521 ha total geographical area. Out of 1329 ha cultivable area, 335 ha was situated below the Aravali hills as barren, uneven, undulating wasteland owned by poor families. This land was providing no returns except its use as common grazing ground. Livestock rearing, labour wages in mining and traditional agriculture were the main sources of income of the meo-muslim community having large size families.

The study was initiated in the year 2010 where all information from primary and secondary sources was collected including SST records. Data were also collected from samples of households involved in the project activities. Out of 38 paals constructed till 31st March 2011, 3 were most recent, 3 in Govt. land and 5 were too small to store enough rain water. The remaining 27 were selected along with the families which leveled their lands above and below the paals for the study. Ordinary rain gauges were installed in all the study villages including one in Gualda. Rain water harvested by paals was recorded by developing storage capacity v/s depth curves based on topographic survey of reservoir area of study Paals. The ground water recharge was worked out by taking well observations at fortnightly interval. 32 families were selected for intensive household survey and assessment of changes in crop yields, production, and family assets. Intensive interactions were made with the

beneficiary families to extract relevant information and their perceptions about the project activities. Some of the major highlights of the study are given as under:

1. The project made total investment of Rs. 33 lakhs in a period of 4 years, Rs. 19.41 lakh on 27 paals and check dams, Rs. 10.17 lakh on land leveling and 3.02 on crops and plantation. Incidentally, farmers also invested Rs. 17.63 lakhs from their own resources on these interventions, thus making a total of Rs. 50.31 lakhs. In addition, farmers leveled another 38 ha of sloping but cultivated land and also invested on installation of tube wells and irrigation systems by spending around Rs 50 lakh. Roughly an investment of 1 crores was made on reclamation of 52 ha wasteland and 38 ha of sloping cultivated land, including irrigation systems and plantation.

2. In a period of 4 years, 49.55 ha m of rainwater was harvested from 15 study paals. The ground water recharge extrapolated to 30 paals stored rain water worth 1066 irrigations which was valued at 10.66 lakh. Paals constructed as such provided benefit : cost ratio of 2.09, net present value of 48.96 lakhs and payback period of 4 years. It was found that when catchment area is half hilly and half sloping sandy land, the runoff was 22.4% but only 10% from sandy wastelands and hardly 5% from cultivated sloping lands. This information would help improve future design norms of Paals.

3. The rise in water table around paals varied from 1.2 to 2.33 m in this period. The dry wells got recharged and tubewells started operating for longer hours before going dry. Farmers perceived it as a major advantage in addition to control of damage by floods, gradual leveling of land, in- situ conservation of moisture and nutrients and better connectivity to scattered habitats and farm lands as Paals acted as embankments across deep gullies.

4. Out of 52 ha of newly reclaimed and 38 ha of sloping land leveled by farmers, an increased production worth of Rs. 43.53 lakhs was recorded in one year, thus, giving a gain of Rs. 28,832/- per family per year. The land development enterprise both on newly reclaimed and sloping land leveled by the farmers involved a total cost of Rs. 63.28 lakh on 90 ha, thus, making an investment of Rs. 17,000/- per ha. However, the net benefits were equally impressive with a benefit : cost ration of 2.24, net present worth of Rs. 57.7 lakh, payback period of 6 years and internal rate of return as 28 percent.

5. The price of 52 ha reclaimed and irrigated land appreciated by Rs. 815 lakhs @ Rs. 3.92 lakh per bigha by which average landed assets appreciated by Rs. 5.4 lakh per household. The land price appreciation and gain in crop and forage production improved the self esteem, social pride, self employment, urge to progress and re-invest in land based assets and activities.

6. In case of horticulture, out of 10147 fruit plants raised over a period 5 years (2006-11), only 2034 survived thus giving a survival rate of 20 percent. Similarly, out of 14986 fodder and other trees, only 2438 survived giving 16% survival rate. This was mainly due to the selection of disinterested farmers and lack of backup support. The economic analysis of surviving fruit plants when taken cost and benefits per plant and not as an orchard indicated benefit : cost ratio of 1.62, net present value of Rs. 9.25 lakh and payback period of 10 years and internal

rate of return as 21.2 percent. In case of fodder and other plants, example of Aru Neem was taken which provided cost : benefit ratio of 2.04, payback period of 11 years and internal rate of return as 22.4 percent with no present value.

7. The promotion of agronomic innovations of improved varieties, balanced fertilization and cultural practices resulted in benefit: cost ration of 1.83 and payback period of only 2 years. In case of sloping lands when leveled, the crop yields decreased by about 30 percent in the following year but quickly picked up in second year and by third year ended with 30 % increase over base year. However, introductions of SST by different type of agronomic trials largely failed and ended with losses to the farmers and disappointed the beneficiaries.

8. The animal wealth changed by gradual replacement of cows and goats by buffaloes and value of animal asset of 32 families increased from Rs 26.88 to 32.30 lakh registering an increase of 20% but by culling out the number of unproductive livestock by almost 40%.

9. Only one Mahila Bachat Samiti was functional in village Gualda with activities limited to inter loaning and scored average on performance index. Four water user groups were formed to take up paal construction, land leveling and production activities but ceased to function as soon as these works were accomplished and payments received. The expansion of activities to new villages resulted in lack of attention to old ones.

10. Thirty two families made an investment of Rs. 47.93 lakh (Rs. 1.49 lakh each) on the purchase of tractors, installation of tubewells, purchase of implements, renovation of houses, and purchase of motor cycles.

11. The number of children going to Govt. Primary School in last 5 years increased from 32 to 111, out of which the number of girl students increased from 9 to 48 and boys from 23 to 63.

12. The villagers as such were quite happy with the paal construction and land leveling works as these activities put them on a trajectory of growth. They indicated scope of another 25 paals and 100 ha of land reclamation. They were, however, not satisfied with the quality of service and lack of technical backup support as promised in the initial years by SST.

13. There was a general consensus that SRF is doing a good job for the poor community and were greatly indebted to the company for the same. They were, however, of the view that only selected families have been benefitted. SRF should expand its umbrella and invest part of the funds on creating better facilities in schools including drinking water, renovation of village ponds and help in village sanitation so that entire village get the benefit of the Project in one form or the other.

14. It became quite evident that expansion of activities over larger number of villages without adequate manpower resulted in poor back up support in old villages. More so, when sufficient scope of work was available in these villages. The implementation strategies, therefore, needs to be redefined with better monitoring and independent appraisal mechanism.

Introduction

Chapter - 1

Includes :-

- ★ Aravali Ecosystem - A Challenge for Development
- ★ SRF Initiative
- ★ Aravali-hills and Project location

Chapter-1

Introduction

1.1 Aravali Ecosystem – A Challenge for Development

The proportion of people who suffer from hunger, mal nutrition, and deprivation is mainly concentrated in environmentally stressed areas like the Aravali hill ecosystem forming parts of Thar Desert. Aravali hills are one of the oldest fold mountains, spread over approximately 300 miles from north-east to south-west across Rajasthan state in western India. The northern end of the range continues as isolated hills and rocky ridges in Haryana state, terminating near Delhi. These low rocky hills were covered with dense forest in the past and not only met the needs of firewood, fodder, and timber of the local community, but also helped in maintaining the delicate ecological balance of the arid ecosystem. The hills were denuded of vegetation cover because of excessive fuel-wood extraction and over grazing by herds of cattle, goats, and sheep. The excessive biotic pressure has taken a heavy toll of the natural forest cover resulting in severe land degradation with concomitant adverse environmental and socio-economic consequences impacting the quality of life of the inhabitants.

A large size *meo*-muslim family in the backdrop of Aravali hills

Severe land degradation in Aravali hills

Large areas of land are community owned and are managed under an open access system. 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 crisis in view of excessive loss of precious rain water by runoff from bare hills and large scale extraction of ground water by ever increasing number of shallow centrifugal pumps. The small and heavy industry is fast coming up in areas of Alwar district adjoining Delhi and Gurgaon which is extracting lot of water. In view of proximity to national capital region, farmers shifted to vegetable growing which on light textured soils need large number of irrigations thus leading to over- exploitation of the underground water. **The *meo-muslim* community inhibiting the area have large family size with very low literacy rate and women** are mostly illiterate. Most men are involved in illegal mining as part of their secondary occupation and drudgery of women is beyond description. **The state forest department has failed to bring back greenery on the barren hills and have practically written these off.** The illegal mining has continued unabated in spite of Supreme Court directives.

The mean annual rainfall is around 550 mm. Monsoon rains occur from June-September contributing 80-85 percent of the total annual rainfall. The daily maximum temperature varies between 40-47^{o} C during summer and 2^{o} to 5^{o} C during winter. **The denudation of Aravili hills, illegal mining, fast depleting ground water reserves, harsh climate, low production potential, lack of money to invest on land improvement, least urge to get education and adopt small family norms and get organized for common welfare are the host of problems which pose serious challenge for ecosystem rehabilitation and sustainable development.**

A typical scene of Aravali Hills and waste lands of Tijara Block of Alwar District of Rajasthan

1.2 SRF Initiative

The SRF Limited, a leading business house in chemical industry established their plant close to Bhiwadi in Jiwana village of Tijara block of Alwar district of Rajasthan state. Bitten by a bug of social commitment, the business house ventured to take head on with these problems and initiated a natural resources management based economic and environmental development project in the year 2006. First of all, a feasibility study was conducted in 35 villages of the Tijara block of Alwar district falling within 30-40 km belt from the plant of the business house. The study was done in partnership with national level NGO named PARDAN to explore the possibility of interventions for livelihood improvement in these poverty ridden villages under the

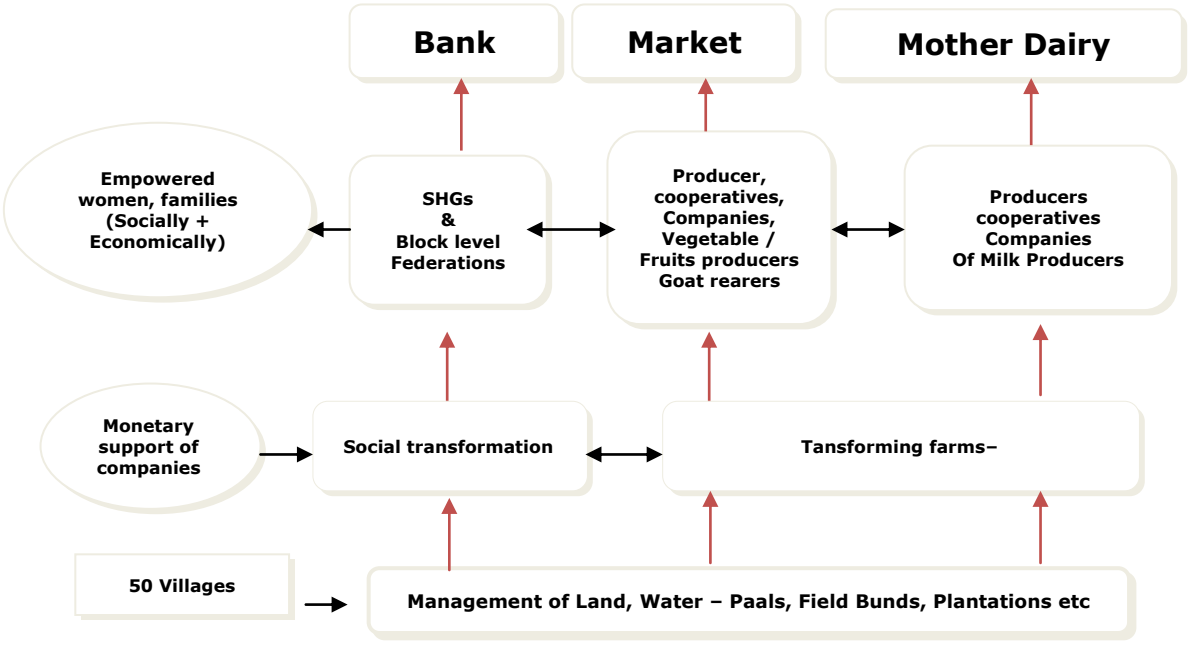
Corporate Social Responsibility (CSR) portfolio. Based on the results of this study, livelihood interventions in 17 selected underprivileged villages of Tijara were initiated on a pilot basis. SRF provided the financial support and PARDAN took up the responsibility to execute the project. The first two years were deemed as the pilot phase while the subsequent 6-8 years as the expansion and consolidation phase. This project aimed at reaching out to 6,500 families by 2015 and increase their annual income by Rs 10,000 on a sustainable basis. The package included:

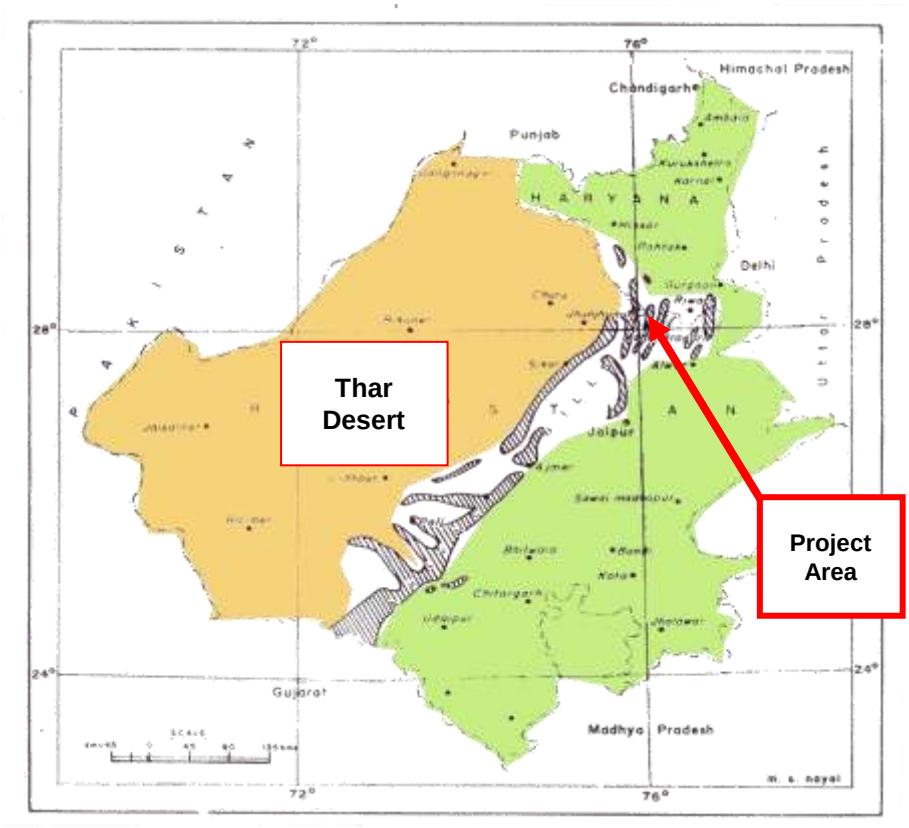
- Community awareness and sensitization, organizing them into self help groups, preparation of watershed based micro-plans and implementation in close partnership as per need and demand of the community subject to technical feasibility.
- The precious rainwater runs off from barren hills during monsoon season and form gullies in wind- blown sandy tract. Since water scarcity mainly hinders economic growth, harvest every drop of rainwater by constructing earthen embankments and check dams across drainage lines.
- The main package covers terracing/land leveling/field bunding of waste/under- utilized private lands of groups and put them under productive use by project supported package of agronomic practices.
- Plantation of fruit and fodder trees on reclaimed lands and adoption of improved packages of practices for sustainable productivity
- Formation of Self Help Groups (SHGs) and watershed groups to undertake construction of such earthen water harvesting dams, land development in blocks of waste lands.
- Initially Padhan executed the project and provide all technical and logistic support as approved by SRF.
- A professional NGO (SPACE) was engaged for impact assessment of the project.
- A steering committee of professionals was constituted to review progress and suggest better implementation strategies

This project was in a critical and challenging phase in the year 2008 when PRADAN decided to wind-up its projects in Alwar district and shifted activities to the tribal belts of Southern Rajasthan. However, some members of PARDAN decided to continue with the project under a newly formed Sir Syed Trust (SST). The year 2008 was also the year of expansion phase and activities of the project were extended from 17 to 34 villages.

In one of the steering committee meeting of the project, it was decided that lessons learnt from past implementation be synthesized and impacts thoroughly analysed so that future strategies of project implementation are modified on the basis of lessons learnt. After good deliberations, it was agreed that village Gualda may be taken up as a test case for such an evaluation and economic analysis because this village was selected for treatment during the first year of the pilot phase and received almost four years of project implementation. In addition, good numbers of Paals were constructed in this village and sizeable area was leveled and terraced. This village received a level of treatment which could be expected in other similar villages in future. So it could be treated as a typical case for exhaustive study. The results of four years (2006-10) of concentrated efforts in a most fragile, dry and desiccating environment inhibited by resource poor *meo muslim* community are encapsulated in this report. The approach adopted by SRF and location of the project area are given as under.

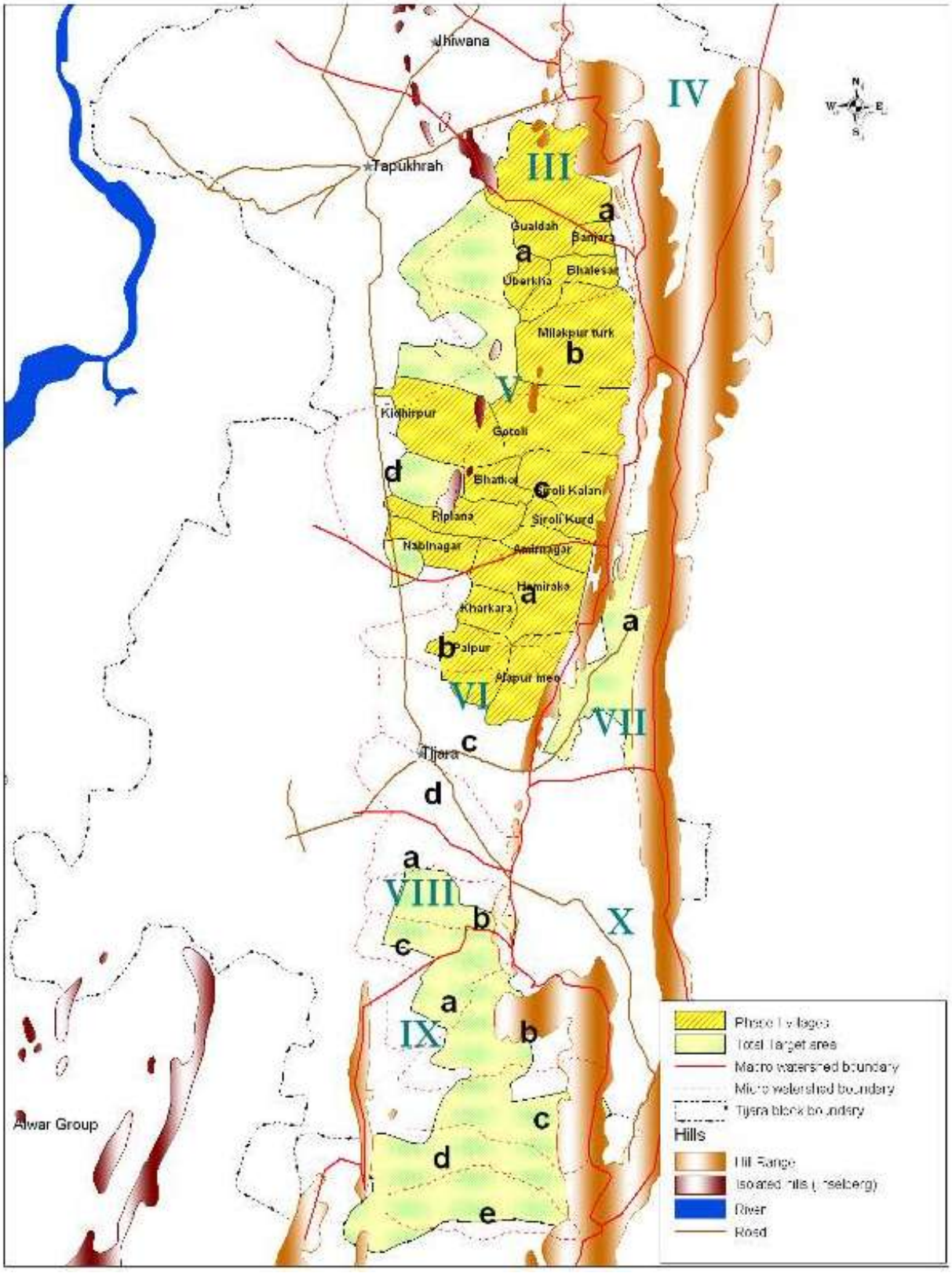
Figure 1 – Approach adopted by SRF





Aravali-hills and Project location

Map of phase-I area



Methodology

Chapter - 2

Includes :-

- ★ Primary data collection
- ★ Storage capacity and ground water recharge
- ★ Determination of runoff coefficient
- ★ Economic analysis
- ★ Community perceptions and social audit

Chapter 2

Methodology

2.1 **Primary data collection**: The study though primarily aimed at economic analysis of project interventions but its scope was enlarged to look beyond to cover some social and environmental aspects as well. It was planned to review and analyse the implementation strategies and impacts of project interventions as mid-term appraisal so that lessons learnt are used to incorporate modifications in the future implementation plans. Village Gualda was selected for the study out of villages taken during the first phase mainly because of its representativeness to the whole project area and reasonably good amount of coverage by project activities. Map of Aravalis and project location was taken from Survey of India topo-sheets and map of project villages was drawn from revenue records. These villages are almost located on 76^{o} Longitude and 28^{o} Latitude. The total expenditure incurred on various activities in project villages and Gualda village upto March31, 2011 was taken from SST records.The package of interventions and approach as described in project document is included as such. Demographic data, land use, and cropping pattern was taken from revenue records. Rainfall was measured by ordinary rain gauges installed in four study villages including Gualda. Data on tubewells, irrigation, and ground water changes before the project was collected by interviewing each tubewell owner.

Data on available services was noted following participatory rural appraisal technique. The drainage pattern was drawn from topo-sheets. The list of paals constructed so far and investments made were collected from SST records. The location of all the Paals constructed so far was marked on the drainage map by actual field traversing. Soil fertility analysis from the land of 8 farmers and water quality from 5 paals was got done from Regional Research Station Bawal of Haryana, Agricultural University Hissar. Soil moisture samples upto 90 cm soil depth before and after the rains provided increase in soil profile storage in leveled lands. This provided an indication about in-situ rainwater conservation.

2.2 **Storage capacity and ground water recharge:** Contour survey of catchment area of 15 *paals* categorized as small, medium and large was carried out at one metre contour interval taking last contour upto the total height of the dam. The storage capacity at different heights was worked out and depth v/s storage curves drawn. Gauges were installed on all the study *paals* to record height of water level and readings were taken daily during monsoon season. Storage of water v/s cumulative rainfall on different dates was worked out. The daily loss of head was separated out into evaporation and seepage. The PAN (Standard US Weather Bureau Pan) evaporation data of Bawal station for that period was taken. Pan evaporation in laboratory x 0.7 was taken as actual evaporation from the water body. The water spread area at different height was worked out from contour plans.

Water spread area X daily loss of head = total volumetric loss of water - daily evaporation loss = seepage into the ground.

Details of water balance parameters (total runoff, evaporation, and ground water recharge) were worked out for each paal. Since no monitoring system was in place during the year 2006-07, the amount of ground water recharge was assessed on the basis of data of subsequent years. Total ground water recharge was divided by number of study paals to get an average recharge per paal which was multiplied by total number of paals constructed to get total recharge by all the paals. 80% of total seepage/ recharge was taken as usable ground water. Taking 7.5 cm depth of irrigation, number of irrigations made possible with recharged water

was worked out. Total cost of one irrigation was taken as Rs. 1600/ha i.e. the rate prevalent in the village. A sum of Rs. 600/ha was deducted as cost of pumping and hence net value of water was assumed as Rs. 1000/ha of irrigation.

In order to quantify the changes in ground water, open wells in vicinity of *paals* were considered as piezometers. Depth to water table from standard reference points was recorded at fortnightly interval. Three piezometers were also installed at locations not represented by wells to monitor ground water levels.

2.3 Determination of runoff coefficient : Data on runoff generated by rainfall events is required to design the height and ultimately the storage capacity of embankments. The main problem was the non-availabily of such data on runoff percentage and water yield. The catchment area of 10 Paals was, therefore, precisely measured from topo-sheets. One heavy storm of 130 mm was taken to know the gain in water level of these Paals. Catchment area X rainfall of the event provided the total volume of water received by the micro-watershed as precipitation. The gain in volumetric storage of Paals with that rainfall was worked out from depth v/s storage curves. This gain divided by precipitation volumes multiplied by 100 provided the value of runoff coefficient. The maximum level attained is quickly exhausted by seepage by the time next storm occurs. At the most we could take two days maximum rainfall, which would be around 130 to 150 mm. The end result would be same.

This way, it was possible to segregate runoff from hilly area, sandy waste lands, and terraced lands because catchment area of these 10 Paals represented the above said land uses either singly or in combination. With this information, future design of Paals would be technically more correct.

2.4 Economic analysis : The economic analysis of paal construction was worked out by taking cost and benefit streams for 10 years period and discounted at 10% rate of interest. Total benefits divided by total cost provided benefit : cost ratio and cumulative benefits minus cumulative cost provided net present value. The increase in crop yield of Mustard with one irrigation and value of additional produce was taken for benefits. 10% of initial cost in first and 2% in 2nd year were taken as maintenance cost. The plot of cumulative cost and cumulative benefits was drawn and point where the curves crossed was taken as payback period.

Out of 151 families involved in project activities, 32 families (21%) were taken as sample and all data recorded from sample families using a structured proforma and extrapolated where necessary. The appreciation in the market value of land was taken from sales which took place in the village and perceptions and views of individual and group of farmers. Information on number of fruits and timber plants planted in village Gualda was taken from the record of SST and actually growing on farmer's fields were counted in March 2010 and survival percentage was recorded.The information on socio-economic changes was collected from 32 sample families and verified by senior consultants by holding individual and group meetings in the village.

2.5 Community perceptions and social audit: Large number of group discussions were organized in different settlements of the village and individual beneficiaries both men and women were interviewed to record their views and perceptions about the benefits of the project. Any draw backs or implementation lacunae noted by these people were noted and reproduced in their language with translated version. The school records were also consulted to find out changes in the number of school going children over a period of four years.

Paal is the local name of an earthen embankment constructed across gullies to harvest rainwater.

Bio Physical and Socio-Economic Conditions of the Village

Chapter - 3

Includes :-

- ★ Geographical location
- ★ Demorgraphic and socio-economic status
- ★ Land-use
- ★ Cropping pattern
- ★ Source of irrigation and groundwater use pattern
- ★ Soil fertility evaluation
- ★ Water quality analysis
- ★ Drainage pattern of Gualda village
- ★ Pastoral economy
- ★ Technological package
- ★ Rainfall ammount and distribution
- ★ Total investments made in Gualda village

Chapter 3

Bio Physical and Socio-Economic Conditions of the Village

3.1 Geographical location

The village is situated north-east of Tapukara town at a distance of 10 km and connected by mettled road. Tapukara town is situated on Bhiwadi-Alwar highway. Gualda village falls in Tijara block of Alwar district of Rajasthan state.

3.2 Demorgraphic and socio-economic status

The Gualda village has a population of 6619 distributed over 1152 families. It is dominated by Meo-muslim community. Literacy rate is dismally poor and women are almost illiterate. However the sex ratio is at par with the national average (Table 3.1).

Table 3.1 Demographic characteristics of Gualda village

S.No.	Particulars	Numbers
1.	Total Population	6619
	Male	3489
	Female	3130
2.	Sex-ratio	1000:897
3.	Literacy rate (%)	—
	Male	25.6
	Female	6.4

Source: Village Records of Block Office

The village lack basic facilities and people have to travel long distances to get the services and farm inputs (Table 3.2).

Table 3.2 Agricultural supply/guidance centers and their distances from Gualda

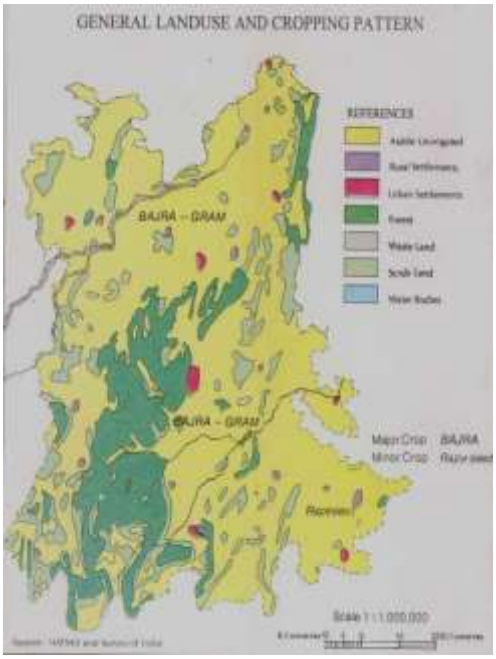
Service Centres	Location	Distance from Gualda(Km)
Electricity office	Tapukara	10
Pesticide shop	Guwalda	Local
Fertilizer store	Guwalda	Local
Co-operative society office	Guwalda	Local
Agro-industry centre	Alwar	80
Grain market	Tijara	30
Bank	Tapukara	10
Petrol pump	Tapukara	10
Agriculture Officer	Guwalda	Local
Krishi Vigyan Kendera	Alwar	80

3.3 Land-use

There are 1417 farming families in village Gualda with average land holding of 0.93 ha. Area under cultivation is 63.3 percent of the total geographical area. The irrigated area is 851 ha but the forest area is hardly 47 ha. An area of 336 ha was lying barren mostly in foot of hills which needed reclamation to make it fit for cultivation (Table3.3).

Table 3.3: Landuse pattern of village Gualda

S. N.	Particulars	Values
1	Total geographical area (ha)	1521
2	Cultivable land (ha)	1329
3	Barren land (ha)	366
4	Cultivated land (ha)	963
5	Irrigated land (ha)	851
6	Unirrigated land (ha)	112
7	Area under forests (ha)	47
8	Hills (ha)	18
9	Farming families	1417
10	Average land holding (ha)	0.93
11	Members of cooperative society	647
12	Kishan Card holders	457



Source: village revenue records

3.4 Cropping pattern

Pearlmillet and guar in *kharif (summer season)* and mustard and wheat in *rabi (winter season)* were the major crops raised at the start of the project. Although barley and toria during *rabi* and cotton, linseed and groundnut during *kharif* were also raised on small area. A quarter of the cultivated land was kept fallow during *kharif* season essentially to conserve rainwater for *rabi* crop (Table3.4).

Table 3.4: Cropping pattern in Gualda village during rabi 2009-10

Area under Rabi crops			Area under Kharif crops		
Crop	Area (ha)	Percent of total	Crop	Area (ha)	Percent of total
Wheat	450	46.73	**Bajra**	623	64.69
Mustard	492	51.09	**Guar**	13	1.35
Barley	13	1.35	**Onion**	19	1.97
Gram	8	0.83	**Fallow**	308	31.98
Total	963	100.00	**Total**	963	100

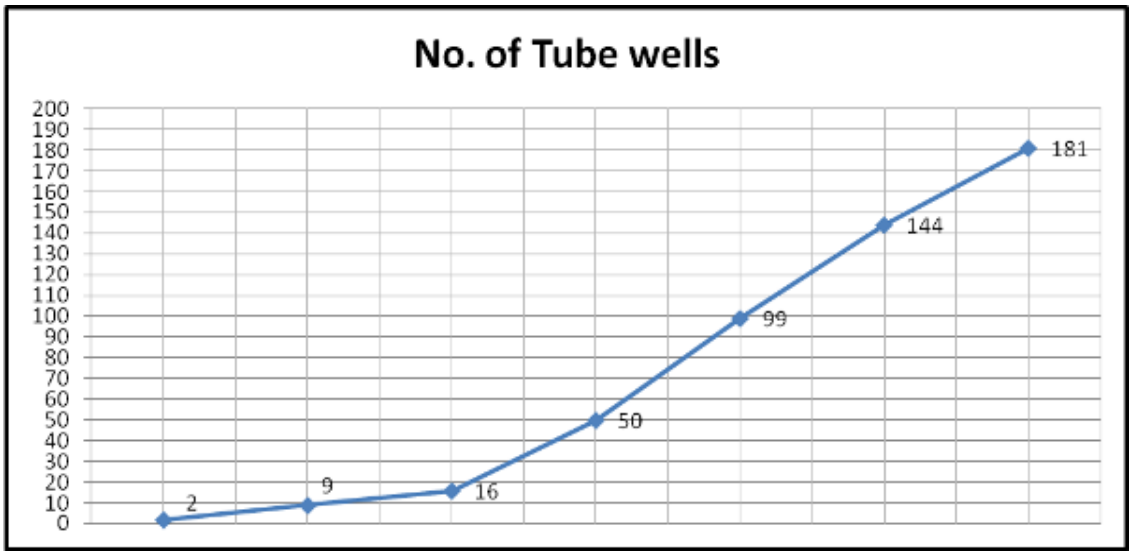
Bajra (pearlmillet) is the most dominant crop of Kharif season occupying 65 % of cropped area. Mustard was the dominant crop of Rabi season covering 51 % of cropped area. Wheat and Mustard were the most preferred crops of Rabi season covering 46.7 % of the area and

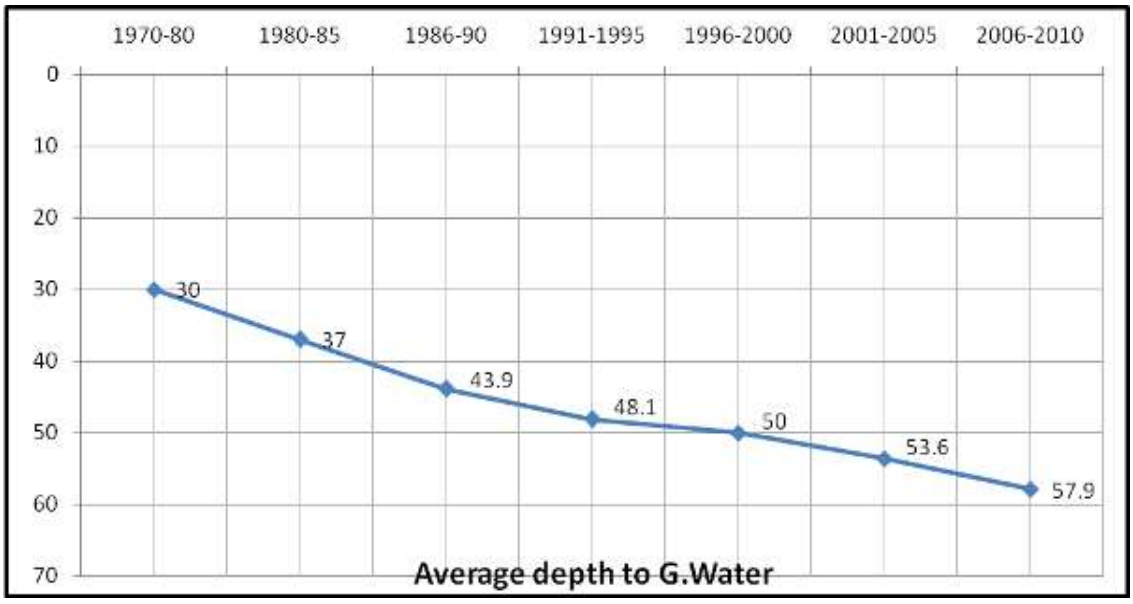
mainly occupied the lands earlier kept fallow during Kharif season. There appears logic behind this practice. In case farmers raise pearlmillet during Kharif on such lands, the moisture would be used by Kharif crop and it would not be possible to raise mustard crop on residual moisture. Keeping such lands fallow during rainy season ensure sufficient storage of moisture in the soil profile on which mustard crop can be raised successfully.

3.5 Source of irrigation and groundwater use pattern

Tubewells, either diesel operated or electricity driven are the main source of irrigation. The bigger land holders have their own tubewells, 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. To have an idea about the change in water table, several farmers were interviewed and following information was obtained.

- Between 1970-80 and 2006-10, the number of tubewells in Gualda increased from just 2 to 181 and in the same period the water table has gone down from 30 to 57.9 feet (Figures).





- Water table is falling at a rapid rate varying from 4-5 feet fall every year In case rainfall onset is delayed. 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 loss.
- Water table is 40 feet deep in tubewells located in lower reaches and 80 feet deep in the tubewells located in upper reaches near the hill. This is because of elevation difference.
- Thirty two percent tubewells are diesel engine operated and remaining 68% are electricity operated.
- Fifty percent tubewells have been converted to submersible during the last 2-3 years.
- Number of submersible tubewells is increasing very fast. In the coming 4-5 years, all the tubewells 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 tubewell.
- 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.

3.6 Soil fertility evaluation

Farmers of the target villages were educated to take samples and helped to get their samples tested from Regional Research Station, Bawal of Chaudhary Charan Singh Haryana Agricultural University, Hissar for soil reaction, salt content, organic matter, P & K. Soil samples were collected from representative sites from the target villages including Gualda and got analysed. It is evident from results of laboratory that watershed 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 precaution measures. Nitrogen and phosphorus was deficient except few sites having phosphorus in medium range, whereas potassium content represented medium class (Table 3.5).

Table 3.5 Baseline Soil properties in village Gualda (Alwar)

S.No.	Farmer name	Texture	pH	Ec	OC (%)	P (kg/ha)	K (kg/ha)
1	Ash Mohamad (Kothi wala Khet)	LS	8.7	0.13	0.2	8.34	295
2	Ash Mohamad (Madha wali)	LS	8.64	0.14	0.22	8.34	240
3	Hakam Deen	LS	8.85	0.13	0.18	10	255
4	Lukeman (Untreated land near orchard)	LS	8.27	0.13	0.2	8.34	273
5	Attaullah (modi wala khet)	LS	8.52	0.1	0.18	10	280
6	Attaullah (Lemon & Guava orchard)	LS	8.54	0.12	0.18	10	265
7	Habib (Ber orchard-planned to be raised)	S	8.8	0.18	0.16	8.34	200
8	Amin Khan	LS	8.75	0.12	0.21	8.34	262
	Range		7.8-8.6	0.11-.28	0.12-0.22	8.34-11.67	200-395

3.7 Water quality analysis

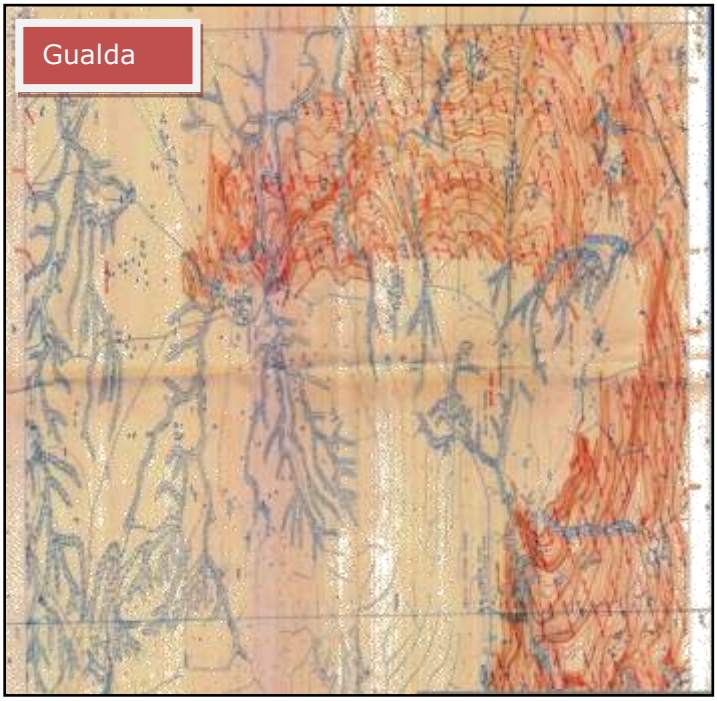
Water samples from all the observation wells were collected and got analysed from CCS Haryana Agricultural University Regional Research Station, Bawal (Haryana). About 60 percent samples of water were not safe for application to crops as such and need to apply required amount of gypsum (Table 3.6).

Table 3.6: Analysis report of water samples (2009-2010).

Name of Well	Ec	CO_3	HCO_3	Cl	Na	Ca	Ca+Mg	RSC	SAR	Recommendation
Gualda										
Kudiwali Kui	1560	Nil	7.5	5	_	_	6.5	1	_	25 Kg Gypsum/ irrigation/ha
Bonawala	1410	Nil	8	5	_	_	5.5	2.5	_	62 Kg Gypsum/ irrigation/ha
Jhalarawala	1490	Nil	8	5	_	_	8.5	_	_	Recommended for all crops
Kaagwala	1310	Nil	7	4	_	_	8	_	_	Recommended for all crops
Fakira wala	1710	0.5	9	5	_	_	6	3.5	_	87 Kg Gypsum/ irrigation/ha

3.8 Drainage pattern of Gualda village

Gualda village is drained by a net work of gullies emerging from the the Aravali hills and passing through the waste lands below the hills and then pass through the farm lands as shown in map. The slope is steep near the hills and becomes flat in the valley portion of the landscape as represented by the map given below.



3.9 Pastoral economy

The survival of rural populace of Aravalis in general and Gualda in particular greatly depend on income from livestock rearing which constitute buffalo, cow, sheep, and goat. Except bufalloes, most of the livestock depend on grazing in open access system in village common grazing lands. The plants of almost all types are browsed and new seedlings are trampled. The forestry initiatives are not yielding any result. The hills have been denuded of all protective tree species. Some may grow being out of reach but are prematurely 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.

3.10 Technological package

- Community awareness and sensitization, organizing them into self help groups, preparation of watershed based micro-plans and implementation in close partnership as per need and 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.
- 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 into Self Help Groups (SHGs) and User Groups to undertake construction of earthen dams, land development in clusters, maintenance of plantations and joint marketing.

3.11 Rainfall ammount and distribution

Daily rainfall was recorded by ordinary rain gauge. The monthly totals for monsoon rainfall for the last four years are giver below in table 3.7.

Table 3.7: Monthly monsoon rainfall (mm) recorded in Gualda village from 2007 to 2010

Month	2007	2008	2009	2010	Mean
May	0	170	49	3	55
June	60	212	0	28	75
July	146	138	111	260	163
August	241	191	220	313	241
September	59	160	194	302	178
Total	**506**	**871**	**574**	**906**	**714**

The average rainfall of last four years was 714 mm.The rainfall was highly variable over time and space. There were two good (2008 and 2010) and two normal (2007 and 2009) rainfall years.The rainfall thus received was classified into classes based on amount of rainfall in individual storms (Table 3.8).

Table 3.8: Categorization of Rainfall under different rainfall classes

Rainfall class mm	2007	2008	2009	2010
0-20	—	178.4 (20)	65.2 (9)	258
20-40	—	188.0 (8)	282.0 (7)	381
40-60	—	148.8 (3)	189.2 (5)	137
Above 60	—	356.7(5)	76.2 (1)	130
Total	—	**870.9 (36)**	**573.6 (22)**	**906**

Number of rainfall events is given in parenthesis

3.12 Total investments made in Gualda village

Total project investments in Gualda village up to March 2011 were Rs 32.68 lakhs. Farmer's contribution was Rs 17.63 lakh thus making a total investment of Rs 50.31 lakh (Table 3.9)

Table 3.9: Total investments (Lakh Rs) made on project activities in village Gualda up to March 2011.

Year	Paals and check dams	Land leveling	Plantation and crops	Total Project share	Community share	Grand Total
2006-07	6.93	-----	1.07	8.00	2.10	10.10
2007-08	3.64	0.46	0.37	4.47	1.35	5.82
2008-09	5.10	1.22	0.62	6.94	1.39	8.33
2009-10	1.44	5.82	0.84	8.10	3.49	11.59
2010-11	2.38	2.67	0.12	5.17	9.30	14.47
Total	**19.49**	**10.17**	**3.02**	**32.68**	**17.63**	**50.31**

Out of the project share, almost 59 % was spent on Paals and check dams, 31 percent on land leveling and remaining 10% on production improvement. This expenditure exclude administrative, logistic, monitoring, institutional and organizational overhead costs.

Assessment of Paal Construction Work

Chapter - 4

Includes :-

- ★ Detail of Paals constructed
- ★ Contour survey of paals for storage capacity
- ★ Techno-economic analysis of paals
- ★ Design implication
- ★ Calculation of run off coefficient
- ★ Rainwater harvested
- ★ Change in water table

Chapter 4

Assessment of Paal Construction Work

4.1 Detail of Paals constructed

As per SST records, 140 paals were constructed under the project up to March 2011 out of which 38 are located in village Gualda.The detail of these paals constructed from 2006 to March 2011 and cost incurred is given below.

- ❑ Total number of Paals constructed up to 2010-11 = 38
- ❑ Number of Paals too small and non functional = 5*
- ❑ Number of Paals constructed on Govt./ common land = 3
- ❑ Number of Paals constructed on private land = 30
- ❑ Number of Paals covered under the study = 27
- ❑ Total cost of 38 Paals = Rs 22,68,125
- ❑ Highest cost of Paal = Rs 2,38,210
- ❑ Lowest cost of Paal = Rs 7,253
- ❑ Average cost = Rs 59,687 or Rs 60,000

Table 4.1 List of Paals constructed in village Gualda up to March 2011

S.N.	Name of Paal	Code	Year of Construction	Cost (Rs.)
1	Hasan Gori wali Paal	GDL-WHP-	2006-07	41072
2	Musawali Paal	GDL-WHP-13	2006-07	36583
3	Dandawali	—	2006-07	22485
4	Muglawali Paal	GDL-WHP-14	2006-07	65969
5	Sohangahti wali Paal	GDL-WHP-12	2006-07	20538
6	Samman swai ki khai ki Paal	GDL-WHP-7	2006-07	44991
7	Chilwali paal	GDL-WHP-1	2006-07	135336
8	Mansarwali Paal	GDL-WHP-2	2006-07	53431
9	Shadara wali Paal	GDL-WHP-09	2006-07	18365
10	Khaiwali Paal	GDL-WHP-08	2006-07	35525
11	Gondiwali	GDL-WHP-	2006-07	34789
12	Sotanwali Paal	GDL-WHP-4	2006-07	52507
13	Chhajanwali Paal	GDL-WHP-3	2006-07	27587
14	Koliwala johadki Paal	GDL-WHP-32	2006-07	53947
15	Malawali wali	GDL-WHP-10	2006-07	79419
16	Dihiwali Paal	GDL-WHP-6	2006-07	115065

17	Sajhaliwali Paal	GDL-WHP-5	2006-07	21243
18	Mangliwali Paal	GDL-WHP-11	2006-07	20482
19	Anadha wali	—	2006-07	20777
20	Jhalwali Paal	GDL-WHP-37	2007-08	56598
21	Chamarwala Tila ki Paal	GDL-WHP_22	2007-08	7253
22	Loharwali modi ki Paal	BJR-WHP-1	2007-08	33176
23	Alamwali Paal	GDL-WHP-38	2007-08	78668
24	Shishamwali Paal	GDL-WHP-29	2007-08	37542
25	Kareelwali Paal	GDL-WHP-28	2007-08	34270
26	Ghamndiwali Paal	GDL-WHP-26	2007-08	57956
27	Kanjarawali Paal	GDL-WHP-27	2007-08	30929
28	Dokawali Paal	GDL-WHP-37	2008-09	67575
29	Kayarawali Paal	GDL-WHP-34	2008-09	110640
30	Phootawali Paal	GDL-WHP-30	2008-09	238210
31	Johadwali Paal	GDL-WHP-30	2008-09	27830
32	Bhainsawali paal	—	2008-09	68715
33	Jhunderwali paal	—	2008-09	126591
34	Shishamwali (BJR)	—	2009-10	140542
35	Kheepwali Paal	—	2009-10	89153
36	Mubin ki modiwali Paal	GDL-WHP-	2009-10	46065
37	Patlawali Dhani ki Paal	GDL-WHP-46	2009-10	86640
38	Nala par ki Paal	—	2010-11	29656
		TOTAL		**2268125**

• The catchment of these five paals was small which was leveled and bunded and no runoff was recorded

Number of Paals constructed during 2006-07 = 19
Number of Paals constructed during 2007-08 = 08
Number of Paals constructed during 2008-09 = 06
Number of Paals constructed during 2009-10 = 04
Number of Paals constructed during 2010-11 = 01
Total number of Paals constructed upto 31 March 2011 = 38

The maintenance of Paals by the beneficiary farmers always remained a problem. Since Paals are constructed with light textured sandy type of soil, these are easily deformed and loose shape because of dust storms and frequent livestock movement over the body of the Paals. As a recommendation to maintain the shape of Paals, the debris of stone queries comprising of small stones and pebbles is spread on the top of Paals. When such material is not available nearby, grass sodding is done to maintain Paal shape. Some of the photographs are included to show newly constructed Paals.

Fig. A typical Paal with catchment area comprising of Aravali hills just after construction.

A long Pall with background of Aravali Hills. This Paal is serving as a passage over the embankment.

4.2 Contour survey of paals for storage capacity

Out of the total Paals constructed, 16 were initially selected randomly for study on impact assessment. Out of these, 11 were selected from village Gualda. Contour survey of all study paals at one meter contour interval was carried out and paals were categorized as small, medium and large.

From the contours, the water spread area and storage capacity at different heights was worked out. Graduated gauges were installed on the up-stream slopes of the study Paals and levels of water during rainy season were recorded daily with the help of service providers placed in the village. Plots of height vs. storage capacity were prepared for calculating the volume of stored water in the reservoirs. Four ordinary rain gauges one in each study village were installed and daily rainfall was regularly recorded. These Paals were divided into three categories of small, medium, and large (Table4.2).

Table 4.2 : List of 11 paals selected for hydrological studies in village Gualda

Village	Name of paals		
	Small	Medium	Large
Gualda	1. Chajjan wali 2. Sotan wali 3. Mangli wali 4. Gondi wali 5. Shadra wali l 6. Khai wali nail ki	1. Mansarwali 2. Sajali wali 3. Aman Sawai wali 4. Malha wali	1. Cheel wali

These paals were also classified into different catchment area classes viz., 0-25, 25-50, 50-75, 75-100, 100-150, 150-200 and >200 ha.

Table 4.3: Classification of paals under different catchments area classes

Village Name	Catchments Area (Ha)							
	0-25	25-50	50-75	75-100	100-150	150-200	>200	Total
Gualda	12	11	5	1	1	3	2	35

The height of Paals varied from 4 to 8 meters and water spread area from o.76 to 2.06 at the maximum designed height (Table 4.4). The location of Paals is given on the map.

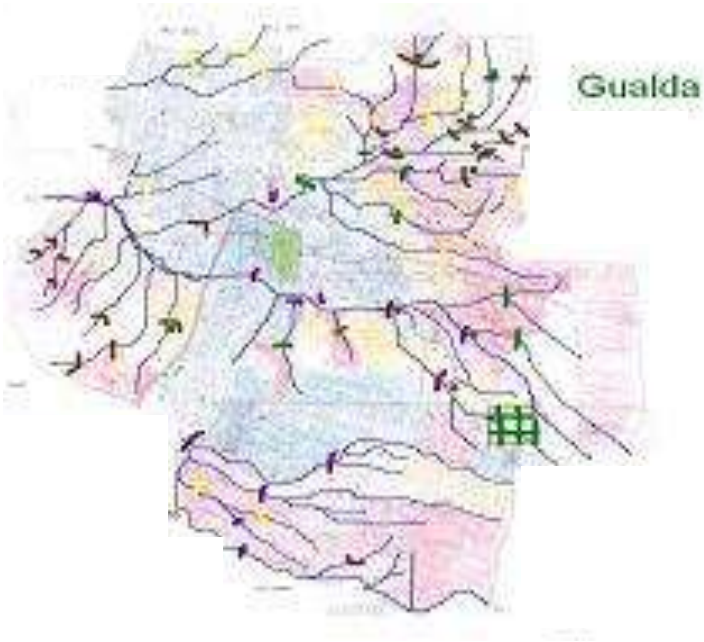


Table 4.4: Height and submergence area of study Paals constructed in village Gualda

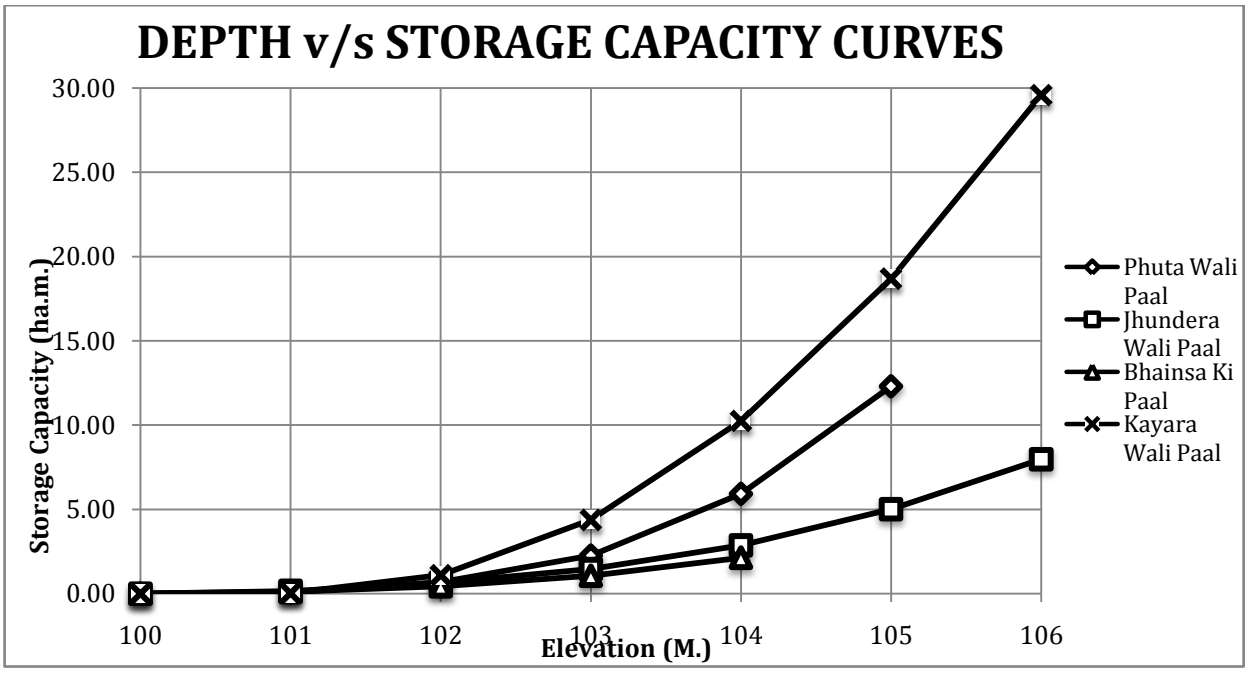
S. No	Name of Pall	Height (m)	Submergence area (ha)
1	Sajali	7.00	0.78
2	Chhajanwali	4.50	1.06
3	Mangali	6.00	1.01
4	Cheelwali	7.00	2.06
5	Mansarwali	5.50	1.48
6	Gondi	5.00	1.07
7	Dihi	8 &3	1.35
8	Samanswali	5.00	1.60 & 0.30
9	Khaiwali	5.00	1.27
10	Sautanwali	8.00	1.25
11	Shadarawali	4.00	0.76

Out of these 11 Paals, the smaller ones stopped storing any water as lands above them were leveled and bunded and no runoff was allowed to the Paals. These were then designated as gully plugs. Subsequently, four more Paals were selected from the newly constructed for the study. The depth vs. storage capacity of these new paals was also worked out and data presented along with the depth versus storage curves.

Table 4.5: Storage capacity at different heights of four new study paals

Name	Elevation	Area (Sq. M.)	Capacity (Cu.m.)	Cummulative capacity (Cu.m.)	Cummulative capacity in Ha.m. (rounded)
Phuta Wali Paal (Gualda)	100	0	0	0	0
	101	1505	753	753	0.07
	102	10573	6039	6792	0.7
	103	20986	15780	22572	2.2
	104	52297	36642	59213	5.9
	105	75408	63853	123066	12.3
Jhundera Wali Paal (Gualda)	100	0	0	0	0
	101	3148	1574	1574	0.16
	102	6402	4775	6348	0.6
	103	10175	8288	14637	1.5
	104	17889	14032	28668	2.9
	105	24911	21400	50068	5.0
	106	34561	29736	79805	8.0

Name	Elevation	Area (Sq. M.)	Capacity (Cu.m.)	Cummulative capacity (Cu.m.)	Cummulative capacity in Ha.m. (rounded)
Bhainsa Ki Paal (Gualda)	100	0	0	0	0
	101	2097	1049	1049	0.1
	102	4459	3278	4327	0.4
	103	8122	6291	10618	1.1
	104	13275	10698	21316	2.1
Kayara Wali Paal (Gualda)	100	0	0	0	0
	101	577	289	289	0.03
	102	20855	10716	11005	1.1
	103	44663	32759	43764	4.4
	104	72957	58810	102574	10.3
	105	95745	84351	186924	18.7
	106	122024	108884	295809	29.6



4.3 Techno-economic analysis of paals

Per unit rainwater storage and catchment area was calculated to analyse economic feasibility of paals. All the paals have been constructed at lowest possible cost of construction of Rs 7850 to 22579/ha-m water storage and Rs 801-2265/ha of catchment area (Table 4.6).

Table 4.6: Techno-economic summary of paals

S.No and Name of Paals of Gualda village		Catchment area (ha)	Storage capacity (ha-m)	Cost of construction (Rs)	Cost (Rs/ha-m water)	Cost (Rs/ha catchment)
1	Sajali	18	2.03	16995	8389.28	944.17
2	Chhajanwali	13	2.21	22070	9991.4	1697.69
3	Mangali	26	2.65	20831	7851.87	801.19
4	Cheelwali	54	5.02	113430	22579.43	2100.56
5	Mansarwali	35	3.5	43124	12324.66	1232.11
6	Gondi	30	2.56	27617	10781.57	920.57
7	Dihi	60	4.79	85110	17751.59	1418.5
8	Samanswai	16	3.28	36241	11034.96	2265.06
9	Khaiwali	45	2.27	28782	12655.88	639.6
10	Sautanwali	77	3.36	37567	11178.99	487.88
11	Shadarawali	9	1.02	14692	14364.49	1632.44
	• Dhakawali	—	—	13097	—	—
	• Patalwali	—	—	—	—	—

• Constructed in 2009-10.

Total 16 paals were constructed during the year 2009-10,out of which 2 were constructed in village Gualda . The average investment on per ha catchment area came to be Rs 2443 which was very cheaper for stabilization of degraded eroded lands. The cost of construction decreased with increasing catchment area of paals.

4.4 Design implication

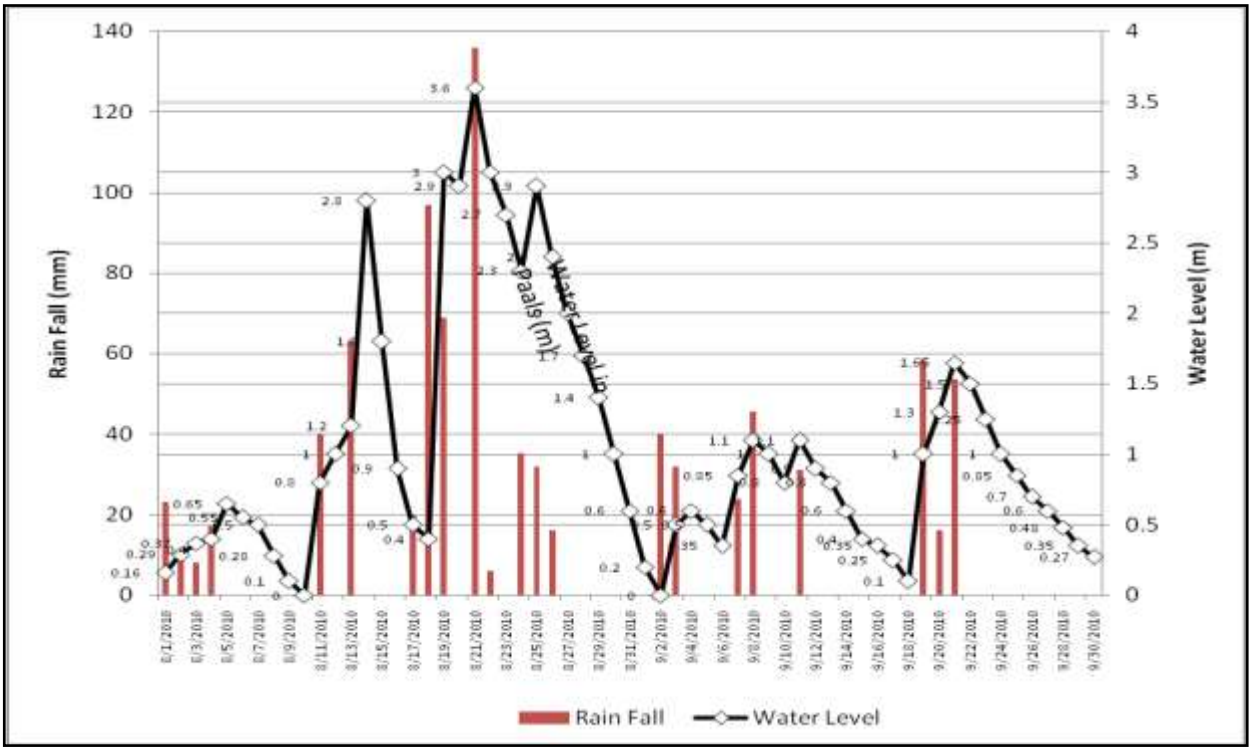
The reservoirs are designed on the basis of catchment area and water yield expected from the average runoff producing monsoon rainfall. In the year 2010-11, four important Paals of Gualda with sufficient storage capacity could not use even 20 percent of their capacity inspite of good rainfall (Table 4.7).

Table 4.7: Designed height and storage and capacity of four study Paals and actual attaned heights and storages.

Name of Paal	Designed height (m)	Storage capacity (ha.m)	Maximum height attained (m)	Storage at attained height (ha.m)
Phutanwali	6	12.3	1.96	0.68
Jhundrawali	6	7.9	2.35	0.80
Bhainsawali	4	2.13	2.08	0.33
Kyarawali	7	29.0	3.17	5.0

This also happens when storage loss is very high due to very fast percolation of stored water. Above data indicated the need of revisiting the design norms of Paals presently followed. During the monsoon of 2010, the monsoon rainfall was good but intensity of rainfall was not very high. Though couple of heavy storms was received, but there was not much rise in the

water level of Paals. However, there was clear relationship between rainfall events and rise of water in Paals. This relationship is shown in the figure given below.



The maximum level of 3.6 metre depth was attained on 21.08.10 with a rainfall storm of 136 mm. As the rainfall stopped, the water level in the reservoir started falling at 40 to 50 cm per day. Between 21.8.10 and 2.9.10, the entire 3.6 metre of water seeped into the ground.

4.5 Calculation of run off coefficient

The arbitrary fixing of Paal heights disregard of expected water yield is leading to wastage of expenditure. The lack of information on run off coefficient is the main constraint in the scientific designing of Paals. An attempt was, therefore, made to calculate runoff coefficient from 9 study Paals. With a high rainfall storm of 130 mm received once in the monsoon of 2010 which created maximum storage in Paals was taken for analysis considering it as a storm which gave maximum water yield. It was observed that when catchment area was comprised of 50 % hills and 50 % sandy waste lands, the runoff coefficient was 22.4 %. When only sandy waste lands formed the catchment, average runoff was 10 percent of rainfall (Table). However when lands are leveled and bunded, the runoff would be around 5 percent. These values should be useful in the planning of future reservoirs.

Table 4.8 : Runoff from some study Paals of Gualda generated by 130 and 40 mm rainfall during 2010

S. No.	Name of paal	HT (m)	C/A (Ha.)	Storage Capacity (Ha/m)	Rainfall (mm)	Water Yield (ha/m)	Original depth (m)	Revised depth (m)*	Original capacity ha/m	Revised capacity ha/m*	Increase in capacity	% of Runoff	Remarks
1	Cheel wali Paal	7.00	40	5.0236	130	5.20	0	2.21	0	0.1165	0.1165	22.40	50% hilly area Rocky 50% waste land area
2	Sotan wali Paal	8.00	54	3.3605	130	7.02	0	0.89	0	0.180	0.180	10.25	Waste land sandy soil
3	Suman wali Paal	5.00	50	3.284	130	6.50	0	0.85	0	0.190	0.190	10.29	-do-
4	Kiara wali Paal	6.00	140	29.580	130	18.20	0	2.16	0	1.800	1.800	9.89	-do-
5	Bhaivsagarh Paal	4.00	18	2.1316	130	2.34	0	1.02	0	0.113	0.113	10.48	-do-
6	Jhunder wali Paal	6.00	70	7.980	130	9.10	0	2.07	0	0.635	0.635	10.69	-do-
7	Godi wali Paal	9.00	20	2.561	40	0.80	0.64	1.23	0.007	0.035	0.028	3.50	-do-
8	Kai wali Paal	5.00	40	2.274	40	1.60	1.08	1.65	0.093	0.225	0.132	8.20	-do-
9	Phuta wali Paal	5.00	90	12.306	40	3.60	3.60	0.98	0.557	0.680	0.123	10.35	-do-

* Revised capacity is after rainfall event.

Kyarawali Paal with all land above and below the Paal was leveled and put to wheat crop. Note the white rods which are guages to measure height of water.

4.6 Rainwater harvested

Amount of rainwater harvested was calculated using the depth versus storage curves. Evaporation losses were worked out using the data of Metereological observatory of CCS Haryana Agricultural University Regional Research Station, Bawal (Rewari). The standard Weather Bureau open pan evaporimeters data was taken to know the daily evaporation rates from pan and the same was multiplied by 0.7 to get evaporation from larger water body.

Groundwater recharge = Rainwater harvested-evaporation losses

Photo : A villager explains multiple benefits of Paal

In the last four years, the rainwater harvested and ground water recharge at Gualda was 4.32 and 3.84 in 2007-08, 8.46 and 8.10 in 2008-09, 11.29 and 10.56 in 2009-10 and 25.30 and 24.05 in 2010-11 respectively thus making a cumulative total of 46.55 ha.m of water harvested in last four years (Table4.9).

Table 4.9: Amount of rainwater harvested and ground water recharge (ha.m) by study Paals during last four years

Number of study Paal	2007-2008		2008-09		2009-2010		2010-11		Total	
	Rain water harvested	Ground water recharge	Rain water harvested	Ground water recharge	Rain water harvested	Ground water recharge	Rain water harvested	Ground water recharge	Rain water harvested	Ground water recharge
Dehi wali	0.3	0.27	0.21	0.2	0.03	0.02	0	—	0.54	0.49
Mangli	0.2	0.18	1.137	1.09	0.07	0.06	0	—	1.407	1.33
Saman wali	0.34	0.32	1.24	1.2	0.11	0.09	1.803	1.726	3.493	3.336
Khai wali	0.56	0.53	1.51	1.44	0.29	0.26	1.081	1.031	3.441	3.261
Mansar	0.22	0.14	0.15	0.14	0	0	0		0.37	0.28
Cheel	1.56	1.43	2.212	2.12	0.5	0.39	1.396	1.338	5.668	5.278
Gondi	0.12	0.1	0.378	0.36	0.02	0.02	0.1768	0.165	0.6948	0.645
Sautan	0.4	0.33	1.603	1.53	0.5	0.47	1.658	1.644	4.161	3.974
Sahadra	0.05	0.04	0.0032	0.003	0	0	0	0	0.0532	0.043
Chhaja	0.53	0.47	0.022	0.02	0	0	0	0	0.552	0.49
Sajli	0.04	0.03	0	0	0	0	0	0	0.04	0.03
Phuta wali	—	—	—	—	4.18	4.02	1.300	1.233	5.480	5.253
Kayra wali	—	—	—	—	3.87	3.62	13.425	12.674	17.295	16.294
Bhainsagarh	—	—	—	—	0.65	0.6	1.459	1.388	2.109	1.988
Jhunder wali	—	—	—	—	1.07	1.01	3.004	2.851	4.074	3.861
Total	**4.32**	**3.84**	**8.465**	**8.103**	**11.29**	**10.56**	**25.30**	**24.05**	**49.38**	**46.55**
Another 3.0 ha.m was harvested in 2006-07 thus making total of 49.55 ha.m										

The increase in water harvested and ground water recharge was due to much higher rainfall in 2008 monsoon and due to addition of four new but bigger paals. In addition, much more ground water was recharged by in-situ rainwater harvesting due to land leveling and bunding. Six paals of Gualda village did not receive any runoff water or very negligible runoff in spite of good rainfall in the last two years because of intensive land leveling and bunding in their catchment areas.

4.7 Change in water table

Twenty observation wells were selected in target villages. Observations of water table was initiated on 30th June 2007 and monitored on fortnightly interval. The status of water table in tubewells was compared on quarterly basis for interpretation of results. Water levels in open wells as well as piezometer wells differed depending on their topographic positions. The area is having three types of topographic positions. The wells situated near the hills are having water table in between 20-30 m, in middle positions water level varies from 15-20 m and <15 m in lower positions. The water table changed depending on groundwater recharge and water-use pattern. Observation wells in village Gualda got enough rainwater for groundwater recharge due to network of paals and village is under mustard cultivation and very little area is under vegetable cultivation. Water table rose up during rainy season and maintained even after withdrawal of monsoon. The discernable rise in water table was noted in village Gualda as shown by three observation wells (Table 4.10)

Table 4.10: Increase in ground water table from December 2007 to December 2010 due to project interventions in Gualda village

Name of well	Ground water level on 31.12.2007	Ground water level on 31.12.10	Rise in water table (m)	Remarks
Jhalra	14.89	12.98	1.91	Used for drinking water and y withdrawal 4000 ltres/day
Bona	20.67	18.34	2.33	Not used for irrigation
Kudi	16.02	14.82	1.2	Used for drinking water and y withdrawal about 4000 litres/day

Some observations about changes in water table are given as under:

- Water level in observation wells differed depending upon topographic positions.
- There was rise in water table in all the observation wells during rainy season.
- After withdrawal of monsoon, there was decline in water table but decline varied depending on water use pattern.
- Some tube well, which were having no water have started pumping water and tube wells which were providing irrigation to 1-2 acres of land are now irrigating to 5-6 acres of land. This information came out during discussion with farmers. Farmers share that water table has come up by 8-10 feet in rainy season. Razzak, a farmer reported that his tube well has started working while it had gone dry about three years back.
- Farmers told that water table was declining by 5-10 feet every year due to more withdrawal by factories situated close to an adjoining village boundary, but after the construction of paals, the trend was reversed.
- Every farmer accepts the fact that ground water recharge took place due to paalconstruction.

Changes in water table over a period of four years are given in table 4.11

Table 4.11: Depth of water table in observation wells from 30.6.2007 to 30.09.2010

Year 2007	Water table depth (m) in observation wells on 15 days interval													
Gualda	**30.6.07**	**15. 7.07**	**31.7.07**	**15.8.07**	**31.8.07**	**15.9.07**	**30.9.07**	**15.10.07**	**31.10.07**	**15.11.07**	**30.11.07**	**15.12.07**	**31.12.07**	
Jhalra	14.91	14.92	14.95	14.92	14.87	14.89	14.85	14.83	14.82	14.81	14.81	14.81	14.89	
Bona	20.72	20.71	20.76	20.73	20.63	20.64	20.64	20.61	20.6	20.59	20.57	20.56	20.67	
Kudiwala	16.01	16.01	16.06	16.04	16	16.02	16	15.98	15.98	15.97	15.97	15.96	16.02	
Idris	18.95	18.95	18.98	18.95	18.84	18.91	18.87	18.85	18.84	18.82	18.8	18.8	18.91	
Kaagwala	—	—	—	—	—	—	—	—	—	—	—	—	—	

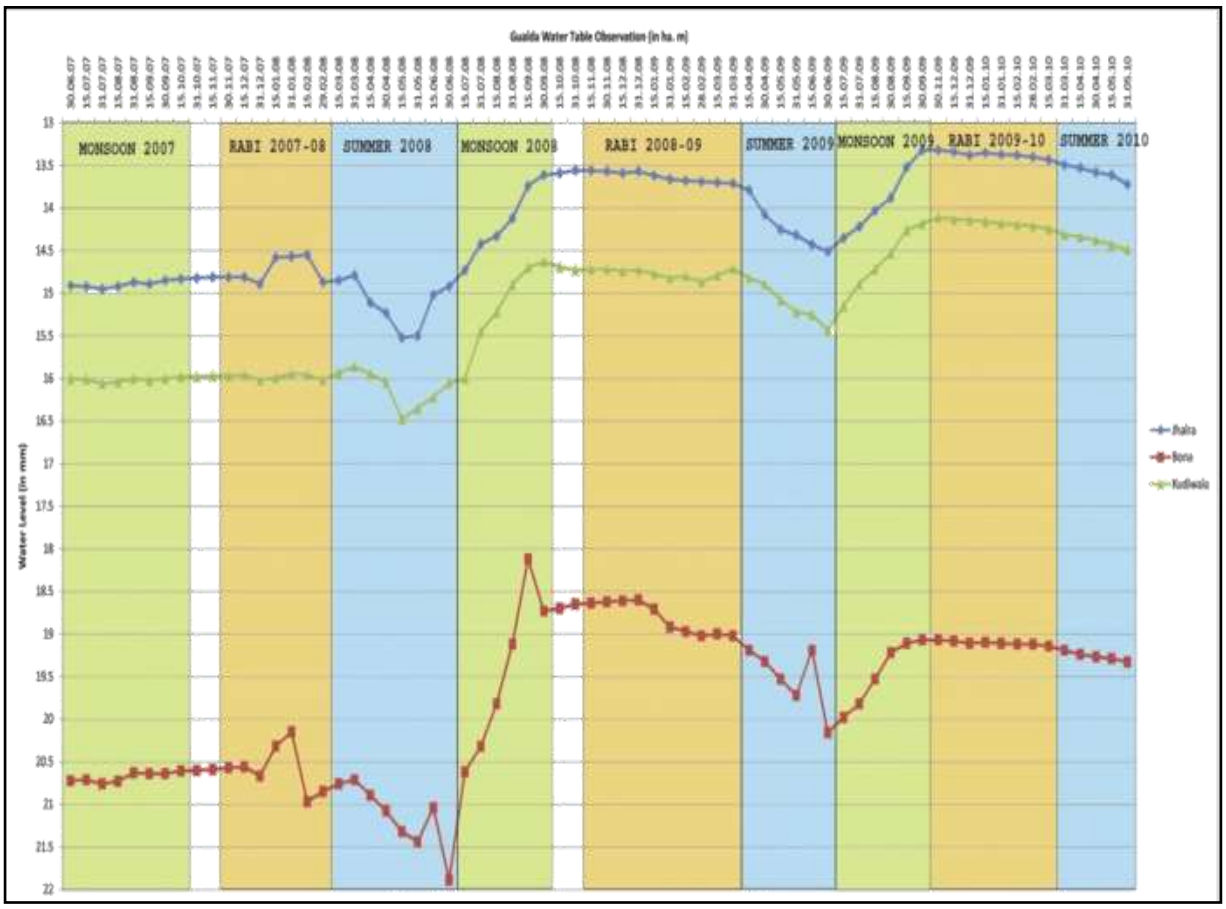
Year 2008	Water table (m) in observation wells														
Gualda	**15.1.08**	**31.1.08**	**15.2.08**	**29.2.08**	**15.3.08**	**31. 3.08**	**15.4.08**	**30.4.08**	**15.5.08**	**31.5.08**	**15.6.08**	**30.6.08**	**15.7.08**	**31.7.08**	**15.8.08**
Jhalra	14.58	14.57	14.55	14.87	14.85	14.79	15.11	15.23	15.52	15.5	15.02	14.92	14.73	14.42	14.33
Bona	20.32	20.15	20.97	20.85	20.76	20.71	20.89	21.08	21.32	21.44	21.04	21.89	20.62	20.32	19.82
Kudiwala	15.99	15.95	15.96	16.02	15.93	15.86	15.95	16.04	16.48	16.35	16.22	16.05	16	15.45	15.22
Idris	18.97	18.92	18.94	18.88	18.74	18.68	—	—	—	—	—	—	—	—	—
Kaagwala	—	—	—	—	—	—	—	—	—	25.17	25.12	25.09	24.98	24.62	24.52
Fakirwala	—	—	—	—	—	—	—	—	—	15.19	15.14	15.04	14.97	14.82	14.71
Piezo-I	8.52	8.5	8.62	8.64	8.72	8.72	8.77	8.76	8.79	8.29	8.09	8.12	8.22	8.02	7.82
Piezo-III	8.81	8.82	8.92	8.94	9.02	9.09	9.07	9.06	9.11	8.72	8.45	8.32	8.30	8.22	8.09

Year 2009	Water table (m) in observation wells										
Gualda	**15.01.09**	**31.01.09**	**15.02.09**	**28.02.09**	**15.03.09**	**31.03.09**	**15.04.09**	**30.04.09**	**15.05.09**	**31.05.09**	**15.06.09**
Jhalra	13.62	13.66	13.68	13.69	13.7	13.71	13.79	14.08	14.25	14.32	14.43
Bona	18.71	18.92	18.97	19.02	19	19.02	19.19	19.32	19.53	19.72	19.19
Kudiwala	14.77	14.82	14.8	14.87	14.79	14.71	14.82	14.89	15.08	15.22	15.25
Idris	—	—	—	—	—	—	—	—	—	—	—
Kaagwala	24.56	24.64	24.65	24.72	24.65	246	24.68	24.65	24.66	24.7	24.68
Fakirwala	14.61	14.72	14.75	14.74	14.64	14.51	14.54	14.52	14.53	14.55	14.53
Piezo-I	7.02	7.22	7.18	8.06	8.12	8.15	8.33	8.42	8.46	8.5	8.5
Piezo-III	7.42	7.57	7.86	8.06	8.22	8.33	8.4	8.46	8.52	8.5	8.52
Year 2009	**Water table (m) in observation wells**										
Gualda	**30.06.09**	**15.07.09**	**31.07.09**	**15.08.09**	**30.08.09**	**15.09.09**	**30.09.09**	**15.10.09**	**31.10.09**	**15.11.09**	**30.11.09**
Jhalra	14.51	14.35	14.22	14.03	13.88	13.52	13.32	13.27	13.25	13.29	13.32
Bona	20.16	19.98	19.82	19.53	19.22	19.11	19.07	19.03	19	19.04	19.07
Kudiwala	15.44	15.15	14.89	14.72	14.53	14.26	14.18	14.09	14.04	14.07	14.11
Idris	—	—	—	—	—	—	—	24.54	24.51	24.53	—
Kaagwala	24.7	24.73	24.77	24.76	24.75	24.68	24.61	14.53	14.5	14.55	24.57
Fakirwala	14.55	14.68	14.7	14.7	14.69	14.63	14.47	11.44	11.4	11.43	14.58
Piezo-I	8.59	8.52	8.52	8.41	8.35	8.12	8.03	8.56	8.53	8.55	11.46
Piezo-III	8.59	8.56	8.6	8.58	8.42	8.23	8.12	—	—	—	8.59

Year 2010	Water table (m) in observation wells										
Gualda	**15.01.10**	**31.01.10**	**15.02.10**	**28.02.10**	**15.03.10**	**31.03.10**	**15.04.10**	**31.04.10**	**15.05.10**	**31.05.10**	**15.06.10**
Jhalra	13.35	13.37	13.38	13.4	13.43	13.49	13.53	13.58	13.61	13.72	13.92
Bona	19.1	19.11	19.12	19.12	19.14	19.19	19.24	19.27	19.29	19.33	19.38
Kudiwala	14.16	14.18	14.2	14.21	14.24	14.31	14.34	14.38	14.43	14.49	14.58
Idris	—	—	—	—	—	—	—	—	—	—	—
Kaagwala	24.61	24.62	24.64	24.64	24.67	24.72	24.75	24.81	24.83	24.85	24.93
Fakirwala	14.62	14.64	14.66	14.67	14.68	14.75	14.79	14.86	14.92	14.99	15.03
Piezo-I	11.49	—	—	—	—	—	—	—	—	—	—
Piezo-III	8.63	8.63	8.65	8.66	8.68	8.73	8.77	8.81	8.85	8.87	8.96

Year 2010	Water table (m) in observation wells						
Gualda	**30.06.10**	**15.07.10**	**31.07.10**	**15.08.10**	**31.08.10**	**15.09.10**	**30.09.10**
Jhalra	14.01	14.17	14.23	14.28	14.08	13.36	13.02
Bona	19.42	19.58	19.61	19.68	19.37	18.73	18.41
Kudiwala	16.63	14.78	14.92	14.99	16.78	16.18	15.89
Idris	—	—	—	—	—	—	—
Kaagwala	24.97	25.28	25.31	25.33	25.06	24.61	24.16
Fakirwala	15.18	15.48	15.43	15.61	15.49	15.12	14.89
Piezo-I	—	—	—	—	—	—	—
Piezo-III	8.99	9.18	9.31	9.36	9.25	8.93	8.67

The monthly change pattern (rise/fall) of ground water is presented in the figure given below.



Analysis of data showed little rise in water table during low monsoon rainfall of 2007and then water level dropped due to scanty rainfall and use of wate for irrigation.The catchment area of paals in Gualda was under rainfed mustard during the year 2007 hence lesser exploitation of ground water . However, there was rise in water table during the monsoon of 2008 in all the observation wells due to heavy rainfall .The observation wells which were situated on/near the paals showed higher rise in water table. These rains increased humidity and reduced evaporation losses. There was further rise in water table in the monsoon of 2009 and much higher level was maintained. Relatively lesser drop was noted in summer of 2010 as compared to summer of 2008.

Photo : Well observations are being recorded from reference points.

Assessment of Land Development Works

Chapter - 5

Includes :-

- ★ Reclaimation of waste lands
- ★ Additional income from reclaimed land
- ★ Appreciation in market value of reclaimed waste lands

Chapter-5

Assessment of Land Development Works

5.1 Reclamation of waste lands

A total of 52 ha of waste lands were made suitable for cultivation where farmers started raising regular crops including fruit and forest plants. Land was improved by means of land leveling, construction of field bunds and recoupment of soil fertility by organic manures. Four rates per bigha were pre-decided by SST as per slope and extent of gullies in the land to be leveled. Group of farmers joined to form a user group. Their applications were processed and cost to be shared by the Project and farmer was decided. The user group on getting approval arranged tractors at their level and leveled the land. Project share of payment cost was paid to user groups after satisfactory completion of work. The rest of the money was spent by the farmers. Such works were done mostly during rainy season when due to sufficient moisture in the soil, work is easy and proper compaction is possible.

Type of private wastelands reclaimed under the Project

The construction of Paals was the necessary pre-requisite to take up the work of reclamation of waste lands because without control of run-off and flooding, there was danger of leveled land getting washed away or bunds breached. Land leveling and field bunding ensured in-situ conservation of rainfall and recharge of soil profile. A cluster approach was followed where Paal was made the neucleous around which lands were developed and production improvement initiatives were started. This approach was called *Paalwadi* concept of natural resource development.

Land leveling work in progress along a gully in foot-hill area of Gualda Village

A study was carried out to calculate the soil moisture conserved due to land leveling / land shaping and bunding. Soil samples from undulating and leveled (treated) sites were collected from four villages, oven dried and difference in leveled and unleveled sites was considered as soil moisture conserved due to land shaping. More soil moisture was recorded in leveled fields, as land leveling reduced the land slope and rainwater was conserved in the same fields, which was otherwise going out as run off and eroding fertile land with it. On an average, 0.03 m water was conserved per hectare of land. It may also be stated that land leveling is more fruitful, as it conserves the natural resources *in-situ* and as a results of improvement in soil moisture and fertility, increase in crop productivity are expected. Land leveling operations were cost effective and hence became very popular with the farmers.

In addition to waste lands, farmers also leveled 38 hectare of sloping but cultivated lands situated in the surrounding areas of gullies by making investments from their oun resources.

5.2 Additional income from reclaimed land

Data on crop production from reclaimed waste land and sloping cultivated land subsequently leveled was compiled with respect to 32 sample families and results extrapolated to 151 families which were involved in land development work. Three main crops of wheat, mustard, and bajra were considered in the analysis. Since straw carries good value, it was included in benefit stream in addition to grains. **The additional income from leveled land worked out to Rs 43, 53 645 and income gain per family was to the tune of Rs 28832.** Maximum contribution was made by the cultivation of wheat crop (Table 5.1).

Table 5.1: Additional income from grain and straw production from newly reclaimed cultivated but and leveled lands

S. N.	PARTICULARS	WHEAT	MUSTARD	BAJRA
1	Production from newly reclaimed waste lands (qtls)	753.8	148.0	284.0
2	Additional production from already cultivated but leveled land (qtls)	748.8	280.3	312.3
3	Total increase in grain production/year (qtls)	1502.6	428.3	596.3
4	Market price of grains Rs/q	1100	2200	850
5	Total value of grains Rs	1652860	942260	506855
6	Total value of increased straw (Rs.)	763920	231250	231250
7	Grand total of income /year (Rs.)	2416780	1173510	763355
8	Grand total of income from crops	Rs. 4353645		
9	Income gain/farmer/year	4353645 % 151 = Rs 28832		
Data of cost, farmers benefitted, land reclaimed, and production increase was collected from areas around 27 Paals				

A bumper crop of wheat on reclaimed land

Mustard was raised as pure crop and also as lines in wheat crop. The additional crop production created sufficient marketable surplus, the income from which was ploughed back on improvement of additional land and irrigation source development. The additional straw production made them self sufficient in forage for livestock. **Earlier, most farmers were purchasing whear straw from Haryana villages but now they are self sufficient.**

Increased availability of green and dry forage prompted them to replace goats and cows with stall-fed buffaloes and adopt dairying as a remunerative subsidiary occupation. Many families shifted their residences to the farms to take care of watch and ward problems.

A bumper crop of Mustard on leveled land

5.3 Appreciation in market value of reclaimed waste lands*

There has been tremendous increase in the value of reclaimed land. The appreciation per bigha has been Rs 3.9 laks and average appreciation in the value of land as an asset was Rs 5.4 lakh per family as per detail given below :

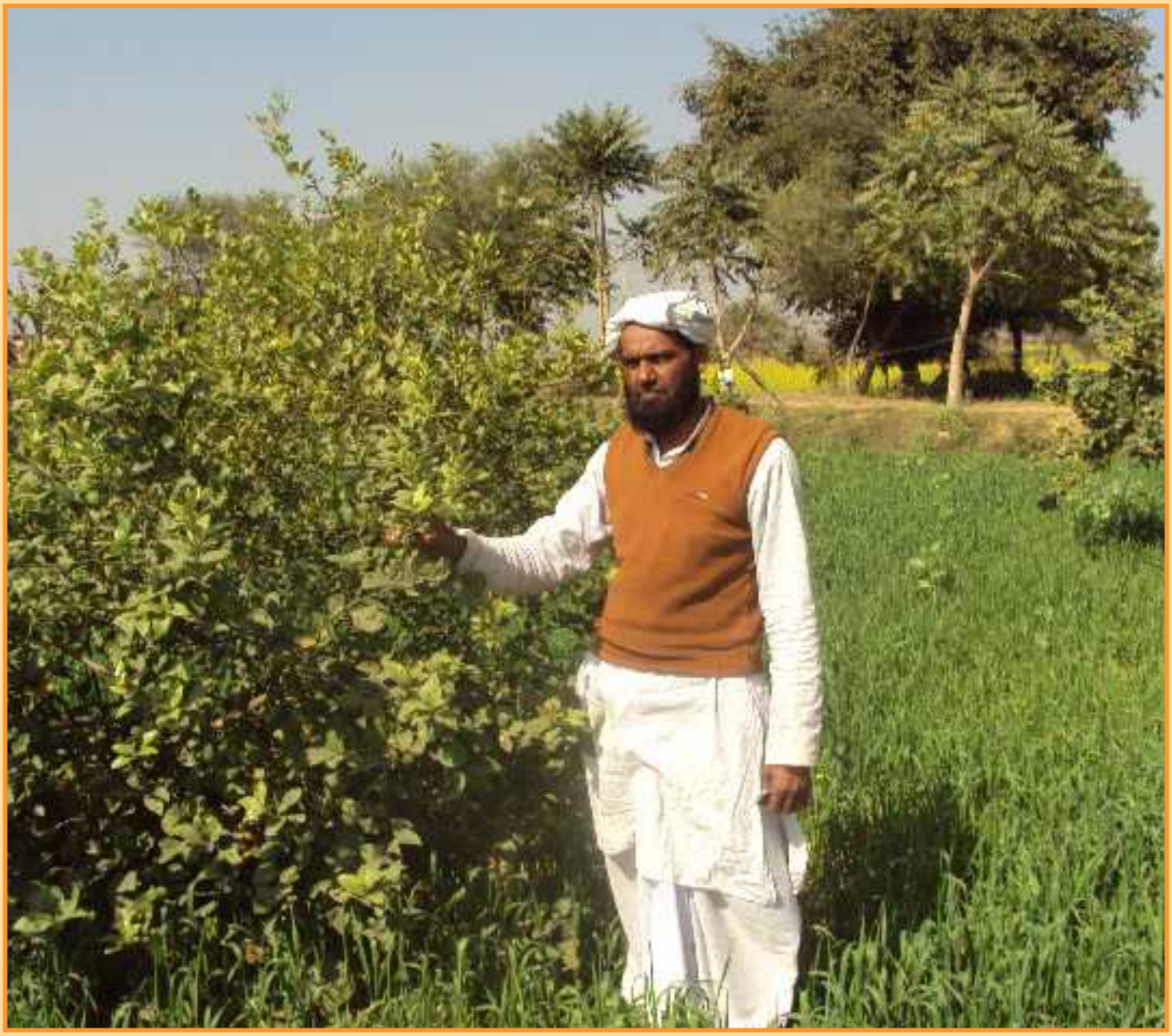
- Number of families involved in waste land reclamation .....= 151
- Total gullied area reclaimed in last four year .....= 52 ha
- Appreciation in market value of reclaimed land .....= Rs 815 lakh
- Appreciation Per ha .....= Rs15.67 lakh
- Appreciation per acre .....= Rs 6.27 Lakh
- Appreciation per bigha .....= Rs 3.92 Lakh
- Average appreciation per family .....= Rs 5.4 Lakh

*Based on interview of sampled families)

The land price appreciation and gain in crop and forage production improved the self esteem, social pride, self employment, urge to progress and reinvest in land based assets and activities. This is perhaps the reason that development of waste lands through land leveling has emerged as the most preferred activity.

Impact assessment of horticulture and forestry plantation

Chapter - 6



Includes :-

- ★ Performance of horticulture crops
- ★ High mortility and possible reasons
- ★ Expert opinion about horticulture promotion
- ★ Improvement in vegetation cover
- ★ Improvement in biomass production

Chapter- 6

Impact assessment of horticulture and forestry plantation

Growing of fruit plants as such was not a normal practice in the area because of scarcity of water, frost damage, problem of wild life damage, longer gestation period, non availability of quality seedling and so on. The project promoted the plantation of fruit and fodder trees on the reclaimed lands to augment income of the farmers. The plants and inputs were supplied by the project but labour and watch and ward was provided by the farmers. Somehow, it was almost made a pre-condition by SST staff that those farmers who want the benefit of land leveling should put fruit and preffered tree species on bunds/blocks of reclaimed lands. However, promotion of plantations on reclaimed lands turned out to be a hard task in the area where this was not a prevalent farm activity.

6.1 Performance of horticulture crops

Information on number of plants planted in Gualda village was taken from SST records and actual numbers available on the farms was recorded in **March 2010**. Farmers growing fruit and fodder plants were contacted personally to record their experiences. Plants raised in their fields were counted, and survival percentage was calculated. Results are presented in table 6.1.

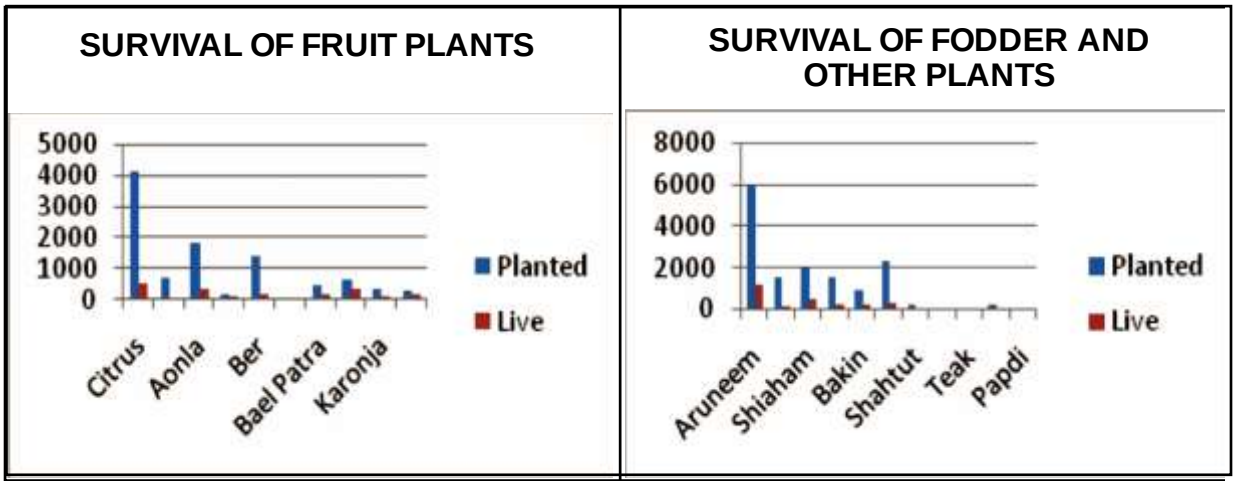
Table 6.1 : Survival percent of different fruit plants in Gualda villages.

S. No.	Species	2006		2007		2008		2009		2010		Total		Survival %
		P	S	P	S	P	S	P	S	P	S	P	S	
	Fruit plants													
1	Citrus	923	70	1305	382	1968	105	0	0	0	0	4196	557	13
2	Mango	0	0	500	0	190	0	0	0	0	0	690	0	0
3	Aonla	1560	352	20	20	278	2	0	0	0	0	1858	374	20
4	Jamun	0	0	150	120	0	0	0	0	0	0	150	120	80
5	Ber	0	0	555	149	880	29	0	0	0	0	1435	178	12
6	Kathal	70	0	0	0	10	0	0	0	0	0	80	0	0
7	Bael patra	451	189	0	0	0	0	0	0	0	0	451	189	42
8	Guava	0	0	80	4	20	8	0	0	536	323	636	335	53
9	Karonja	70	8	1	1	275	112	0	0	0	0	346	121	35
10	Papaya	0	0	50	0	5	0	0	0	250	160	305	160	52
	Total	**3074**	**619**	**2661**	**676**	**3626**	**256**	**0**	**0**	**786**	**483**	**10147**	**2034**	**20**
	Fodder & other plants													
1	Aruneem	1592	459	1395	365	1927	145	0	0	1150	205	6064	1174	19
2	Ratanjot	1500	112	0	0	0	0	0	0	0	0	1500	112	7
3	Shiaham	248	52	843	351	478	59	10	3	480	30	2059	495	24
4	Sirus	247	46	260	25	872	114	0	0	130	7	1509	192	13
5	Bakain	127	27	480	114	10	6	0	0	350	21	967	168	17
6	Neem	155	52	670	140	1133	58	0	0	350	19	2308	269	12
7	Shahtut	0	0	183	0	20	13	0	0	0	0	203	13	6
8	Bamboo	44	0	0	0	0	0	0	0	0	0	44	0	0
9	Teak	0	0	0	0	40	0	0	0	0	0	40	0	0
10	Sahjana	0	0	0	0	152	0	0	0	70	9	222	9	4
11	Papdi	0	0	0	0	0	0	0	0	70	6	70	6	9
	Total	**3913**	**748**	**3831**	**995**	**4632**	**395**	**10**	**3**	**2600**	**297**	**14986**	**2438**	**16**

P = Planted ; S = Survived

Mango and Kathal ended up with total failure. Ber and Citrus gave only 12 and 13 percent survival. The overall survival was hardly 20 percent in fruit plants. Bamboo and Teak among forest trees ended with total failure. Even most promising tree species like Aruneem and Shisham gave 19 and 24 percent survival. The overall survival of forest tree species was only 16 percent. In general, survival percentage of plants was low and zero also in case of some species.

Though survival varied from location to location, but by and large was quite low and remained serous cause of concern (Figure).



Most farmers preferred to raise fruit plants along with field crops and forest tree species on field bunds.

Fruit plants raised along with wheat crop

6.2 High mortality and possible reasons

During discussion with the farmers, the following reasons of high mortality emerged.

- The project area represents problems of poor sites viz., adaphic, climatic and anthropogenic, which demand special techniques of establishment and are relatively costly.
- For any strategy of plantation in Rajasthan Aravalis, proven plant species, mostly indigenous, coupled with a focus on *in-situ* moisture retention and conservation is extremely important.
- Moreover, farmers of the region are following traditional cropping system of bajra-mustard and guar-wheat. The horticulture and farm forestry as commercial block plantations are new, and require intensive training of farmers and after care.
- The soils must be tested before raising plants.
- In some orchards, farmers applied unrecompensed cattle dung directly to plants, which increased the termite attack.
- There is need for timely digging of pits, application of well rotten FYM, inorganic fertilizers and pesticides to check the mortality rate of newly planted seedlings.
- Seedlings must be purchased from reliable nurseries and farmers should be trained in nursery preparation, planting techniques, precautionary measures for disease and insect-pest attack and nutrient application.
- Being a very demanding activity, the matching back up support should be provided by SST staff with technical expertise on the subject.

6.3 Expert opinion about horticulture promotion

SPACE arranged the visits of Dr. J.S. Kanwar a retired Professor and Head, Department of Horticulture, Punjab Agriculture University, Ludhiana to guide SST staff and farmers in successful raising of fruit-plants. Dr Kanwar noted the following basic shortcomings :-

- Lack of soil analysis prior to orchard planting
- Too many fruit plant species selected for planting
- Poor health of seedlings
- Poor planting practices
- Lack of training of fruit plants in the field after planting
- Lack of knowledge on identification of fruit pests, diseases and their timely management.
- Lack of knowledge on identification of nutritional disorders and their correction.
- Selection of farmers not interested in raising fruit plants.

Dr. J.S. Kanwar in a training session with SST staff

Farmers were not provided proper guidance and as a result sprouts from root stock were not removed. These have over grown and grafted plants have been smothered. Several plants were damaged during interculture operations. Since fruit plants were planted in the standing wheat crop and after the harvest of wheat crop in April, these were not regularly irrigated during hot summer months. Incidently, there is no greenery around in the fields at that time; these plants attracted lot of wild life. Due to these reasons, commercially viable fruit plantations could not show promise.

Going into the progress, limitations of SST and factors governing these, as detailed in the foregoing pages, it becomes evident that lot more needs to be done, especially sensitising the farmers about the correctness and timeliness of doing field operations. Proper and timely planting the fruit trees in the field is the first important step in establishing a good orchard. The commercial success in this venture would depend on operations like tree training, following recommended agronomic practices, identification of pests, diseases and their management and lastly the marketing and utilization of the farm produce.

Since orcharding is highly specialised and demanding job, only comparatively well-educated, interested and enterprising farmers may be involved. For others, their involvement may be limited to planting trees in homestead, near tubewells, farm roads, and kitchen gardens to meet their personal needs.

Fig. Ch. Aashmohmad planted Citrus fruits on his land. This land is near to his residence so he could save the plants.

Note citrus shoot from root stock has smothered the buded plant.

In almost half the plants, root stock shoots were not cut

Note guava shoot emerged from root stock and not cut

6.4 Improvement in vegetation cover

Three paals having catchment of forest area in Gualda were selected for vegetation survey and biomass/ litter deposition. Survey for record of vegetation and biomass deposition was carried out in June 2007, March 2008 and again Feb 2011.The counting of trees and bushes from 100x100m plots (data reported for 100 sq.m area) and grasses from 1x1m plots was done to enumerate the species composition.

In case of all the three study Paals, the catchment areas registered considerable stocking of natural vegetation in a period of four years (Table 6.2).

Table 6.2: Vegetation in catchment of paals (numbers in 10m x 10 m area)

S. No	Species	Cheelwali Paal			Mansarwali Paal			Samanswali Paal		
		June 2007	March 2008	Feb. 2011	June 2007	Mar 2008	Feb. 2011	June 2007	Mar 2008	Feb. 2011
1	Ber	18	22	42	1	1	-	1	13	13
2	Hingoth	-	--		-	-	-	-	-	4
3	Kharsana	43	55	35	29	39	-	29	45	
4	Jhojharu	26	29	134	23	25	165	23	-	117
5	Jandi	2	2	-	1	1	-	1	1	
6	Munj	3	5	-	-	-	-	-	10	
7	Kair	-	--	-	-	-	-	-	2	1
8	Kikar	-	-	-	4	-	5	4	3	2
9	Alwakanta	-	7	15	1	4	6	8	-	7
10	Ak	1	-	-	1	6	2	1	-	-
11	Khip	2	-	3	-	9	2	1	-	-
12	Bansa	15	1	-	-	2	3	-	-	-
13	Jaal	3	2	1	-	2	1	-	-	-
14	Pawad	33	22	118	-	-	52	-	-	2
15	Bui	-	35	-	-	-	-	-	-	14
Total		146	180	348	60	89	236	68	74	160

The major plants present in forest area are kikar, jandi and bushes are ber, kher. The grasses are dabh, bakhari, doob, motha etc. The population of grasses and shrubs increased two to three times in the catchment of three Paals of Gualda.

6.5 Improvement in biomass production

Undecomposed leaves and twigs and decomposed organic matter was collected regularly at six monthly intervals from six 1mx1m plots marked by stakes. The material was filled in paper bags and air dried till constant weight. Biomass collected was compared with the biomass harvested in previous years from the same plots (Table 6.3).

The un-decomposed as well as decomposed biomass almost doubled in a short period of two years, whereas un-decomposed biomass increased by 3.5 times during this period. Increase in decomposed biomass during the month of June was more in comparison to un-decomposed biomass during both the years. It was probably due to extreme temperature but data recorded during March and Sept. showed sharp increase in decomposed as well as un-decomposed biomass in comparison to both the values recorded during previous years. Values during Sept. 2008 and March 2009 showed significant increment in biomass.

Table 6.3: Biomass deposition on forest floor (t/ha)

S. No.	Name of paal	Biomass deposition (t/ha)									
		Un-decomposed					Decomposed				
		June 2007	Mar 08	Sept. 08	Mar 09	June 09	June 07	Mar 08	Sept. 08	Mar 09	June 09
1	Cheelwali	3.12	3.4	5.98	6.38	6.79	0.51	0.48	0.98	1.33	1.62
2	Mansar-wali	2.78	3.1	4.24	4.98	5.47	0.49	0.50	0.62	1.11	1.35
3	Samans-wai	2.12	1.9	3.98	4.82	5.27	0.33	0.28	0.51	0.98	1.23

Improvement in Vegetation cover on the denuted waste lands of village Gualda

Assessment of Crop Improvement Works

Chapter - 7

Includes :-

- ★ Demonstration of improved pearl millet
- ★ Demonstration on mustard crop
- ★ Demonstration on Kabli gram
- ★ Demonstration on wheat
- ★ Economic analysis of *rabi* crops
- ★ Economic analysis of *kharif* crops

Chapter-7

Assessment of Crop Improvement Works

The project attempted to increase the crop production by atleast 50 percent by organizing demonstrations on improved package of practices on farmer's fields. The results of such demonstrations are discussed in this chapter.

7.1 Demonstration of improved pearl millet

The project farmers were allocating 90 percent of crop area to pearl millet in kharif season. Thirty trials of promising rainfed bajra variety (HHB-67 & HHB-117) were laid out during Kharif 2008 on farmers' fields to popularize improved hybrids released by the Chaudhary Charan Singh Haryana Agricultural University, Hisar. These were dwarf, short duration and less water requiring crops, specially developed for the rainfed regions and had been tested on farmers' fields in Haryana. Farmers were advised to follow complete package of practices. But results could not fulfil the expectations of the farmers. Farmers are growing seed of various varieties released by different seed agencies. The results of the demonstration plots are presented in Table 7.1

Table 7.1 Yield of pearlmillet in demonstration plots at Gualda village during Kharif 2008

Farmer's name	Area (ha)	Production (q)	Yield (q/ha)
Variety: HHB-67 (HAU Hisar)			
Ram kumar	1.00	9.6	9.6
Krishan	0.25	0.8	3.2
Harphool	0.25	1.0	4.0
Noor Hasan	0.50	2.4	4.8
Rukaiya	1.00	4.8	4.8
Emmal	0.50	1.8	3.6
Kasam	1.50	2.8	1.9
Lukeman	0.38	2.4	6.3
Suleman	0.38	2.8	7.4
Attaullah Khan	0.75	5.4	7.2
Average yield (q/ha)			**5.28**
Variety: HHB-117 (Private Company)			
Rahilla	0.5	2.6	5.2
Rihana	0.5	2.2	4.4
Kasam	1.5	15.2	10.1
Sayara	0.75	7.4	9.9
Average yield (q/ha)			**7.4**

The yield of bajra HHB-67 was 10 to 40 percent less in comparison to variety HHB-117. This is quite obvious that variety purchased from the private seed company had more yield potential. Most of the farmers are using hybrids developed by Pioneer Seed Company, which provides more favourable results in this locality. Varieties used by farmers were long duration and took 90-100 days to complete its life cycle in comparison to 60-70 days in case of varieties demonstrated.

During *rabi* 2009-2010, mustard, kabli gram and wheat crops were demonstrated on farmers' fields. Improved varieties were provided and complete package of practices were followed. Production improvement programme was executed with the help of water users' groups and Mahila Bachat Samiti**.** The results of demonstrations are presented below.

7.2 Demonstration on mustard crop

Bhawani variety was demonstrated on farmers' fields but it completely failed due to severe attack of white rust. Bhawani is early sown variety and is prone to white rust when if sown early. After that Pioneer variety was introduced, which yielded almost same what the farmers were getting already but in some plots, it yielded 10-20 percent less (Table 7.2).

Table 7.2: Yield of mustard under different demonstration plots

S.No.	Farmer's name	Area (ha)	Production (q)	Yield (q/ha)
1.	Attaullah Khan	0.25	1.4	5.6
2.	Salman	0.25	1.3	5.2
3.	Hifju	0.25	1.2	4.8
4.	Habib	0.25	1.5	6.0
5.	Hakam	0.5	3.3	6.6
6.	Ashu	0.5	2.9	5.8
7.	Amin	0.5	3.4	6.8
8.	Kallu	0.5	3.1	6.2
9.	Rasdeen	0.5	3.3	6.6
	Average	—	—	6.0
	Average yield under farmers' practice			6.0

In general, mustard yield was low due to severe frost and extreme cold conditions and lack of winter rainfall. Under normal conditions, the yield of Mustard is around 14 to 16 q/ha.

7.3 Demonstration on Kabli gram

The crop of kabli gram demonstrated by SST could not perform better and provided average yield of only 2.52 q/ha, which was 15-20 percent less than the normal yield of kabli gram (Table 7.3).

Table 7.3. Yield of kabli gram under demonstration plots

S.No.	Farmer's name	Area (ha)	Production (q)	Yield (q/ha)
1.	Sayara	0.25	0.25	1.00
2.	Hasina	0.25	0.18	0.72
3.	Rukaiya	0.25	0.22	0.88
4.	Iliyas	0.25	1.20	4.8
5.	Nisar	0.25	0.9	3.6
6.	Arsad	0.25	0.95	3.8
7.	Ashu	0.25	0.6	2.4
8.	Kallu	0.25	0.75	3.0
	Average			2.52

7.4 Demonstration on wheat

A short duration variety of wheat belonging to Vadisha (MP) was demonstrated on farmers' fields. According to the staff of SST, this variety is of short duration and requires only 2-3 irrigations. Idea was to take the crop after harvest of short duration Bhawani sarson. The variety was tested with complete package of practices, but it resulted in 30-35 % lesser yield in comparison to PBW-343 variety sown by the farmers of the village (Table 7.4).

Table 7.4. Yield of wheat under demonstration plots

S.No.	Farmer's name	Area (ha)	Production (q)	Yield (q/ha)
1.	Sayara	0.25	5.2	20.8
2.	Rukaiya	0.25	5.4	21.6
3.	Hasina	0.25	3.4	13.6
4.	Emana	0.25	4.6	18.4
5.	Sarbari	0.25	3.6	14.4
6.	Basaf	0.25	3.8	15.2
7.	Husain	0.25	3.9	15.6
8.	Ash	0.5	11.2	22.4
9.	Hakam	0.5	13.3	26.6
10.	Amin	0.5	6.4	12.8
11.	Kallu	0.5	5.8	11.6
12.	Illiyas	1.75	8.9	20.3
	Average			17.77
Yield range in farmers' variety				25-30

7.5 Economic analysis of *rabi* crops

Wheat and mustard are the major crops raised during *rabi* season in these villages. Economic analysis of the crops was carried out. Input costs were calculated by taking average of the inputs used by the farmers. Output quantities were worked out from crop harvests and duly verified by group discussion with farmers. Average of yield data recorded during first quarter and market rates were used for calculating returns. Economic analysis of wheat and mustard crops is given in table 7.5

Table 7.5: Economic analysis of *rabi* Crops based on per ha at 2010 rates

Input cost (Rs)	**Wheat**			**Mustard**		
Particulars	**No./qty**	**Rate (Rs/unit)**	**Total cost (Rs)**	**No./qty**	**Rate/unit**	**Total cost (Rs)**
Ploughing	6	500	3000	2	500	1000
Seed	150 kg	20	3000	4 kg	35	140
Fertilizers						
DAP	200 kg	11	2200	200 kg	11	2200
Urea	400 kg	5	2000	80 kg	5	400
Fertilizer application	1	100	100	1	100	100
Irrigation	6	16000	9600	2	1600	3200
Harvesting	-	5600	5600	-	2000	2000
Threshing	-	2200	2200	-	1400	1400
Threshing Labour	5	150	500	3	150	450
Transportation	-	200	200	-	200	200
Watch/ward		LS	1000		LS	500
Total input cost			**29600**			**11590**
Out put (Rs)						
Particulars	**Produce (Qtls)**	**Rate (Rs/q)**	**Total cost (Rs)**	**Produce (Qtls)**	**Rate (Rs/q)**	**Total cost (Rs)**
Grain	34.51	1100	37961	14.93	2100	31353
Straw	40.25	400	16100	29.86	250	7465
Total	**-**	**-**	**54061**	**-**	**-**	**38818**
B-C ratio			**1.83**			**3.35**

- **Input expenses are 2.5 times more in case of wheat crop in comparison to mustard.**
- **Return per rupee investment is 1.83 in case of wheat and 3.35 in case of mustard.**
- **Water requirement of mustard crop is 1/3rd of wheat crop.**
- **Mustard crop is the most suitable crop for the region in terms of economic benefits as well as checking falling groundwater table in the project area.**

7.6 Economic analysis of *kharif* crops

Farmers were asked about the expenses on input used and total output received from crops during *kharif* 2010. Vegetable growers were maintaining proper records but costs incurred and output received on pearl millet and cluster bean were estimated through group discussion with farmers. All the average values of input as well as output costs were used for economic analysis. The details are presented in table 7.6.

Table 7.6. Economic analysis of *kharif* crops of 2010

Input cost (Rs/ha)	**Crops demonstrated**				
Input Head	**Pearl millet**	**Clusterbean**	**Arhar**	**Tomato**	**Chilly**
Field preparation	2000	2000	2400	2073	2500
Seed/seedling	100	600	1400	4400	4800
Fertilizers	2255	0	6084	4001	4140
Pesticides	0	0	0	2909	1280
Irrigations	0	1600	2400	7273	7465
Intercultural operations	0	0	1050	5092	8000
Harvesting, processing & transportation	2000	2000	1750	4545	6200
Watch and ward	500	500	500	1000	1000
Total input cost (Rs)	6855	6700	15584	31293	35385
Total output (Rs)	14121	15862	28304	62472	62162
Net profit (Rs/ha)	7266	9162	12720	31179	26777
Benefit : cost ratio	1.9	2.4	2.2	2.0	2.3

Analysis shows that cultivation of **vegetable crops is quite profitable and it is possible to improve livelihoods in the region by promoting vegetable cultivation but with less water.** Among the crops tested, tomato proved to be the most profitable, followed by chilly, arhar, cluster beans and pearl millet. **Tomato crop was able to provide a net profit of Rs 31179/ha against Rs 7266/ha in case of peral millet crop.** Arhar crop failed at many sites. But when crop was successful, arhar proved to be quite beneficial crop for kharif season. In addition to good return, arhar fixes atmospheric nitrogen and improves soil fertility. In case arhar crop is grown with good care, farmers can earn net profit of Rs 12720/ha, with only 1-2 irrigations whereas, vegetables require 12-15 irrigation. However, the problem of pod borer continues and need control at the right stage. Three issues emerged from the above data.

- Firstly, the demonstrations of new varieties by the SST largely failed and farmers have suffered losses. They firmly hold the view that such experiments should not be conducted at their cost.
- Secondly, when prevalent varieties are raised with balanced fertilization, recommended package of practices and limited irrigation they can provide reasonably good returns.
- Thirdly, vegetable crops though fetch handsome returns but require a large number of irrigation and are likely to deplete ground water at a faster rate.

Assessment of Economic Viability of the Project

Chapter - 8

Includes :-

- ★ Economic viability of Paal construction
- ★ Economic viability of land development
- ★ Economic viability of crop production
- ★ Economic viability of fruit plants
- ★ Economic viability of forest plants

Chapter 8

Assessment of Economic Viability of the Project

Integrated watershed management is considered an appropriate approach to develop both arable and non-arable land in rain fed areas for increasing and stabilizing production by adopting improved soil and water conservation measures. Development of water resources, land leveling and shaping, diversified and mixed cropping systems are recommended to achieve the twin objective of sustainable production and restoration of ecological balance in a harmonious manner through scientific management of land and rainwater resources. The economic evaluation of such programmes is, however, essential to provide justification for investment of scarce financial resources. Moreover, this exercise strengthens the hands of decision makers for future investment. An attempt was made to evaluate the benefits and cost structure of the project investment. Economic analysis was done by working out benefit-cost (B-C) ratio, net present value (NPV), pay back period, and internal rate of return (IRR). Activity wise economic viability is presented below.

8.1 Economic viability of Paal construction

Aravalis constitute a water scarce area, where monsoon rainfall provides 400-500 mm of rain water per year. Because of sandy strata, there is very little runoff from the farmlands. However, the rocky Aravalis which are totally devoid of vegetative cover produce 70-80 percent runoff which forms gullies in the lands immediately below the hills. The rural community suffers in two important ways in this process. One is that the precious rainwater is lost as runoff during these storms. Secondly, this runoff is discharged through a network of gullies, which are deepening and widening. As a result, these lands can not be put to much productive use.

Traditionally, the practice of rainwater harvesting from Aravalis by constructing long embankments at strategic locations was a practice primarily aimed at recharging the wells, which were primary source of drinking water. More recently, number of tube wells has started increasing, resulting in more exploitation of groundwater, and lowering of water table. Fast rate of ground water depletion is putting question mark on sustainability of farm production systems precariously linked to recharge by monsoon rains.

Communities are seriously concerned about the depleting water table and heavy cost involved in shifting of centrifugal pumps to submersible electric motors for exploiting water from lower layers. The only way which appears viable is to go in for (a) large scale *in situ* rainwater conservation by land leveling and bunding and (b) by capturing the runoff from Aravalis in almost all individual gullies by constructing earthen embankments at suitable locations, locally called “paals”. The initiative of the project for land development and construction of paals, therefore, fits very well into the strategy of sustainable development of this area. The additional benefits of the paals are also perceived e.g:

(a) Farmers prefer the location of paals where the boundary of their land ends.

(b) The paals recharge the wells/tubewells located in their close viscinity and centrifugal pumps can be used to extract water rather than submersible motors.

(c) As the silt accumulates in the gullied area above the paals, the land becomes leveled with better moisture regime. As a result, better *kharif* and *rabi* crops can be raised in/around the submergence area.

(d) As the paals completely check the runoff from top of the gully, land below the paals is leveled and put to productive use.

(e) Some of the farmers prefer to raise fodder/fruit trees on the slopes of the paals, thereby using the lands occupied by paal construction for tree fodder, fuel wood and timber.

(f) Lastly, crossing of deep gullies with tractor trollies remain a problem. So earthen embankments across gullies have made access to fields and settlements quite easy.

Monetary benefit from ground water recharge

Rain water harvested by paals contributed to ground water recharge and this was extracted by tubewells for irrigation. Conversion of irrigation water to money terms was carried out by using the charges of Rs 1600 for 7.5 cm irrigation in one hectare, which farmers pay for irrigating their crops. Taking Rs 600 as the cost of pumping of water, the remaining Rs 1000 was taken as the monetary value of one irrigation over one hectare of land. As per the calculations given below, the monetary value of recharged water comes to Rs 5.34 lakh when used for irrigation.

- Ground water recharge by 15 study Paals in last five years

  2006-07 = 3.00 ha.m (Assumed as paals were not gauged)

  2007-08 = 3.84 ha.m

  2008-09 = 8.10 ha.m

  2009-10 = 10.56 ha.m

  2010-11 = 24.05 ha.m

  Total = 49.55 ha.m

- Total recharge in 5 years = 49.55 ha. m
- Average GW recharge/Paal (49.55 % 15 study paals) = 3.33 ha. m
- GW recharge by 30 Paals (30x3.33) = 100.0 ha.m
- Assuming 80 % recharge used for irrigation(100x0.8) = 80.0 ha.m
- No of irrigations made possible with recharged water(80 % 0.075) = 1066

  Value of 1066 irrigations @ Rs 1000 /ha/irrigation = Rs10, 66,000

Paals contributed Rs 10.66 lakh in five years in terms of irrigation water against the total cost of construction of Rs 19.49 lakh. This benefit would continue every year with some variation.Three paals contributed more than what was invested, 5 another yielded more than 50 percent and remaining 10 to 30 percent of the cost of construction.

Economic Analysis of Paal Construction

Cost and benefit streams in Paal construction were worked out for a period of ten years. The discount rate of 10 % was taken. Maintenance cost of 5% in first and 2 % in second year were taken. Benefits in terms of irrigation water were taken for analysis. Benefit stream was worked out by first estimating the rainwater harvested through paals and then applying it in terms of production of mustard. The benefit stream was thus generated for the period of 10 years. Discounting techniques were applied to calculate the present value of benefit and cost. The pay back period and IRR were found out by using graphical methods. **It was found that benefit : cost ration comes to 2.09 and investments are recovered in a period of five years** (Table 8.1 and Fig).

Table 8.1 Cost and benefit streams of Paal construction (Lakh Rs)

Cost Stream

Year	Construction Cost	Maintenance		Total	Discounting Factor @ 10% Interest	Total Cost	Cumula-tive Cost
		1st Year (10%)	2nd Year (20%)		$\sum_{E=1}^{n} \frac{Ct}{1+r^t}$		
2006-07	6.93	0	0	6.93	1.0000	6.93	6.93
2007-08	3.64	0.693	0	4.333	0.9091	3.94	10.87
2008-09	5.10	0.364	0.138	5.602	0.8264	4.63	15.50
2009-10	1.44	0.51	0.0728	2.0228	0.7513	1.52	17.02
2010-11	2.38	0.144	0.102	2.626	0.6830	1.79	18.81
2011-12	0	0.238	0.0288	0.2668	0.6209	0.16	18.97
2012-13	0	0	0.0476	0.0476	0.5645	0.03	19.00
2013-14	0	0	0	0	0.5132	0.00	19.00
2014-15	0	0	0	0	0.4665	0.00	19.00
2015-16	0	0	0	0	0.4241	0.00	19.00
Total	**19.49**	**1.949**	**0.3892**	**21.8282**		**19.00**	**19.00**

Benefit Stream

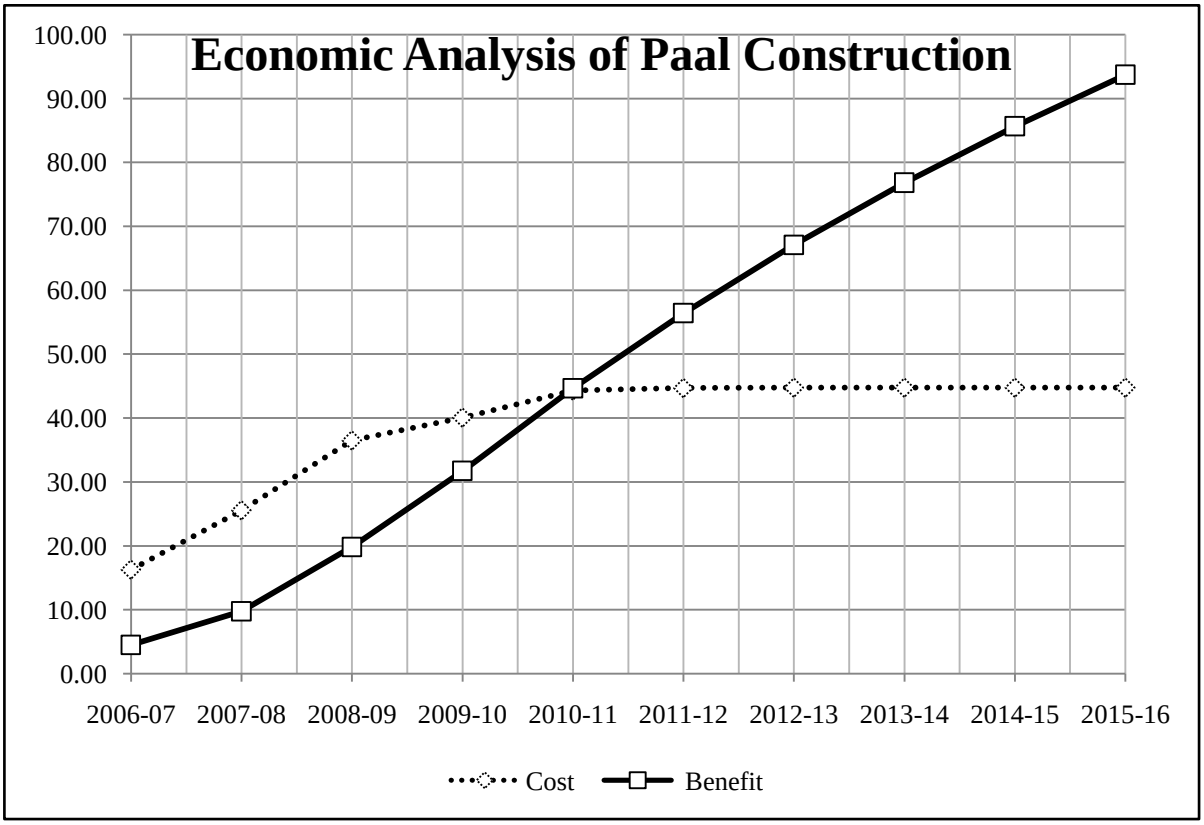
Year	Harvested Water Ham	Recharge @80%	No of Irrigation	Mustard 2 Qtl. @ 3000/Qtl. = Rs 6000	Discounting Factor @ 10% Interest	Future Benefits	Cumulative Benefit
2006-07	3.00	2.4	32	1.92	1.0000	1.92	1.92
2007-08	3.84	3.07	41	2.46	0.9091	2.24	4.16
2008-09	8.10	6.48	86	5.16	0.8264	4.26	8.42
2009-10	10.56	8.45	112	6.72	0.7513	5.05	13.47
2010-11	12.56	10.05	134	8.04	0.6830	5.49	18.96
2011-12	0	0	134	8.04	0.6209	4.99	23.95
2012-13	0	0	134	8.04	0.5645	4.54	28.49
2013-14	0	0	134	8.04	0.5132	4.13	32.62
2014-15	0	0	134	8.04	0.4665	3.75	36.37
2015-16	0	0	134	8.04	0.4241	3.41	39.78

Benefit cost ratio = **39.78% 19.00 = 2.09**

Net present value = **39.78 – 19.00 = Rs 20.78 lakh**

Pay back period = **5 years as per break even curves (See Figure)**

Internal rate of return = **30%**



It is thus seen that the investment made on such systems is highly economical and viable. Moreover, no other system for conservation of moisture in the area is technically feasible in view of the low rainfall received in the area.

8.2 Economic viability of land development

The land development initiatives of the project are perceived by the farmers in a positive sense. The farmers perceived the following benefits.

(i) In the process of land leveling, sand dune type light textured top soil is dumped in the depression and relatively heavy/more retentive soil is spread on the surface, resulting in better texture of the soil, which hold more water and nutrients.

(ii) The fields are divided into blocks separated by large size field bunds/embankments. As a result, rain water is not lost as runoff. Rather it is conserved in soil profile. Field data indicates 3 cm of additional water in top 60 cm soil. This is repeated with each and every rain shower.

(iii) The embankments made around the fields are used for raising fruit/fodder plants, which in due course, not only give additional productive benefits but also serve wind breaks and improve micro-climate.

(iv) The field bunding operations are carried out in a cluster involving 15-20 farmers whose watch and ward problems are shared by the groups and hence, management costs are reduced.

(v) It is also observed that families shift to their developed lands by making temporary huts. When several families shift their place of residence to new area, women then provide lot of assistance in farm operations. Thus, women are empowered and get gainfully employed.

(vi) A single small/poor farmer is unable to install a tube well because of high cost. When, group of farmers have developed their lands, one of them install tube well by arranging loan, and sell water to other group members. Some of the groups have jointly purchased rubber/plastic pipes to carry the scarce water from tubewell to farmlands. This not only reduces capital cost but also results in saving of water.

(vii) Land price registered a quantum jump from 1.5-2.0 lakh to 6-8 lakhs/acre in a period of 2 years after land and infrastructure development.

Economic analysis

Economic analysis of land leveling and plantation was carried out using the same indicators described in the above para. The economic indicators viz. B-C ratio, NPV, PBP and IRR were used for the analysis. The details have been furnished in table 2. The cost and benefit streams were generated for 10 years period which was supposed to generate benefits as a result of the watershed interventions. The discount rate has been taken 10 % matching with the prevailing rates in the market. The capital cost includes cost of leveling and plantation cost for the initial years. The maintenance cost @10 % for first and 2% for the second year were taken. In addition to land leveling, the cost of development of irrigation source was also worked out. Nominal maintenance for rest of the period was provided. The benefits in terms of production both from rewly reclaimed and sloping cultivated land leveled during the project period were worked out from the data collected from 27 Paals. In case of tree plantation, the cost of Aru Neem planted in Gualda was taken and number of trees survived and their market value at the 9^{th} year of harvest was considered (Table 8.2).

Table 8.2 Value of increased production from nearby sloping land leveled thereafter.								PRODUCTION from Newly reclaimed land (Qtls)			INCREASED PRODUCTION from sloping cultivated but levelled land (Qtls)			TOTAL ADDITIONAL PRODUCTION from leved lands (Qtls)		
	Production	Salient Details of Study Paals														
S.N.	Name of Paal	Code	YoC	Cost	Farmers	LR (ha)	VA Lac	W	M	B	W	M	B	W	M	B
1	Muglawali Paal	GDL-WHP-14	2006-07	65969	11	3.50	28.00	50.00	10.50	24.00	35.00	16.00	16.50	85.00	26.50	40.50
2	Sohangahti wali	GDL-WHP-12	2006-07	20538	6	1.30	10.40	15.00	3.30	7.00	0.00	0.00	0.00	15.00	3.30	7.00
3	Musawali Paal	GDL-WHP-13	2006-07	36583	2	0.90	7.20	18.00	0.00	2.80	30.00	14.00	16.00	48.00	14.00	18.80
4	Chamanwali	—	—	5253	2	0.25	2.00	2.00	0.00	1.75	24.00	6.40	9.00	26.00	6.40	10.75
5	Mubin modi Paal	GDL-WHP-	2009-10	—	6	1.90	30.40	30.00	5.25	10.50	25.00	6.75	9.00	55.00	12.00	19.50
6	Loharwali Paal	—	—	33176	2	3.30	39.60	55.00	11.70	17.50	35.00	8.75	15.00	90.00	20.45	32.50
7	Jhudarwali	—	2008-09	—	6	5.00	50.00	68.00	11.20	24.00	32.00	7.00	12.00	100.00	18.20	36.00
8	Patlawali ki Paal	GDL-WHP-46	2009-10	—	5	2.75	22.00	43.75	6.25	14.00	33.00	7.00	10.50	76.75	13.25	24.50
9	Jhalwali Paal	—	—	56598	3	2.40	19.20	34.50	5.85	9.75	55.00	10.00	12.50	89.50	15.85	22.25
10a	Samman swaii Paal	GDL-WHP-7	2006-07	44991	5	2.50	40.00	39.00	0.00	12.00	28.00	5.63	7.50	67.00	5.63	19.50
10b	Samman-Onion	—	—	—	—	—	—	—	—	—	—	—	16.00	—	—	—
11	Chilwali paal	GDL-WHP-1	2006-07	1E+05	2	0.50	4.00	12.00	0.00	1.75	12.00	3.50	3.00	24.00	3.50	4.75
12	Mansarwali Paal	GDL-WHP-2	2006-07	53431	6	0.75	6.00	11.50	1.50	1.75	9.00	1.50	2.50	20.50	3.00	4.25
13a	Khaiwali Paal	GDL-WHP-08	2006-07	35525	7	2.50	30.00	30.00	3.50	7.00	22.00	5.50	8.75	52.00	9.00	15.75
13b	Khaiwali Paal -Ber	—	—	—	—	—	—	—	—	10.00	—	—	—	—	—	—
14	Sotanwali Paal	GDL-WHP-4	2006-07	52507	1	0.25	3.00	5.50	0.00	0.00	11.00	2.00	2.25	16.50	2.00	2.25
15	Chhajanwali Paal	GDL-WHP-3	2006-07	27587	2	0.80	9.60	19.20	0.00	1.75	15.40	2.10	1.50	34.60	2.10	3.25
16	Koliwala johad Paal	GDL-WHP-32	2006-07	53927	3	1.50	24.00	15.75	6.00	3.25	15.40	7.20	8.00	31.15	13.20	11.25
17	Malawali wali	GDL-WHP-10	2006-07	79419	8	3.53	77.50	68.80	8.05	8.50	28.50	8.00	8.75	97.30	16.05	17.25
18a	Karayawali Paal	—	—	1E+05	12	4.80	96.00	100.00	8.00	0.00	55.00	18.00	—	155.00	26.00	0.00
18b	Karayawali -Onion	—	—	—	—	—	—	—	—	—	—	—	10.00	—	—	—
19	Dihiwali Paal	GDL-WHP-6	2006-07	1E+05	7	1.63	39.00	13.00	12.00	13.20	48.00	35.00	36.00	61.00	47.00	49.20
20	Sajhaliwali Paal	GDL-WHP-5	2006-07	21243	8	1.38	33.00	11.50	8.25	6.00	42.00	12.50	35.00	53.50	20.75	41.00
21	Shishamwali	—	—	37542	6	1.25	30.00	11.00	9.75	6.00	40.00	18.00	20.00	51.00	27.75	26.00

22	Mangliwali Paal	GDL-WHP-11	2006-07	20842	6	0.85	17.00	0.00	0.00	5.50	22.00	15.00	6.50	31.00	15.00	12.00
23	Kareerwali	—	—	34270	4	0.75	15.00	0.00	0.00	3.00	11.00	10.50	14.00	19.25	10.50	17.00
24	Phootawali Paal	GDL-WHP-30	2008-09	2E+05	14	4.00	112.00	69.00	12.00	25.00	60.00	24.00	24.00	129.00	36.00	49.00
25	Ghmandiwali Paal	—	—	57956	7	1.75	49.00	23.00	5.25	11.00	33.00	24.00	21.00	56.00	29.25	32.00
26a	Kanjrawali Paal	—	—	30990	5	1.00	12.00	0.00	12.00	55.00	16.50	5.00	15.00	16.50	17.00	70.00
26b	Kanjrawali -Onion	—	—	—	—	—	—	—	—	—	—	—	10.00	—	—	—
27	Johadwali Paal	GDL-WHP-30	2008-09		5	0.75	9.00	0.00	8.25	12.00	11.00	7.00	8.00	11.00	15.25	20.00
	Produce W/M/B	**Total**	**Qtl**	—	**151**	**51.8**	**814.9**	**753.75**	**148.60**	**284.00**	**748.80**	**280.33**	**322.25**	**1502.55**	**428.93**	**606.25**
	Produce Onion	**Total**	**Qtl**	—	—	—	—	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**36.000**	**0.000**	**0.000**	**36.00**
	Produce Barley	**Total**	**Qtl**	—	—	—	—	**0.000**	**0.000**	**10.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**10.00**
	Market Rate	Rupees	—	—	—	—	—	1100.00	2100.0	650.00	1100.00	2100.0	650.00	1100.00	2100.00	650.00
	VALUE W/M/B	(Rupees in Lacs)		—	—	—	—	8.29	3.121	1.846	8.24	5.887	2.095	16.53	9.008	3.941
	Value of Barley	(Rupees in Lacs)		—	—	—	—	0.000	0.000	0.100	0.000	0.000	0.000	0.000	0.100	0.100
	Vaalue of Onion	(Rupees in Lacs)		—	—	—	—	0.000	0.000	0.000	0.000	0.000	0.360	0.000	0.360	0.360
	TOTAL VALUE	**(Rupees in Lacs)**		—	—	—	—	**8.29**	**3.121**	**1.946**	**8.24**	**5.887**	**2.455**	**16.53**	**9.368**	**4.401**
	GRAND TOTAL	**(Rupees in Lacs)**												**GRAND TOTAL**		**30.299**

YOR = Year of Construction; LR = Land reclaimed; VA = Value addition; W = Wheat; M = Mustard; B = Bajra

Table 8.3 : Production and value of straw/ dry fodder obtained from newly reclaimed area around 27 Paals of Gualda village (Rs).

S.N.	Name of Paal	Bajra		Wheat		Mustard	Total Value of dry fodder
		Production (Bundle)	Value @ Rs 10/ bundle	Production (Qtls)	Value @ Rs400/q	Value of straw LS	
1	Muglawali Paal	1200	12000	62.5	25000	6000	43000
2	Sohangahti wali Paal	350	3500	18.75	7500	2200	13200
3	Musawali Paal	140	1400	22.5	9000	0	10400
4	Chamanwala Tila ki Paal	87.5	875	2.5	1000	0	1875
5	Mubin ki modiwali Paal	525	5250	37.5	15000	2800	23050
6	Loharwali modi ki Paal	875	8750	68.75	27500	7200	43450
7	Jhundarawali	1200	12000	85	34000	6400	52400
8	Patlawali Dhani ki Paal	700	7000	54.6875	21875	4000	32875
9	Jhalwali Paal	487.5	4875	43.125	17250	3600	25725
10	Samman swai ki Paal	600	6000	48.75	19500	4000	29500
11	Cheelwali paal	87.5	875	15	6000	0	6875
12	Mansarwali Paal	87.5	875	14.375	5750	1000	7625
13	Khaiwali Paal	350	3500	37.5	15000	2000	20500
14	Sotanwali Paal	0	0	16.8	5750	0	5750
15	Chhajanwali Paal	87.5	875	24	9600	0	10475
16	Koliwala johadki Paal	162.5	1625	19.6875	7875	3000	12500
17	Malawali wali	850	8500	81	32400	4600	45500
18	Kayarawali Paal	0	0	125	50000	3200	53200
19	Dihiwali Paal	660	6600	16.25	6500	4000	17100

S.N.	Name of Paal	Bajra		Wheat		Mustard	Total Value of dry fodder
		Production (Bundle)	Value @ Rs 10/ bundle	Production (Qtls)	Value @ Rs400/q	Value of straw LS	
20	Sajhaliwali Paal	300	3000	14.375	5750	3000	11750
21	Shishamwali Paal	300	3000	13.75	5500	3000	11500
22	Mangliwali Paal	275	2750	0	0	3000	5750
23	Kareelwali Paal	150	1500	0	0	3000	4500
24	Phootawali Paal	1250	12500	86.25	34500	4000	51000
25	Ghamndiwali Paal	550	5500	28.75	11500	3000	20000
26	Kanjarawali Paal	275	2750	0	0	4000	6750
27	Johadwali Paal	300	3000	0	0	3000	6000
	Total	**11850**	**118500**	**936.8**	**373750**	**80000**	**572250**

Table 8.4 Production and value of straw/ farm residues from nearby sloping but cultivated land leveled in the upper and lower area of 27 Paals (Rs).

S. N.	Name of Paal	Code	Year of construction	Bajra				Wheat	Mustard						Total value of fodder (Rs.)
				Production before treatment (Bundle)	Production after treament (Bundle)	Increase (Bundle)	Value	Production before treatment (Bundle)	Production after treament (Bundle)	Increase (Bundle)	Value	Value of produce before treatment	Value of produce after treatment	Value of increased production (Rs.)	
1	Muglawali Paal	GDL-WHP-14	2006-07	1375	2200	825	8250	65.625	109.375	43.75	17500	11200	16000	4800	30550
2	Sohangahti wali	GDL-WHP-12	2006-07	0	0	0	0	0	0	0	0	0	0	0	0
3	Musawali Paal	GDL-WHP-13	2006	1200	2000	800	8000	56.25	93.75	37.5	15000	9800	14000	4200	27200
4	Chamar-wala Tila ki Paal	GDL-WHP-22	2007-08	600	1050	450	4500	45	75	30	12000	4480	6400	1920	18420
5	Mubin ki modiwali paal	GDL-WHP-	2009-10	750	1200	450	4500	46.875	78.125	31.25	12500	4200	6000	1800	18800
6	Loharwali modi ki Paal	BJR-WHP-1	2007-08	1250	2000	750	7500	93.75	137.5	43.75	17500	7000	10000	3000	28000
7	Jhundarawali	UBK-WHP-04	2008-09	1000	1600	600	6000	75	115	40	16000	5600	8000	2400	24400
8	Patlawali Dhani ki Paal	GDL-WHP-46	2009-10	875	1400	525	5250	41.25	82.5	41.25	16500	5600	8000	2400	24150
9	Jhalwali Paal	GDL-WHP-37	20007-08	1250	1875	625	6250	81.25	150	68.75	27500	7000	10000	3000	36750

S. N.	Name of Paal	Code	Year of construction	Bajra				Wheat	Mustard						Total value of fodder (Rs.)
				Production before treatment (Bundle)	Production after treament (Bundle)	Increase (Bundle)	Value	Production before treatment (Bundle)	Production after treament (Bundle)	Increase (Bundle)	Value	Value of produce before treatment	Value of produce after treatment	Value of increased production (Rs.)	
10	Samman swai ki khai ki Paal	GDL-WHP-7	2006-07	750	1125	375	3750	49	84	35	14000	6300	9000	2700	20450
11	Chilwali paal	GDL-WHP-1	2006-07	450	600	150	1500	30	45	15	6000	2800	4000	1200	8700
12	Mansarwa li Paal	GDL-WHP-2	2006-07	250	375	125	1250	18.75	30	11.25	4500	1400	2000	600	6350
13	Khaiwali Paal	GDL-WHP-08	2006-07	687.5	1125	437.5	4375	37.5	65	27.5	11000	4200	6000	1800	17175
14	Sotanwali Paal	GDL-WHP-4	2006-07	225	337.5	112.5	1125	17.5	31.25	13.75	5500	1400	2000	600	7225
15	Chhajanw ali Paal	GDL-WHP-3	2006-07	300	375	75	750	22.75	42	19.25	7700	1680	2400	720	9170
16	Koliwala johadki Paal	GDL-WHP-32	2006-07	600	1000	400	4000	44	63.25	19.25	7700	4480	6400	1920	13620
17	Malawali wali	GDL-WHP-10	2006-07	812.5	1250	437.5	4375	54.375	90	35.625	14250	5600	8000	2400	21025
18	Kayara-wali Paal	GDL-WHP-34	2008-09	0	0	0	0	100	168.75	68.75	27500	8400	12000	3600	31100
19	Dihiwali Paal	GDL-WHP-6	2006-07	2100	3900	1800	18000	60	120	60	24000	14000	20000	6000	48000

S. N.	Name of Paal	Code	Year of construction	Bajra				Wheat	Mustard						Total value of fodder (Rs.)
				Production before treatment (Bundle)	Production after treament (Bundle)	Increase (Bundle)	Value	Production before treatment (Bundle)	Production after treament (Bundle)	Increase (Bundle)	Value	Value of produce before treatment	Value of produce after treatment	Value of increased production (Rs.)	
20	Sajhali-wali Paal	GDL-WHP-5	2006-07	2000	3250	1250	12500	52.5	105	52.5	21000	7000	10000	3000	36500
21	Shishamwali Paal	GDL-WHP-29	2007-08	1200	2600	1400	14000	70	120	50	20000	8400	12000	3600	37600
22	Mangliwali Paal	GDL-WHP-11	2006-07	500	812.5	312.5	3125	32.5	60	27.5	11000	8400	12000	3600	17725
23	Kareelwali Paal	GDL-WHP-28	2007-08	700	1400	700	7000	17.5	31.25	13.75	5500	4200	6000	1800	14300
24	Phootawali Paal	GDL-WHP-30	2008-09	1400	2600	1200	12000	75	150	75	30000	11200	16000	4800	46800
25	Ghamndiwali Paal	GDL-WHP-26	2007-08	1225	2275	1050	10500	45	86.25	41.25	16500	11200	16000	4800	31800
26	Kanjarawali Paal	GDL-WHP-27	2007-08	875	1625	750	7500	20.625	41.25	20.625	8250	2800	4000	1200	16950
27	Johadwali Paal	GDL-WHP-30	2008-09	300	700	400	4000	15	28.75	13.75	5500	2800	4000	1200	10700
	Total		**2008-09**	**22675**	**38675**	**16000**	**160000**	**1267**	**2203**	**936**	**374400**	**161140**	**230200**	**69060**	**603460**

Table 8.5 Crop wise value of straw/dry fodder both from reclaimed and nearby sloping area (Rs)

S.N.	Name of Paal	Value of Bajra Fodder	Value of wheat fodder	Mustard straw	Total
1	Muglawali Paal	20250	42500	10800	73550
2	Sohangahti wali Paal	3500	7500	2200	13200
3	Musawali Paal	9400	24000	4200	37600
4	Chamarwala Tila ki Paal	5375	13000	1920	20295
5	Mubin ki modiwali Paal	9750	27500	4600	41850
6	Loharwali modi ki Paal	16250	45000	10200	71450
7	Jhundarawali	18000	50000	8800	76800
8	Patlawali Dhani ki Paal	12250	38375	6400	57025
9	Jhalwali Paal	11125	44750	6600	62475
10	Samman swai ki Paal	9750	33500	6700	49950
11	Chilwali paal	2375	12000	1200	15575
12	Mansarwali Paal	2125	10250	1600	13975
13	Khaiwali Paal	7875	26000	3800	37675
14	Sotanwali Paal	1125	11250	600	12975
15	Chhajanwali Paal	1625	17300	720	19645
16	Koliwala johadki Paal	5625	15575	4920	26120
17	Malawali wali	12875	46650	7000	66525
18	Kayarawali Paal	0	77500	6800	84300
19	Dihiwali Paal	24600	30500	10000	65100

Table 8.5 Crop wise value of straw/dry fodder both from reclaimed and nearby sloping area (Rs)

S.N.	Name of Paal	Value of Bajra Fodder	Value of wheat fodder	Mustard straw	Total
20	Sajhaliwali Paal	15500	26750	6000	48250
21	Shishamwali Paal	17000	25500	6600	49100
22	Mangliwali Paal	5875	11000	6600	23475
23	Kareelwali Paal	8500	5500	4800	18800
24	Phootawali Paal	24500	64500	8800	97800
25	Ghamndiwali Paal	16000	28000	7800	51800
26	Kanjarawali Paal	10250	8250	5200	23700
27	Johadwali Paal	7000	5500	4200	16700
	Total	**278500**	**748150**	**149060**	**1175710**

Table 8.6 Area wise total monetary returns from straw/dry fodder from newly reclaimed and sloping land levelled

S.N.	Name of Paal	Code	Year of Cons-truction	Reclaimed area	Nearby areas	Total
1	Muglawali Paal	GDL-WHP-14	2006-07	43000	30550	73550
2	Sohangahti wali Paal	GDL-WHP-12	2006-07	13200	0	13200
3	Musawali Paal	GDL-WHP-13	2006	10400	27200	37600
4	Chamarwala Tila ki Paal	GDL-WHP-22	2007-08	1875	18420	20295
5	Mubin ki modiwali Paal	GDL-WHP-	2009-10	23050	18800	41850
6	Loharwali modi ki Paal	BJR-WHP-1	2007-08	43450	28000	71450

7	Jhundarawali	UBK-WHP-04	2008-09	52400	24400	76800
8	Patlawali Dhani ki Paal	GDL-WHP-46	2009-10	32875	24150	57025
9	Jhalwali Paal	GDL-WHP-37	2007-08	25725	36750	62475
10	Samman swai ki khai	GDL-WHP-7	2006-07	29500	20450	49950
11	Chilwali paal	GDL-WHP-1	2006-07	6875	8700	15575
12	Mansarwali Paal	GDL-WHP-2	2006-07	7625	6350	13975
13	Khaiwali Paal	GDL-WHP-08	2006-07	20500	17175	37675
14	Sotanwali Paal	GDL-WHP-4	2006-07	5750	7225	12975
15	Chhajanwali Paal	GDL-WHP-3	2006-07	10475	9170	19645
16	Koliwala johadki Paal	GDL-WHP-32	2006-07	12500	13620	26120
17	Malawali wali	GDL-WHP-10	2006-07	45500	21025	66525
18	Kayarawali Paal	GDL-WHP-34	2008-09	53200	31100	84300
19	Dihiwali Paal	GDL-WHP-6	2006-07	17100	48000	65100
20	Sajhaliwali Paal	GDL-WHP-5	2006-07	11750	36500	48250
21	Shishamwali Paal	GDL-WHP-29	2007-08	11500	37600	49100
22	Mangliwali Paal	GDL-WHP-11	2006-07	5750	17725	23475
23	Kareelwali Paal	GDL-WHP-28	2007-08	4500	14300	18800
24	Phootawali Paal	GDL-WHP-30	2008-09	51000	46800	97800
25	Ghamndiwali Paal	GDL-WHP-26	2007-08	20000	31800	51800
26	Kanjarawali Paal	GDL-WHP-27	2007-08	6750	16950	23700
27	Johadwali Paal	GDL-WHP-30	2008-09	6000	10700	16700
	Total			**572250**	**603460**	**1175710**

Table 8.7 Cost stream of land development (Lakh Rs).

Year	Exp on reclaimed land Area –Pro.Exp.+ Far.ex		Expenditure on						Discoun-ting Factor @ 10%	PROJEC-TIONS	
			sloping land		Tree planting		Maint. 10% + 2%	Total	$\sum_{t=1}^{n} \frac{Ct}{1+r^t}$	Total Cost	Cum. Cost
2006-07	0	0	0		1592	0.32	0	0.32	1.0000	00.320	00.320
2007-08	2.3ha-0.46+0.32	0.78	1 ha	0.15	1395	0.28	0.03 + 0	1.24	0.9091	01.130	01.450
2008-09	6.1ha-1.22+1.00	2.22	9 ha	1.50	1927	0.38	0.12 + 0.006	4.23	0.8264	03.490	04.940
2009-10	29.2ha-5.82+5.07	10.89	16 ha	3.2	0	0	0.41+ 0.024	14.52	0.7512	11.000	15.940
2010-11	14.4ha-2.67+3.13	5.80	12 ha	2.64	1150	0.23	1.41-0.082	10.16	0.6830	06.93	22.870
2011-12	0	0	0	0	0	0	0.87-0.28	1.15	0.6209	0.714	23.580
2012-13	0	0	0	0	0	0	0.2	0.2	0.5645	0.110	23.690
2013-14	0	0	0	0	0	0	0.2	0.2	0.5132	0.100	23.790
2014-15	0	0	0	0	0	0	0.2	0.2	0.4665	0.090	23.880
2015-16	0	0	0	0	0	0	0.2	0.2	0.4241	0.080	23.960
Total	**52ha 10.17+9.52=19.69**		**38 ha**	**7.49**	**6064**	**1.21**	**2.84+1.19 =32.42**			**23.96**	**23.960**

Table 8.8 Cost stream of irrigation resources development

Year	Rec+ slop	Irrigation sources Dev/ha	Irrigation source cost	Disc. factor	Total Irrig cost	Total L.L cost	Grand Total	Cum. Total
2006-07	0	0	0	**0**	0	0.32	0.32	0.32
2007-08	2.3+1=3.2	0.15	0.48+0= 0.64	**1.0000**	**0.64**	1.13	0.72	1.04
2008-09	6.1+9=15.1	0.16	2.42+0.06= 3.36	**0.9091**	**13.05**	3.49	6.54	7.58
2009-10	29.2+16 = 45.2	0.17	7.68+0.33=11.63	**0.8264**	**9.58**	11.00	20.58	28.16
2010-11	14.4+12 = 26.4	0.18	4.75+1.1=8.49	**0.7512**	**6.38**	6.93	13.31	41.47

2011-12	0	0	1.74	**0.6830**	**1.19**	0.71	1.90	43.37
2012-13	0	0	1.0	**0.6209**	**0.62**	0.11	0.73	44.10
2013-14	0	0	1.0	**0.5645**	**0.56**	0.10	0.66	44.76
2014-15	0	0	1.0	**0.5132**	**0.51**	0.09	0.60	45.36
2015-16	0	0	1.0	**0.4665**	**0.40**	0.08	0.54	45.90
2016-17	0	0	1.0	**0.4241**	**0.42**	0.08	0.50	46.40
Total	**52+38=90**		**30.86**		**1.0**		**46.40**	**46.40**

Investment on newly reclaimed land by the project 52 ha = 10.17 lakh

Investment by the farmers on newly reclaimed land 52 ha = 9.52 Lakh

Investment by the farmer on sloping land leveled 38 ha = 7.49 Lakh

Total initial investment on land development on 90 ha = 27.18 Lakh

Cost of planting 6064Aru Neem on bunds and watering; = 1.21 Lakh

hoeing and maintenance@ Rs20/Plant over 90 ha land

Maintenance cost for ten years = 4.03 Lakh

Cost of installation of tubewell, engine, pipes and maintenance for 10 years = 30.86 Lakh

Total cost on land development including irrigation source = 63.28 Lakh or Rs 70,000/ha

Table 8.9 Benefit stream of land development

Year	Net gain from reclaimed land	Net gain from sloping land	Total Gain	Gain from trees	Grand total of gains	Discounting Factor @ 10%	Discounted Total gains	Discounted Cumulative Gains
	Rs.	Rs.	Rs.	Rs.	Rs.	%	Rs. in lakh	Rs. in lakh
2006-07	—	—	—	—	—	—	—	—
2007-08	5950	8900	14850	—	14850	1.00	0.15	0.15
2008-09	33430	119835	153265	—	153265	0.9091	1.39	1.54
2009-10	231320	366960	598280	11740	610020	0.8241	5.03	6.57
2010-11	777261	1443844	2221105	11740	2232845	0.7512	16.77	23.34
2011-12	912500	1443844	2356344	23480	2379824	0.6830	16.25	39.59
2012-13	912500	1443844	2356344	11740	2368084	0.6209	14.70	54.29
2013-14	912500	1443844	2356344	11740	2368084	0.5645	13.37	67.66
2014-15	912500	1443844	2356344	23480	2379824	0.5132	12.21	79.87

2015-16	912500	1443844	2356344	700000	3056344	0.4665	14.24	94.11
2016-17	912500	1443844	2356344	—	2356344	0.4241	9.99	104.10
Total								

Rupees in lakh

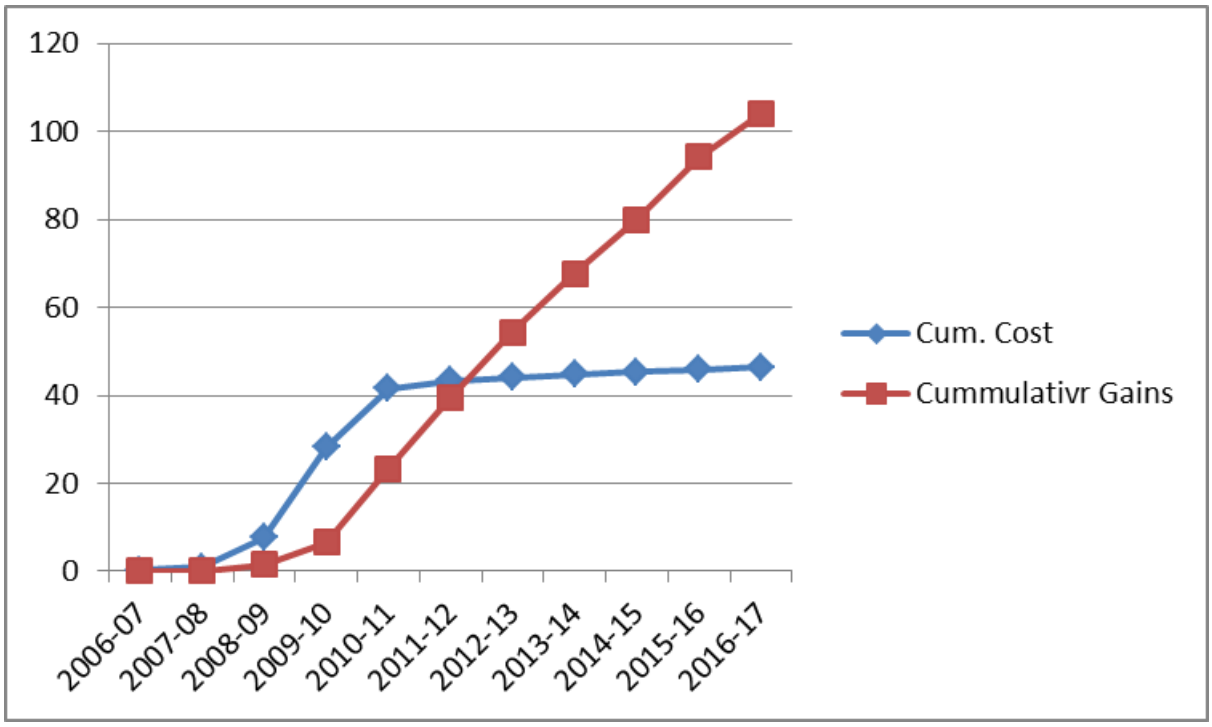
Benefit cost ratio 104.10/46.40 = 2.240

Net Present Worth 104.10-46.4 = 57.70

Internal Rate of return = 28%, Pay back period = 6 years

The B-C ratio comes to 2.24, the net present worth is Rs 57.70 lakh, IRR as 28%, and pay back period comes to 6 years. It means, investment made on land leveling and plantation would be returned back in a short period of 6 years. Thus, the land development and plantation activities in such area have proved to be highly beneficial in monetary terms.

Break even curve for land development



Data on increase in value of fodder was collected from 15 families and noted that in the year 2009-10, the total gain was worth Rs 88780 thus benefitting each family to the tune of Rs 5912/ year (Table 8.10).

Table 8.10. Increased value of fodder and straw from the developed land of 15 sampled farming families.

S. N.	Year of levelling	Name of beneficiary	Increased value of fodder and straw (Rs.)			
			Bajra	Wheat	Mustard	Total
1	2008-09	Iliyas, Nisar, Kala	3500	3920	1680	9100
2	2007-08	Attaulla, Habib, Lukaman, Salman, abdul, Rahman, Suleman	3000	1316	564	4880
3	2007-08	Lukaman, Habib, Rahman, Hifjurahman	3000	2100	900	6000
4	2007-08	Habib, Rahman	1750	700	300	2750
5	2007-08	Habib, Rahman	0	350	150	500
6	2006-07	Basir khan	3500	2240	960	6700
7	2007-08	Hakam, Ashmohamd	3500	5600	2400	11500
8	2007-08	Jamil, Kallu, Jamshed	3000	8400	3600	15000
9	2008-09	Mahmud	3750	4200	1800	9750
10	2008-09	Fajru	2000	1120	480	3600
11	2008-09	Hakam, Ashmohamd	2000	700	300	3000
12	2007-08	Lalluram	2500	0	0	2500
13	2008-09	Isaq	2500	2100	900	5500
14	2008-09	Harfool	2500	1400	600	4500
15	2007-08	Basir	2500	700	300	3500
	Total		**39000**	**34846**	**14934**	**88780**

8.3 Economic viability of crop production

Soils in Aravalis are light textured and poor in fertility and productivity. Moreover, low and scanty rainfall further increases the problem. One rainfed *rabi* crop fails out of every 3 years. Farmers of the region hesitate to apply balanced fertilizers due to risk of crop failure. Farming has become gamble in this region. Yields of traditional crops are low and it is difficult for farmers to lead a comfortable life. Vegetable production could become the profession of benefit, as the region is situated near New Delhi Capital Region, but more diversification of area under vegetable production creates the problem of over exploitation of ground water.

Efforts were made to improve farmers' profits by introducing improved variety seeds and applying complete package of practices. Bajra, guar, mustard, wheat demonstrations were laid for two years.

Economic analysis of wheat cultivation

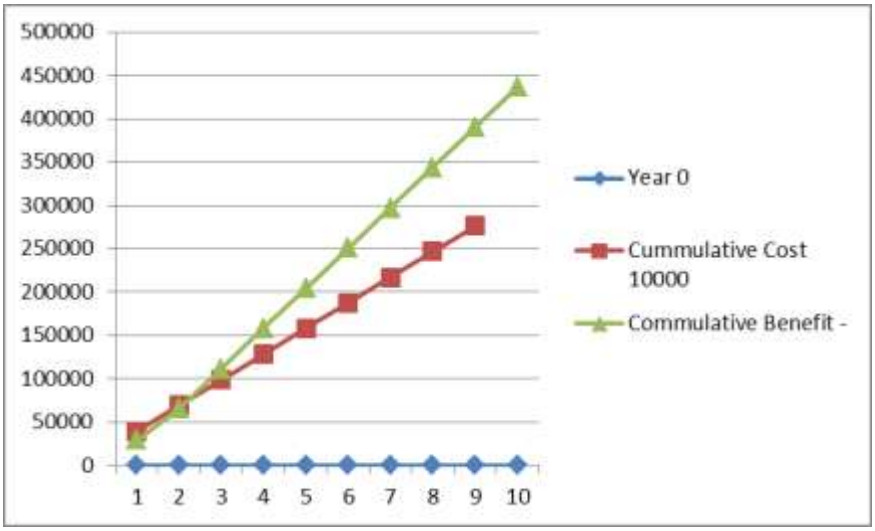
Cost benefit analysis based on two years results are presented as table 8.11. Input cost involved in demonstrations was considered as capital cost and returns as benefits.

Table 8.11. Economic analysis of wheat crop improvement (Rs)

Year	Capital cost	Present value Lakh Rs			BENEFITS			
		At 10% discount	TOTAL cost	Cummulative Cost	Projected Benefit	Discount Factor	Total Benefit	Commulative Benefit
0	10000		10000	10000	0	-	-	-
1	29600	1.00	29600.00	39600	29500	1.00	29500.00	29500.00
2	32560	0.9091	29600.30	69200.30	39212	0.9091	35647.63	65147.63
3	35816	0.8241	29515.97	98716.27	56200	0.8241	46314.42	111462.05
4	39397	0.7512	29595.03	128311.30	61820	0.7512	46439.18	157901.23
5	43336	0.6830	29598.49	157909.79	68002	0.6830	46445.37	204346.60
6	47669	0.6209	29597.68	187507.47	74800	0.6206	46420.88	250767.48
7	52435	0.5645	29599.56	217107.03	82282	0.5645	46448.19	297215.67
8	57678	0.5132	29600.35	246707.38	90510	0.5132	46449.73	343665.40
9	63445	0.4665	29597.09	276304.47	99561	0.4665	46445.21	390110.61
10	69789	0.6241	43555.31	319859.78	109520	0.4241	46447.43	436558.04
		TOTAL	**319859.78**	**319859.78**		**TOTAL**	**436558.04**	**436558.04**

B: C Ratio=436558 / 319859 = 1.365 **Net Present Value** = 436558-319859 = 116699

Cultivation of wheat crop on reclaimed land provided benefit: cost ratio of 1.3 and pay back period is two years (Figure).



Break even curve for wheat cultivation

This shows that if crops are raised scientifically, farmers can earn reasonably good profit.

Recovery of crop yields after land leveling

It was noted that when sloping land was leveled, the yield of the following crop decreased but with the addition of manure and fertilizer and rainwater conservation it again started rising during second and stabilized by the third year (Table 8.12).

Table 8.12 : Improvement in crop yield from sloping lands after land leveling and manuring in the area of selected Paals.

Name of Paal	Crop Yield (q / ha)				Increase (+)or decrease (-) in yield (%)
Wheat	**2006**	**2007**	**2008**	**2009**	
Luhar wali	24.00	20.00	26.25	33.50	+39.58
Malha wali	24.50	21.00	26.75	34.00	+38.77
Shisham wali	23.50	20.50	29.00	33.00	+40.42
Sotan wali	24.00	19.50	27.50	33.50	+39.58
Luhar wali	24.00	20.25	28.75	34.50	+38.00
Futa wali	25.00	24.00	21.75	28.00	+16.66
Kayra wali	-	24.75	20.25	27.50	+11.11
Mansar wali	-	-	25.00	22.00	-12.00
Sahadra wali	-	-	24.25	20.00	-17.52
Mustard					
Luhar wali	12.00	8.75	12.50	16.25	+35.41
Malha wali	12.25	9.50	12.00	16.00	+30.61
Shisham wali	11.75	8.50	13.00	16.50	+36.17
Sotan wali	12.25	9.00	13.50	16.50	+37.69
Luhar wali	12.00	9.25	13.00	16.00	+33.33
Futa wali	-	12.50	9.75	13.75	+10.00
Kayra wali	-	12.25	10.00	14.25	+16.32
Mansar wali	-	-	12.00	9.50	-20.83
Sahadra wali	-	-	12.50	9.75	-22.00
Barley					
Luhar wali	22.05	18.75	25.00	32.00	+42.20
Malha wali	22.00	18.25	24.00	30.75	+47.77
Shisham wali	23.00	20.00	27.25	33.50	+45.65
Sotan wali	23.50	20.75	26.75	33.00	+41.30
Luhar wali	24.00	20.00	25.25	32.75	+36.45
Futa wali	-	23.25	20.00	25.50	+9.67
Kayra wali	-	23.75	19.00	25.00	+6.26
Mansar wali	-	-	23.00	19.25	-16.30
Sahadra wali	-	-	23.50	20.00	-14.89

In a period of three years, crop yields increased by 30 to 40 percent over the original crop yields.The trend are shown in the figure given below.

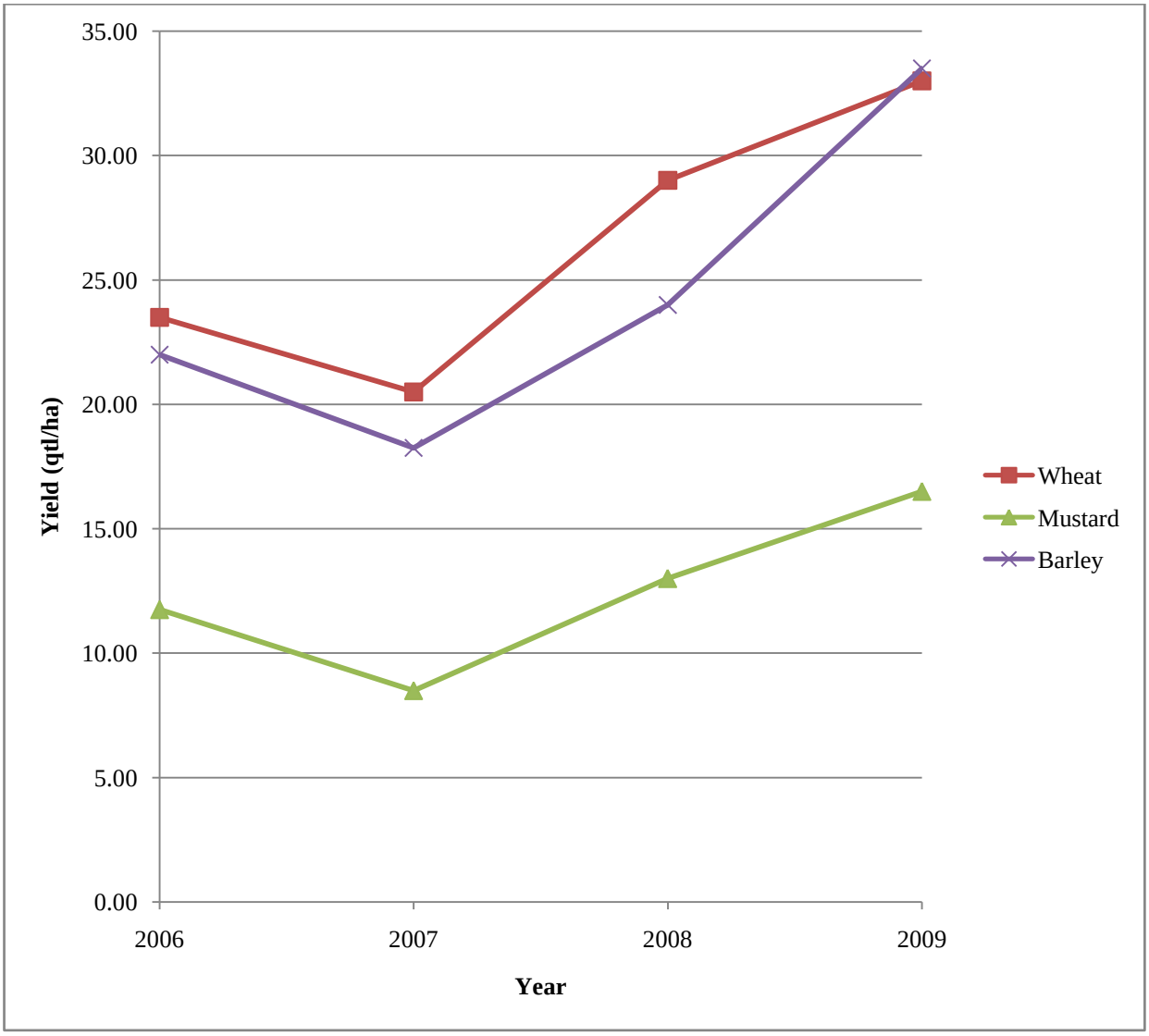


Fig: Trend in crop yield reduction after land leveling and rise thereafter

Crop of wheat on reclaimed land earlier infested with gullies

Bumper crop of mustard on reclained land

Farmers practice v/s improved package of mustard

8.4 Economic viability of fruit plants

As such, the plantations recorded a very low survival percentage. For economic analysis, the cost involved in plantation and subsequent maintenance cost of survived plants for a period of 10 years since planting was considered in cost stream. In case of benefit stream, it was assumed that some fruit bearing starts from third year and keep on increasing in subsequent years and a period upto 10^{th} year was considered. Though fruit plants would have some variation in yield and price but we assumed same yield and price of main fruit plant species of citrus, amla, ber and guava for benefit stream. The result of analysis is as under.

The benefit: cost ratio of fruit plants = 24.15 %14.90 = 1.62

The net present worth = 24.15 -14.90 = 9.25 Lakh

Internal rate of return = 21.2 %

The pay back period = 10 years (See break even curves)

Table 8.13: Cost stream of fruit plants

Year		No of fruit plants planted	Cost of planting Rs/ plant	Cost of hoeing weeding watering	Total initial cost/ plant 0 year	Total cost in 0 year	Plants survived	No of plants maintained over 10 Yers										Total	Mainte-nance cost for 10year / plant	Total mainte-nance cost	G.Total of cost Rs.	Discount factor @10% interest	Discoun-ted yearly costs Rs. In lack	Discounted cumulative costs Rs. In lack
								1 Yr	2 Yr	3 Yr	4 Yr	5 Yr	6 Yr	7 Yr	8 Yr	9 Yr	10 Yr							
0	2006	3074	20	15	35	107590	619														107590	1.00	1.07	1.07
1	2007	2661	22	18	40	106440	676	619										619	60	37140	143580	0.909	1.30	2.37
2	2008	3626	24	21	45	163170	256	676	619									1295	70	90650	253820	0.8264	2.09	4.46
3	2009	0	26	24	50	0	0	256	676	619								1551	80	124080	124080	0.7513	0.93	5.39
4	2010	786	28	27	55	43230	483	0	256	676	619							1551	90	139590	182820	0.6830	1.25	6.64
5	2011	0						483	0	256	676	619						2034	100	203400	203400	0.6209	1.26	7.90
6	2012	0							483	0	256	676	619					2034	110	223740	223740	0.5645	1.26	9.16
7	2013	0								483	0	256	676	619				2034	120	244080	244080	0.5132	1.25	10.41
8	2014	0									483	0	256	676	619			2034	125	254250	254250	0.4665	1.19	11.60
9	2015	0										483	0	256	676	619		2034	125	254250	254250	0.4241	1.08	12.68
10	2016	0											483	0	256	676	619	2034	125	254250	254250	0.3855	0.98	13.66
11	2017	0												483	0	256	676	1415	125	176875	176875	0.3505	0.62	14.28
12	2018	0													483	0	256	739	125	92375	92375	0.3186	0.29	14.57
13	2019	0														483	0	483	125	60375	60375	0.2897	0.17	14.74
14	2020	0															483	483	125	60375	60375	0.2633	0.16	14.90
																						TOTAL	**14.90**	**14.90**

Table 8.14 : Benefit stream of fruit plants

Years		Survived plants	Production of fruit plant Kg	Value @ Rs 8/Kg	Discount Factor	Projected returns	Projected cumulative returns
0	2006	-	-	-	1.00	0.00	0.00
1	2007	619	-	-	0.9091	0.00	0.00
2	2008	1295	-	-	0.8264	0.00	0.00
3	2009	1551	2	24816	0.7513	0.19	0.19
4	2010	1551	10	124080	0.6830	0.85	1.04
5	2011	2034	15	244080	0.6209	1.51	2.55
6	2012	2034	20	325440	0.5645	1.84	4.39
7	2013	2034	30	488160	0.5132	2.51	6.90
8	2014	2034	40	650880	0.4665	3.04	9.94
9	2015	2034	40	650880	0.4241	2.76	12.70
10	2016	2034	40	650880	0.3855	2.51	15.21
11	2017	2034	40	650880	0.3505	2.28	17.49
12	2018	2034	40	650880	0.3186	2.07	19.56
13	2019	2034	40	650880	0.2897	1.88	21.44
14	2020	2034	40	650880	0.2633	1.71	24.15

Benefit: cost ratio = 24.15%14.90 = 1.62
Net Present Value = 24.15 -14.90 = 9.25
Pay back period = 10 years
Internal rate of return = 21.1 %

Fig. Cost : benefit stream of fruit cultivation

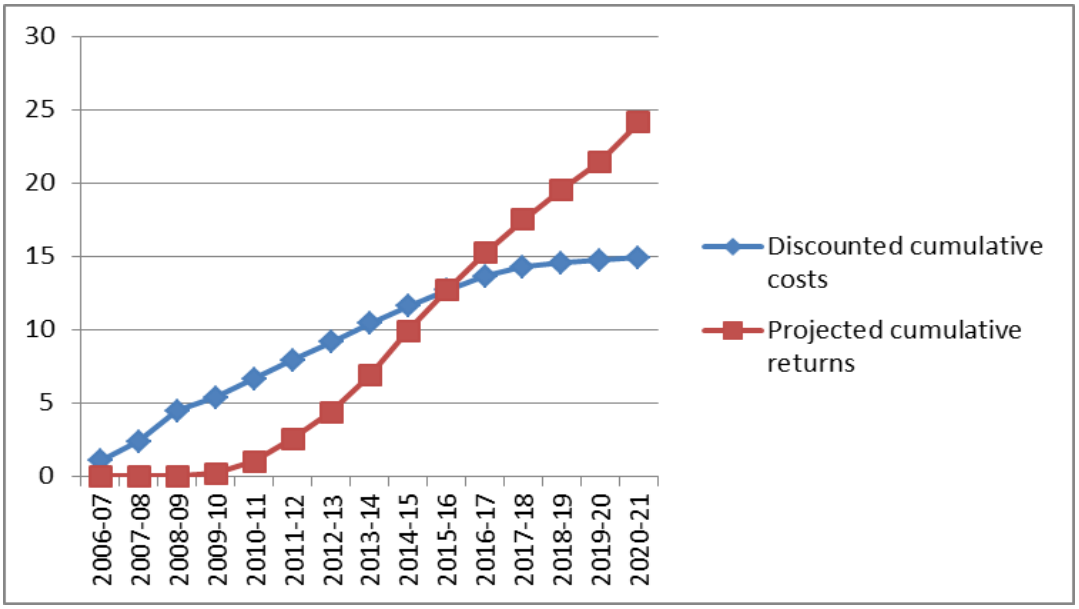


Table 8.15 : Cost stream of Aruneem (Rs)

Year		No of forest plants planted	Cost of planting Rs/ plant	Cost of hoeing weeding watering	Total initial cost/ plant in 0 year	Total cost	Plants surv-ived	No of plants for maintenance over 10 Yers										Total	Mainte-nance rate/ plant	Total amount	Initial mainte nance	Discount factor	Total yearly cost	Cumulative cost
								1 Yr	2 Yr	3 Yr	4 Yr	5 Yr	6 Yr	7 Yr	8 Yr	9 Yr	10 Yr							
0	2006	1592	7	10	17	27064	459														27064	3.79	102573	102573
1	2007	1395	8	12	20	27900	365	459										459	10	4590	32490	3.45	112091	214663
2	2008	1927	9	14	23	44321	145	365	459									824	11	9064	53385	3.13	167095	381758
3	2009	0	10	16	26	0	0	145	365	459								969	12	11628	11628	2.85	33140	414898
4	2010	1150	11	18	29	33350	205	0	145	365	459							969	13	12597	45947	2.59	119003	533901
5	2011	0						205	0	145	365	459						1174	14	16436	16436	2.35	38625	572525
6	2012	0							205	0	145	365	459					1174	15	17610	17610	2.14	37685	610211
7	2013	0								205	0	145	365	459				1174	16	18784	18784	1.94	36441	646652
8	2014	0									205	0	145	365	459			1174	17	19958	19958	1.77	35326	681977
9	2015	0										205	0	145	365	459		1174	18	21132	21132	1.61	34023	716000
10	2016	0											205	0	145	365	459	1174	19	22306	22306	1.46	32567	748567
11	2017	0												205	0	145	365	715	20	14300	14300	1.33	19019	767586
12	2018	0													205	0	145	350	21	7350	7350	1.21	8894	776479
13	2019	0														205	0	205	22	4510	4510	1.1	4961	781440
14	2020	0															205	205	23	4715	4715	1.00	4715	786155

Table 8.16 : Benefit stream of Aruneem

Years		Surviving plant	Matured plant	Green fooder	Fuel wood	Total	Harvested wood	Wood value	Total value of wood	Grand Total	Discount factor	Total yearly benefit	Cumulative benefit
0	2006	0	0	0	0	0	0	0	0	0	1.00	0	0
1	2007	459	0	0	0	0	0	0	0	0	0.9091	0	0
2	2008	824	0	0	0	0	0	0	0	0	0.8264	0	0
3	2009	969	0	0	0	0	0	0	0	0	0.7513	0	0
4	2010	969	459	10	0	4590	0	0	0	4590	0.6830	0.3130	0.0313
5	2011	1174	824	10	10	16480	0	0	0	16480	0.6209	0.1023	0.1336
6	2012	1174	969	10	0	9690	0	0	0	9690	0.5645	0.0547	0.1883
7	2013	1174	1174	10	10	23480	0	0	0	23480	0.5132	0.1208	0.3088
8	2014	1174	1174	10	0	11740	0	0	0	11740	0.4665	0.0547	0.3635
9	2015	1174	1174	10	10	23480	0	0	0	23480	0.4241	0.0996	0.4631
10	2016	1174	1174	10	50	70440	459	800	367200	437640	0.3855	1.6871	2.1502
11	2017	715	715	10	50	42900	365	800	292000	334900	0.3505	1.1738	3.3240
12	2018	350	350	10	50	21000	145	800	116000	137000	0.3186	0.4355	3.7605
13	2019	205	205	10	0	2050	0	0	0	2050	0.2897	0.0058	3.7663
14	2020	205	205	10	50	12300	205	800	164000	176300	0.2633	0.4642	4.2305

B/C Ratio = 2.04 **NPR = Rs. 2.16 Lakh @10%** **PBP = 11 Years**
IRR = 22.4%

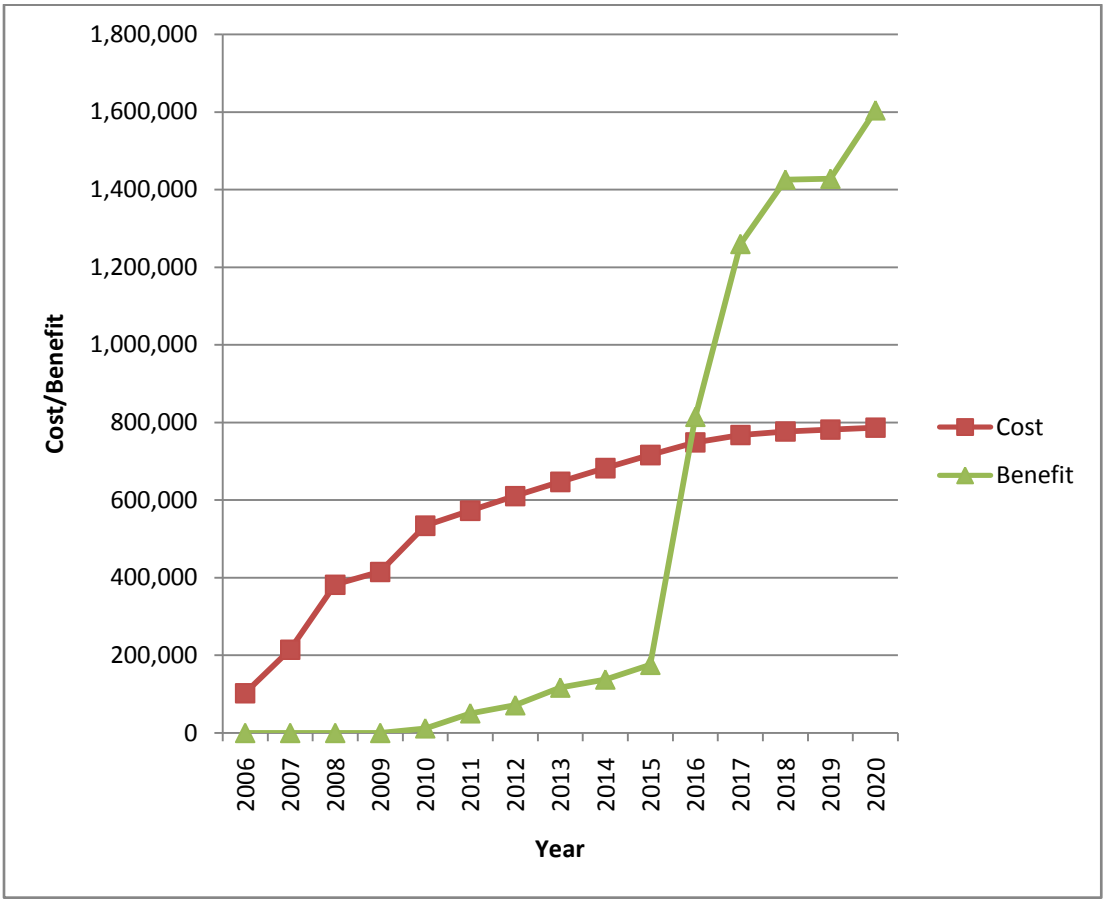
*** Green leaf fooder worth Rs 10/plant at fourth year**

*** Some sticks as fuel wood in 5th, 7th, 9th year worth Rs 10/plant**

*** Trees would be harvested at 10th year and provide green fooder worth Rs 10/plant**

*** Fuel wood worth Rs 50/plant and timber worth Rs 800/plant**

Fig. Cost and benefit streams of Aruneem cultivation



8.5 Economic viability of forest plants

In case of forest/fodder plants, the choice of species was such that almost half of the species were either totally eliminated and gave extremely low survival. Aruneem, Shisham and bakain/drake gave survival percentage of 19, 24, and 17 percent respectively. Finding not much difference in the cost and benefit streams of these tree species, the Aruneem was taken as a test case for economic analysis. It was noted that out of 6064 saplings planted; only 1174 survived which sere harvested at 10 years of age. The cost of establishment varied from Rs 17 to 29 per plant over the years. The plants were maintained for 10 years and harvested thereafter. The value of green fodder and fuefood was taken as Rs 10/plant when this was available. The cost of wood was taken as Rs 800/ plan. The cost and benefit streams are given in table 8.15 and 8.16.

The benefit: cost ratio was 16.04% 7.86 =2.04

The net present worth is zero as trees were harvested at ten years of age.

The pay back period is 10 years.

A unique example of Aruneem on slopes of Paal

In Mugalwali Paal of Gualda, a family took up the responsibility of maintenance of 400 plants plantes on both the slopes of the embankment. Incidentally, the Paal was constructed in their private land and fields both on upstream and downstream of Paal were owned by them. Small trenches made to raise the plants were irrigated during summer months of first two years. They had leveled the land and installed a tubewell. In the interview, this family informed that

they own 327 Aruneem plants which are source of green fodder and also provide some fuelwood from prunnings. This family is of the firm view that Aruneem plants have protected the side slopes of the Paal. After two years, this family is planning to sell 70 to 80 plants every year for four years and would earn Rs 50 to 60 thousand every year. This example is worth replication in other Paals also.

Plantation of Aruneem on both slopes of Mugal wali Paal in Gualda village. The land owner protected the plants and is the proud owner of 327 plants.

The family is satisfied with fuel and fodder received from the Aruneem.

Assessment of Social Development Initiatives

Chapter - 9

Includes :-

- ★ Assessment of self help groups
- ★ Assessment of Water Users' Groups

Chaptar 9

Assessment of Social Development Initiatives

9.1 Assessment of self help groups

Formation of Self Helf Groups (SHG) of women under the name Mahela Bachat Samits (MBS) and Water User Groups are only two types of community organizations promoted to achieve the objectives of the Project.Though large number of MBS has been formed under the project but in village Gualda only one MBS under the name Noor Nisha is functional.Some observations made during interaction with MBS members are presented below.

- All members are not attending meetings regularly but most of them attend.
- Group remained defunct for more than four months because no official visited group.
- Members are doing inter loaning and repaying their loan at pre-decided time.

The capability assessment of this MBS was attempted on the basis of nine commonly used indicators. Overall capability of the group was assessed by calculating scores (Good-1, average 0.5 and weak 0). The group scoring grade <4 was given capability score weak, 4-6-average and >6-good. This group scored 5 marks and rated as average (Table 9.1).

Table 9.1. Capability assessment of womenof Mahila Bachat Samitis of Gualda village

S.No.	Indicator	Noor Nisha, Gualda
1	Organizational capacity	Good
2	Savings & credits	Good
3	Financial management	Average
4	Awareness & attitudes	Average
5	Empowerment & influence	Average
6	Skills development	Weak
7	Micro-enterprises	Average
8	Networking & linkages	Weak
9	Plans & visions	Good
Overall capability scores out of 10		**5**
Overall capability rating		**Average**

This group was constituted on 17.04.07 and in a period of three years, it held 33 meetings and their net saving was Rs 4990. This self-help group is good in organizational capacity and savings. Most members attend the meetings regularly, contribute money, and obey the rules of the groups. There is also transparency in loan and income. All the needy members are offered money on interest basis. Members have saved money by means of weekly contribution and interest on loan. But group is weak in skill development, net-working, and linkages.

There are problems in the long term sustainability of this MBS. The group could not move beyond interloaning and this is the case with other similar MBSs. The loans were taken for treatment of sick members of the family, purchase of farm inputs, house repairs, social ceremonies, and purchase of animal. The members have developed a sense of economic security as they can get money in any emergent situation. The external motivating support has been lacking and group is again on the verge of collapse.The linkages with the Banks could not be established.

9.2 Assessment of Water Users' Groups

Water Users' Groups were organized to carry out Paal construction and land development activities. The groups so constituted are basically an association of farmers in a cluster of land where Paal construction and land development activities are planned. The group passes a resolution of doing project work in the villages. The works are carried out under the supervision of group members. Payments are made to the groups on getting the interventions satisfactorily completed. Participation of water users' groups and watershed committees was

ensured by carrying out construction work through socities. Tractors as well as labours were hired and payments were made by watershed committees. However, SST team extended technical support. Information on funds allotted to various water users' groups was collected from SST record and verified from account register of water user groups and given in table 9.2.

Table 9.2. Detail of funds allocated and works done by water users' groups

S.No.	Water Users' Group	Funds allocated Rs	Works done
1	Bismila Phal and sabji Utapadak Samiti	1,99,138	1. Renovation of pond 2. Construction of paals 3. Two check dams
2	Jagriti Phal and Sabaji Utapadak Samiti	70,629	1. Field bunding 2. Paal construction
3	Nabia Karim Phal Utpadak Samiti	77,022	1. Paal construction 2. Field bunding 3. Contour bunding 4. Land leveling 5. Plantation
4	Shuruwat Phal utpadak Samiti	5,89,005	1. Paal construction 2. Provided pipeset

The members of watershed committees were interviewed and their records were checked. Summary is presented in table 9.3.

Table 9.3. Details of watershed committees in Gualda village

Name	Date of constitution	No. of members	No. of meetings	Saving in account	No. of microplan implemented
Nabia Karim	20.05.06	8	48	645	12
Jagriti	21.07.06	8	42	1007	15
Bismillah	08.07.07	9	19	1000	6

The watershed committees are participating well in project intervention. Activities are undertaken after getting micro- plans from the respective committees and works are either done or tendered by the watershed committees. They call monthly meetings or as and when proposal is to be passed. The members of the committee are not very clear about sustainability and do not have future plans on consolidation.

Assessment of Socio- economic development

Chapter - 10

Includes :-

- ★ Assets created
- ★ Changes in livestock assets
- ★ Employment generation
- ★ Improvement in girl education

Chapter 10

Assessment of Socio- economic development

As the income from crops and livestock increases, it is important to know how the additional money generated is invested. In case the investments are made on economically viable options, the chances of socio-economic development improve. Data collected from 32 sampled families on assets created produced very interesting results.

10.1 Assets created

The investment made after the project interventions on nine activities taken as indicators of socio-economic development are given in table 10.1

Table 10.1: Investments made by sampled families on economic activities

S.No	Type of assets created	No of families	Investment made (Lakhs)
1	Renovation/construction of house	8	7.05
2	Purchase of tractors	6	22.99
3	Installation of tube -wells	8	6.85
4	Purchase of new motor bikes	8	3.2
5	Purchase of Jeep/van	1	4.5
6	Purchase of Land (bigha)	1	3
7	Purchase of Chaff cutter	2	0.06
8	Purchase of Engine	1	0.25
9	Purchase of Bicycle	1	0.03
	Total	**36**	**47.93**

A sum of Rs 47.93 lakh was invested by 32 families @ Rs 1.5 lakh each on most useful activities. Almost half the amount was invested in the purchase of 6 tractors which are being used for custom hiring in the village. A van was purchased to carry milk to the market. Eight new tubewells were installed to augment farm income.

10.2 Changes in livestock assets

Livestock is the second most important asset of the community after land. Discerneable change was noted in favour of buffalo by replacing cows and goats (Table 10.2).

Table 10.2 Changes in livestock assets of sampled families of Gualda village*

Type of livestock	No before in 2006	No after in 2010	Local price Rs	Total value before	Total value after
Cows	250	133	5000	1250000	665000
Goats	166	85	3000	498000	255000
Buffaloes	31	77	30000	930000	2310000
Camel	1	0	10000	10000	0
Total	448	295		2688000	3230000

* Data of 32 sampled families

The total value of the livestock at market rates increased from Rs 26.88 lakh to Rs 32.30 lakh thus registering an increase of 20 percent. But more impotant is that cows and goats denuding the forest cover have been decreased and number of stall- fed buffaloes has been increased. The general response of the community was that there is not much left for grazing in the forest area.The wastelands earlier used for grazing animal have been mostly leveled. The boys and girls who used to take animal for grazing now go to school. Since fodder supplies have improved, it is more economical to keep buffaloes as stall-fed and sell milk daily to generate ready cash.

House to house survey of15 families selected randomly out of 151 beneficiary families indicated that these families owned 189 bigha of land out of which 130 bigha was leveled under the project (Table 10.3).

Table 10.3 : Assets created by 15 sampled families after project implementation

Name of Farmer	Father's name	Family members	Type of house	Land holding	Land level	Irrigation source	School going children before	School going children after	Assets before	Assets after	Value of created assets	Animal before treatment				Animals after treatment			Difference in value of animals (Rs.)
												Cow	Goat	Buffalo	Camel	Cow	Goat	Buffalo	
Arashad	Ch. Iliyas	8	Pucca	15	8	well	0	2	motorcycle	Motor cycle	40000	15	16	2		5	2	5	108700
Chhanga		9	Kuchcha &Pucca	10	6	well	1	3	no major asset	Tube well	50000	10	8	1		2	0	2	20600
Tahir	Fazru	7	Kuchcha &Pucca	15	5	well	0	2		TV, Bike	45000	17	5	1		2	0	5	91500
Azad	Fazru	9	Kuchcha &Pucca	10	7	Tube well	1	0	motorcycle	No	0	10	8	2		2	0	3	40600
Rudar	Wajirkhan	9	Pucca	15	15	well	1	3		no	0	15	7	1		3	3	2	29900
Habib	Attulla	8	Pucca	10	8	Tube well	1	3	motorcycle	Pucca house, tube well	150000	20	15	5		4	0	10	193000
Abdul	Mugli	11	Kuchcha &Pucca	5	5	Tube well	1	2		Pucca house, tube well	130000	14	18	1		3	8	3	68600
Bilal	Mugli	12	Kuchcha &Pucca	5	5	Tube well	1	3	motorcycle	One pucca room, Tractor	425000	5	20	0		0	5	3	61500
Hanif	Isab	12	kuchcha &Pucca	15	10	Tube well	2	4	Tractor	Tube well	60000	10	8	1		2	0	4	80600

Name of Farmer	Father's name	Family members	Type of house	Land holding	Land level	Irrigation source	School going children before	School going children after	Assets before	Assets after	Value of created assets	Animal before treatment				Animals after treatment			Difference in value of animals (Rs.)
												Cow	Goat	Buffalo	Camel	Cow	Goat	Buffalo	
Ishan	Jomkhan	9	Kuchcha &Pucca	2	2	well	1	2		Motorcycle	40000	10	15	0	2	4	2	4	68000
Haqam	Sherkhan	9	Pucca	10	10	well	4	7		Jeep	450000	5	2	1	0	3	1	3	93900
Aash Mohmad	Sherkhan	12	Pucca	12	12	well	6	10	Motor cycle	Pucca house added	75000	5	5	1	0	0	0	2	23500
Iliyas	Asraf	10	Pucca	30	15	Tube well	2	4		Tube well	55000	15	13	2	0	0	0	7	114100
Mubin		12	Kuchcha & Pucca	20	10	Tube well	5	8	no major asset	Tube well	70000	135	50	2	0	55	25	6	272500
Noor Hasan	Isab	8	Pucca	15	12	Tube well	1	0	no major asset	tractor	400000	9	7	2	0	0	0	3	25900
Total				**189**	**130**		**27**	**53**			**1990000**	**295**	**197**	**22**	**2**	**85**	**46**	**62**	**1292900**

These families were sending 27 children to school before the project but are now sending 53 children to school after the project. The family assets created after the project was valued at Rs 19.9 Lakhs. In addition, they replaced cows and goats with buffaloes and value of livestock assets (*Pashu Dhan*) increased by Rs 12.93 Lakhs. Roughly, the combined value of assets generated was Rs 33 Lakh or Rs 2.2 Lakh per family in the last four years.


Woman milking the good breed of buffalo

10.3 Employment generation

Development works in the project were carried out by farmers by means of physical labor and tractors. Stakeholders contributed 30 % share of the investment made in project. Activity wise payment paid during the year 2006-07 & 2007-08 was taken from PRADAN record and man days were calculated using government rate of wages i.e. Rs 73/manday (Table 10.4).

Table10.4. Employment generation in SRF supported watershed project

Intervention	Wages paid (Rs)			Employment generated (man days)		
	2006-07	2007-08	Total	2006-07	2007-08	Total
Paal construction	1662435	2288396	3950831	22773.1	31347.9	54121
Land leveling & shaping	695688	1926806	2622492	9530	26394.6	35924.6
Engineering structures	285956	35654	321610	3917.2	488.4	4405.6
Plantation & plant protectionmeasures	145413	66592	212005	1992	912.2	2904.2
Goat rearing	--	13200	13200	--	180.8	180.8
Project share	2789492	4330648	7120138	38212.3	59323.9	97536.2
Community share	1195497	1855992	6102513	16376.7	25424.5	41801.2
Grand total	**3984989**	**6186640**	**10171625**	**54589**	**84748.4**	**139337.4**

* wages for the year 2007-08 are up to January 2008

Project created a sizeable employment for poor farmers of the project area in a short period of less than two year. A total sum of Rs 101, 71,625 were paid as labour charges and Rs 61, 02,513 was the share of farmers. If this amount is converted to mandays, it comes to be 1, 39,337 mandays. Paal construction created maximum employment followed by land leveling, construction of engineering structures, plantations and least by goat rearing.

More livelihood opportunities were available to the farmers and also the landless in the village. The daily wages of the labour also increased due to the mining activities.

The project intervention lead to food security, fodder security, and livelihood security to the villagers.In the last 2-3 years, Panchayat has not done much work under MNREGA, Rajiv Gandhi water mission, village sanitation, Indira Awas etc mainly because wage rates in these schemes are much lower than the prevalent wages they earn from mining related activities.

10.4 Improvement in girl education

We noted buses from convent schools taking children from Gualda. An interaction was held with the local Govt. school teachers who clarified that number of students in classes is increasing particularly the ratio of girl students is improving. We collected data from school register which clearly showed that in primary school, **the percentage of girl students improved from 28.1 % in 2006 to 43.2 % in 2010 (Table 10.5).**

Table 10.5 Number of students in Primary school of Gualda

Class	Admitted in	Boys	Girls	Total	%age of girls
1	2010	63	48	111	43.2
2	2009	54	38	92	41.3
3	2008	31	15	46	32.6
4	2007	32	12	44	27.3
5	2006	23	9	32	28.1
	Total	**203**	**122**	**325**	**37.5**

Previously, the ratio of girl students on an average in secondary school was only 17.1 percent (Table 10.6).

Table 10.6 Number of students in Gualda secondary school

Class	Admitted in	Boys	Girls	Total	% of girls
6	2005	77	19	96	19.8
7	2004	49	14	63	22.2
8	2003	91	12	103	11.6
9	2002	65	13	78	16.6
10	2001	39	8	47	17.0
	Total	**321**	**66**	**387**	**17.1**

School of village Gualda lack basic amenities

10.5 Summary of benefits

The summary of benefits Indicated by the study is given as under.

Nature of benefits	Description of benefits
Economic benefits	• Huge appreciation of reclaimed land value • Considerable increase in production gains- crops/milk •Positive changes in livestock assets (Pashu dhan)
Environmental benefits	• Ground water recharge to sustain agrarian economy • Flood control and reduced threat perceptions • Positive changes towards greening of landscape
Social benefits	• More spending on education, health, housing, clothing •Positive changes in living standards – mobiles, tv, m.cycles, better furniture, more spending on social ceremonies
	• Better nutrition – milk/vegetables and food security
	•More children attending schools. •Substantial number of girls started attending schools. •Inter-loaning by SHGs provided sense of economic security

Overall assessment through community consultations

Chapter - 11

Includes :-

- ★ Overall assessment by the community
- ★ General community reactions and suggestions
- ★ Views about the Implementing Agency
- ★ Additional suggestion of the community
- ★ Perceptions of the villagers about the project work
- ★ Interaction with Gram Pardhan and Ex MLA

Chapter 11

Overall assessment through community consultations

This analysis was taken as part of social audit by the village community. Moreover,this was not conceived as an entirely an economic study of investments in Gulda village but in addition, a mid-term appraisal and assessment which may facilitate the decision making process in SRF and also provide leads for better targeted budgetary provisions and improved implementation strategies based on lessons of experience.Moreover, it would provide insite on the usefulness of investments made and safeguards against possible failures.Discerneable changes were sweeping across Gulda village which were triggered by project interventions and it was decided to capture those changes through this study. In addition to other investigations, an intensive interaction across village community was attempted. Both individual beneficiaries and groups were interviewed in a structured manner to illicit information on project performance, past experiences of implementation, future scope of work and expectations.

The villagers of Gualda participating in group discussion

People had mixed reactions as usual but three conclusions were clear without an iota of doubt.

- They were hesitant to disclose monetory benefits but generally agreed that huge benefits have flown.
- They realised the mistake of not putting faith in the project in initial years.
- They wanted the project to stay and complete the unfinished work.

- **Discerneable changes are sweeping across Gulda**
- **There is clear need of 22 more paals and about 100 gully plugs and check dams.**
- **Some 500 bigha of more land need leveling.**
- **How project can leave Gualda with half finished agenda**

Discussions with beneficiaries and villagers of Gualda

11.1 Overall assessment by the community

Firstly, the usefulness and benefits of 38 paals constructed are universally accepted, appreciated, and well realized. There is clear need of 22 more paals and about 100 gully plugs and check dams as per the perceptions of the groups.

Secondly, the land reclamation work initiated after Paal construction generated large number of benefits through vast improvement in crops and forage production, rainwater conservation, soil fertility improvement thus creating abilityfor enhanced investments in agriculture as an enterprise. These two activities made a paradigm shift in failing farm economy and have put them on a trajectory of economic growth and social development with associated environmental benefits withinbuilt elements of sustainability.

Thirdly the interventions of crop improvement through better seeds, backup support, training, and awareness largely failed and ended up with losses to farmers. The plantations of fruit and fodder plants did not produce the desired results and almost failed with miserably low survival and lack of after care and backup support. Aru Neem and fruit plants are maintained by few farmers and yet not reached the fruiting stage. The fruit plants are not reared on commercial lines and package of practices are not followed.

The effects of rising income both from agriculture and supported by wage earnings in mining activity are evident in more investments on installation of new tube wells,purchase of sprinklers, farm implements, and increased spending on education, health, housing, clothing, nutrition and purchase of vehicles.

Views about SST as an institution are dismally poor, but great respect and regards for SRF commonly known as company are evident but people do not know why company is spending on these people asnobody does that in these days of greed. The Gram Panchayat as an institution was not involved in the project activities.

11.2 General community reactions and suggestions

Paal construction

- Still 22 more Paals needs to be constructed at various locations which are well identified by the people. Some 100 check dams and gully plugs are also required.
- All paals must have spreading of Malba (query stones/rubble) to keep them in good shape for long.
- It is better to plant Aru Neem plants on both the paal slopes inlines (3-4 lines)for extra income and also the slope stability. Farmers hold the view that maintenance responsibility of Aru neem should be given to farmer/farmers in whose land the paal is made & if on border then those whose land is located on upstream and downstream side. Such farmers should be made the owners of the plant and they may get the benefit of getting fuel wood from branch pruning and leaf fodder which is in great demand.
- The side slopes of paals are bit steeper. These should be more slanting and in that case, tree establishment would be much easier.
- The function of committees of self-help groups remain limited to receiving payments and no maintenance is being carried out. All the old Paals should be repaired by mobilizing community support. Alternatively, some cess fund should be created for maintenance and a mechanism of contributions for maintenance be developed where contributions are made before taking up Paal construction and not afterwards.
- Payments of paals are often delayed. The measurements are not made for months which create problem because diesel for tractors and other day to day expenses are made by borrowing money. The delayed payment to money lenders means payment of more interest.
- The model of Aruneem plantation done on Muglawali Paal should be replicated on all the Paals. This is more economical than the plantation of *Sachharum munja.*This model gives more green fodder (for goats) and loppings to farmers to use as fuel wood. The entire cost of Paal construction can be recovered from the sale of Aruneem trees with chances of better maintenance of Paals.
- Though 38 paals have been constructed and 90 hectare of land has been leveled in the village but still 20 more Paals are to be constructed. Another 100 hectare land is yet to be leveled. Therefore, there is need to step up the activities in the coming years.
- In Paal construction and land leveling some user groups have been formed. As per procedure, group is responsible to execute the program and in turn also to get payment of that work through this group. There is time leg between the work executed and payments made which should be minimized.
- Payment procedure should be transparent enough. All the activities done in the village should be displayed at suitable place, which is not being doing at present.

Reclamation of waste lands

- This is most beneficial and preferred activity but it is associated with Paal construction. Paal construction is necessary before starting the reclamation of gullied land.
- The criteria adopted for division of land leveling into four categories for assessing the extent of work involved and payment thereof is generally acceptable to the farmers and this is decided in consultation with the beneficiary and the criteria is not disputed.

- But often bigger farmers are given priority as targets are achieved with the land of fewer farmers and many small farmers have to wait. The rates prescribed for each category are low and need up-ward revision.
- Higher cost involved in land leveling also compel the farmer to opt for rough leveling and not complete leveling as that involves expenditure more than his paying capacity.
- Moreover, the payment for the diesel to contractors and other day to day expenses are first born by the farmers and payments are made afterwards. This expenditure makes their pockets empty and many farmers have to borrow money at exorbitant rate of interest to complete the work.
- The payments for leveling work are often delayed. The SST pace of processing payments is slow and erratic. Some parties get payments much early and some keep on visiting SST office for payments.
- Still, lot more landin Gualda village need leveling. Some 500 bigha land needs reclamation and an equal area is uneven and undulating which also need leveling. According to the estimates of the farmers, almost 50 percent of leveling work is still pending. It may need at least 3 to 4 years of period to complete the pending work.

Horticulture promotion

- Longer gestation period, lack of marketing infrastructure, wildlife damage and need of watch and ward is the main dampening factors in raising fruit plants. Moreover, there are alternate employment opportunities with good wages in stone quarries which keep the able male members away from the homes during day time.
- Secondly, healthy plants should be supplied at the most appropriate time of planting. Often the plants are planted when rainy season is almost over and seedlings suffer high mortality.
- Thirdly, there is an express need of back up technical support. Inputs promised should be supplied as promised. Termite attack is serious and without insecticides, plants fail to survive. Farmers need service at the door.
- More serious efforts need to be made to organize and educate the farmers. Many plants have sprouted from below the union and never removed. Then what is the use of grafting? Plants are not pruned properly to give proper shape for optimum bearing.
- Most farmers are of the opinion that SST men should regularly visit them and remain in contact for help and advice. Farmers are unable to diagnose disease and nutritional deficiency symptoms and as a result plants are surviving but not attaining the desired growth.

Few suggestions and shortcomings observed in execution are given as under :

1. Need of motivation by the SST to farmers to adopt this activity.
2. Supply of seedlings in time.
3. A calendar of activity must be followed under this programme.
4. Some expert on horticulture is placed on board with SST.
5. Sometimes, the seedlings are brought from far off places and some of them are damaged in transit. There is problem of adjustment to climate change in case of few species brought from far off places. Sometimes delay in planting affect the survival of plants adversely.

6. There should be proper training and pruning of plants, identification of mother plant and grafted one, as a result of which in many cases, mother plants have grown and the grafted one are damaged or suppressed.

7. Commitments in providing secateurs, fertilizer, pesticides are fulfilled in time.

8. A system of regular monitoring shuld be put in place so that one knows fully well as to which species are performing well and which are not.

9. There should be some component of providing good seed (hybrid) of vegetables to farmers so that they are encouraged to sow better seeds and harvest better crops to take advantage of water available from recharged tube wells.

Fodder plants:

- Aru Neem has performed well and in case of other plants, the mortality rates are very high.
- Farmers should not be pressed to plant seedlings just after land leveling when fields are not in perfect shape. It is better to go in for plantation during the second year monsoon.

Crop production:

This is another programme which is suffering due to following reasons:

- The technical back up support with the SST in agronomy needs strengthening.
- When varieties promoted have done well in demonstrations, multiplication of their seed to benefit other farmers should be attempted.
- Some new varieties were brought from far off places, experimented at farmer's field and did not perform well. This type of experimentation at farmers cost should be avoided.
- At least one before Kharif and one before Rabi sowing season, a Kishan *Sammelan* should be organized to educate the farmers about recommended package of practices with with the help of expert/ technical persons. This should be a regular practice with the SST.
- Few salient features of crops promoted are distributed to farmers in such farmer's fair.
- Proper coordination with state agriculture department should be made so that few activities can be taken after dovetailing with their activities.
- Farmers Information and Service Centre (FISC) planned at village Gulada has not been made functional and should be made as early as possible.

Livestock development:

As a result of Paal construction, land leveling and other factors there has been reduction of cows and goats and increase in population of buffaloes. The reasons of reduction in livestock population are as under :

- One reason of reduction in the population of cows and goats is deforestation in the hills and mining activities going on the area. There is hardly left any place for grazing.
- Children have started going to school and the old practice of child boy and girl taking cattle for grazing have been stopped or reduced substantially.

- As a result of increased crop production in the area, there is adequate availability of dry fodder in the village itself.
- With good crops, more green fodder is available to farmers, so also to the landless people. They can take the green fodder (weeds mainly) from the standing crops.
- Good fodder and availability of water to animals resulted in more milk production and people are selling now more milk as compared to 4-5 years ago.
- Stall feeding has increased in the recent past which is a positive outcome for the environment.
- Reduction in grazing has also helped in the decrease of soil erosion.
- There is also need to organize few cattle health check up camps at selected places in consultation with animal husbandry department.
- In a village, at least one or two cattle catcher shouldcan be provided by SST, so that farmers can easily feed some medicines etc by holding animal tight in the catch.
- Water trough at some places can also be constructed where cattle population is more and it can be dovetailed with farmers having tube well nearby to fill it with water regularly.
- As a result of more availability of dry and green fodder in the village, fodder prices have gone down. Dry fodder from wheat and Bajra is available in sufficient quantity.
- Village Gualda has become self sufficient in fodder as compared to past when they used to buy dry fodder from Haryana areas.
- Food grains to the land less people are now available from the village itself otherwise they used to buy from the nearby area.
- Due to more stall feeding, more FYM is now available as compared to past which is good for agriculture and a positive step for environment improvement.

How the savings from Agriculture were invested:

- Land improvement (leveling, manuring, bund making) carried the first priority of the farmers mainly to optimize returns.
- Second priority went to installation of tube well to ensure the regular water supply. The purchase of rubber pipes and sprinkler sets on which there is 50 percent subsidy became the next priority. The returns from first two to three years at least were reinvested on these farm development activities.
- In addition, farmers started investing more on better seeds, fertilizer, and weedicides.
- The investment on education, housing, health care, clothing, nutrition, bikes, religious ceremonies have increased. Many have started sending children to private school where education standards are considered better than local Govt. schools.
- Lastly, people visit towns more frequently, awareness levels have increased and interaction with line departments have improved.

11.3 Views about the Implementing Agency

Sir Syed Trust (SST) suffered from several inherent constraints which became apparent during interaction with farmers and our own observations.

- SST is seriously constrained by man power shortage. The staff recruited does not stay for long. The young recruits use the period to find better opportunities.Turnover of the staff in the SST is very fast and hence program suffers. It takes time to learn and familiarize with the procedures and develop relationships with the people.
- In case of suitable staff crunch, compact area approach (limit operation to compact area where scope is also there) rather than expanding at the cost of losing contacts with old villages. This should have been better option.
- There appears a clear need of appropriate monitoring mechanism. Failures should bet seriously analyzed and corrections made. The strategies must change on the basis of ground realities and feed back.
- SST should hold regular meetings in villages particularly in which presence of senior people is necessary to increase confidence levels.
- There should be proper match between activities and professionals hired by the SST. There is a need of persons having good expertise with agriculture/horticulture so that there is follow up and proper advice is tendered to the farmers.
- The commitments made with the farmers to provide goods and services should be honoured to establish credibility in the community.
- Display boards about activities of SRF/SST have been painted but no information is filled in the columns provided.
- Most people are not aware about the background of SST. Only few know SRF as a company but are not clear why they are spending money in villages.

11.4 Additional suggestion of the community

School education

In the recent past, a trend is picking up among the people to educate their children. As a result now private schools have multiplied in the area. There is only one private school in Gualda but many children are going to private schools at Tapukada. The Govt. school of the village has now more students as compared in the past. However, the condition of the school is very poor. No white washing has been done since long. There is no proper arrangement of drinking water and only hand pump is usually out of order. No electricity and hence no fans, no proper toilet facility in school for boys and girls. There is less number of rooms in the school as compared to the number of students. There is also no cleanliness in the school and no tree has even been planted for shade.

In case some grant is provided for creating facilities in the school, SRF can earn a lot of respect among the villagers. This gesture of the company can extend benefits even to landless people who otherwise remain deprived because Project activities are land based. Even one or two rooms can be added to school. Electricity connection, installing fans, white washing of the rooms, electrified hand pump, and toilets with overhead tank can help the school children.

Village sanitation

There is lot of filth around in the village.The village Panchayat has not done much except putting malba on some paths It has constructed boundary wall of the grave yard and installed few hand pumps.There is no implementation of MNREGA and other Govt. schemes like sanitation, drinking water supply etc. in the village.There is lack of proper drainage. Water is standing around without proper disposal and village pond is also silted up. Village well is having filth all around. In view of the above, few steps can be taken to improve the sanitation in the village.

- Proper draining out of the water by providing few rectifications, burying of pipes, small culvert, construction of small portion of channel, providing pavement around the village well can improve sanitation in the village.
- Desilting of village pond with proper inlets/ outlets can be very useful.
- Campaign not to use plastic bags and putting garbage collection and disposal mechanism can be beneficial to improve the sanitation.
- Few hand pumps in the thickly populated pockets can reduce the drudgery of the women.
- One or two parks for children to play can also be developed. At present, there is no place to play for children.

In view of poor sanitary conditions of the villages in the area, a small portion of 5 to 10 percent of the total budget provided to SST can be invested in different villages as an entry point activities under the programme. It can provide good opportunity to the SRF to take people along and would ensure better participation in project activities. It would be better to keep this fund with the company itself and can invest directly. It will help the program in many ways. Company shall have the feelings of the farmers and will be in touch with villagers.The short comings in the implementation of the programme will be known to the company and rectification measures can be taken quickly to improve the implementation of the program.

11.5 Perceptions of the villagers about the project work

The comments made by beneficiaries during discussions are reproduced in this section alongwith translation in English.

Farmer Umardin expressing his views about the benefits of Paal construction

Umardin S/o Jumma Khan : *Hamari tin bhaiyo ki 5 bigha jamin thi jisme se keval 1.5 bigha main hi kheti kar pate the. Baki main nale ke pani ka katav lagta tha aur achhi mitti bahkar chali jati thi. Ab Mugla wali paal banane se hum poori jamin ko jot lete hain. Pahle chhoti chhoti med bandhte the parantu jyada pani aane se bahkar chali jati thi. Paal banane se pahle jamin unchi nichi thi ab semar ho gayi hai.Ab khet nahi bigar raha hain. Kheton ka pani bahkar nahi jata aur, isse kuwon aur tubewellon main pani ka star badha hai. Kheton se kamai achhi ho rahi hai, to bachon ki padhai par dhyan dene lage hain. Paal banane se pashuonko barsat main pine ka pani mil jata hain. Pehle pani bahkar jhiwana taraf nikal jata tha ab paal banane se pani yahi ruk jata hai. Pahle 10 man bigha ka gehun hota tha ab 15 se 20 man hone laga hai. Amdani badhne*

se hum subzi hamesa banane lege hain pahle chatni aur ghee se roti kha lete the. Aajkal hum achar aur aaloo gobhi aadi ki subzi khate hain, pahle sirf chane ki subzi he banate the.

We are three brothers having total 5 bigha of land out of which only 1.5 bigha was cultivable. Remaining land was eroded by rainwater and good soil used to be washed down with rainwater. Now due to the construction of Muglawali paal, we are able to cultivate the whole land. Before it, we were constructing small bunds in our fields but due to more rainwater, these bunds were breached with runoff water. The land was undulated before paal construction and now it is leveled. Now the fields are not damaged. The rainwater is not going outside the fields and the water level in wells and tube wells rose due to it. We are getting good returns from field's that is why emphasis is given on educating the children. Drinking water remains available for cows during monsoon season due to the construction of paal. Before it, water used to go outside the village towards Jhiwana village but now the water remains in the village due to paal construction. The production of wheat was 400kg in one bigha which increased to 600 to 800 kg per bigha. Due to increase in income, we are taking vegetables daily with meals but before it we were eating chapatti with Chatni and ghee. Now we are eating potato and cauliflower vegetables while before it only green chick pea vegetable was mostly prepared with food.

Rukkaya W/o Abdul : *Paal banane se pahle hamare kheton mein naale pad jate the. Ab sab khet theek ho gai hain. Kheton ki paidawar badh gaya hai aur kheti karne layak jamin bhi badh gayi hai. Paid podhe lagane se jalau lakdi bhi milne lagi hai jisse jangal se kam lana padta hai. Bakriyon ke liye Ardu ki pattiya mil jati hain. Kheto se chare ki matra adhik hone lagi hai to jyada bhains rakhne lage hain.*

Rukkaya, a member of SHG telling about the benefit of plantation on Paal and bunds

There were gullies in our fields before the construction of Paal. Now the fields are improved. The productivity has increased from the fields as well as the cultivable land has also increased. We are also getting fuel wood from the plantation by which bringing of fuel wood from forest is decreased. The leaves of Aruneem are fed to the Goats. Due to more production of fodder from the fields, we are keeping more number of buffaloes.

Bassan: *Pani kheton main he samane laga hain jo ki pahle kheto ko katkar bahar nikal jata tha. Jiske sath khad bhi behkar nikal jati thi.Ab paal banane se hamare khet eksar ho gai hain aur sarson ki paidawar badh gai hai. Kheton main chara badhne se janwar jyada rakhte hain to gobar ki khad jyada hone lagi hai jisko kheti main dalne se paidawar badi hai.*

Bassan telling about the benefits of Paal construction

The rainwater has started percolating in the soil which was going waste through runoff from the fields. The manure was also lost with the runoff water. Now due to the construction of paal, our fields have become level and the production of mustard has increased. The production of fodder from the fields has increased so we have

increased the number of animal. The availability of manurehas also increased due to more number of animal. By applying more manure to the fields, the production has also increased.

Nasru S/o Safeda: *Paal banane se pashu dhan Pani Pi lete hain, jangal ban raha hai. Hamare khet ke paas abhi nai paal bani hai jisse kheti mainabi jyada fayda nahi hua hai par umid hai ki kuwon mein pani Chadh sakta hai. Jamin bhi dhere dhere level ho jayegi. Akele na to paal bandh sakte the aur na hi jamin samar karwa sakte the.Thodi madad mil rahi hai to kar lete hain.Pahle koi salah dene wala bhi nahin tha.*

Nasru is telling about the benefit to be received in future

Due to the construction of Paals, the cattle can drink water from it. Still we do not get any benefit due to new paal construction near to our filds but expecting that in future water table can rise slowly. We alone cannot construct the paal or even level land without getting help from the organization. Before it, there was none to guide us.

Ch. Illiyas: "*Pahle pani behkar jata tha ab ruk gaya hai. Pani ke sath sath gobar khad bhi bahkar nikal jati thi. Paal banane se jamin ka katav ruk gaya hai, jisse jamine iksar ho rahi hai. Pahle jamino se 10 man bigha gehun hota tha ab paal banane se 15 se 20 man bigha hone laga hai. Jamin sammar hone se aurten aaram se kheton mein kam kar leti hain pahle ubad khabad jangal jaise kheton mein kam karne se mahilaonko dar lagta tha. Paal mein pani bharne se pashuon ke liye pani mil jata hai, pahle dur le jakar kuwen se nikalkar pilana padta tha. Paal main kabhi kabhi gwala bhi pani pi lete hain. Paal banane se pahle boron mein pani 50 phut tha jo ab 47 feet par aa gaya hai. Paid podhe lagne se jalau lakdi milne lagi hai jisse mahilaon ka jangal jana thoda kam hua hai aurjangal ke lakde bhi kam jala rahe hain Ab gobar ki jyada matra kheton mein dalne lage hain. Ardu neem ki patti chara ke kam aane laga hai. Pehle chara kam hone ke karan bhains nahi rakh pate the ab adhik chara hone se adhik bhains rakhne lage hain. Hara chara bhi ugate hain jisse bhains ke doodh ki matra main virdi hui hai. Pahle bhains 7 liter doodh deti thi ab 10 se 12 liter dene lagi hain. Paal banane se jangle se lakdi lane ka rasta ban gaye hai jisse lakdi tractor se le aate hain pehle mahilaon ko sir par lana padta tha. Paidawar badhne se aarthik estiti main sudhar hone laga hai aur khan pan achcha ho raha hai*.

Ch. Illiyas sharing the benefit of the project activities and providing some suggestions

Before the project, the rain water used to go outside and now it is stored. The manure was also going with the water. Due to the construction of Paals, soil erosion has been checked and that is why lands are becoming level. Before paal, the production of wheat was only 10 maund (400 kg) per bigha and now it has increased to 600 -800 kg per bigha. The women can now work without fear in the fields but before it there was much undulated terrain with khads and wilderness where women used to fear to work. Due to filling of water in the Paals, water is available for the cattle but earlier we used to take them to well and the water was withdrawn from the well by hands. Sometime, the shepherd's also drink water from the Paals.In the bores of tubewells, the water level was at 50 feet which has reduced to 47 feet due to paal

construction. After the plantation activity, the fuel wood has become available so the going of women to the forest is reduced to some extent and the cow dung cakes are used in fewer amounts and therefore more manure is applied to the fields. The leaves of Aru Neem are being used as fodder. Before it, due to less production of fodder, we could not rear buffalo but now fodder has increased so we are keeping more number of buffaloes. The green fodder is being grown because of which milk yield has increased. The buffalo was giving 7 liter of milk before and now it is increased to 10-12 liter. The path to jungle is improved becaue khads were plugged by Paals so now we bring the fuel wood on tractor. Before it, women used to bring fuewood as head load. The economic condition is improving due to the increase in production and the nutrition is becoming better.

Suggestions*: Malba achchhe se dalna chahiye, patla patla puri paal par dalna chahiye jisse barsat mein Paal katkar nahi jayegi.*

Compaction kam hota hain jisse barsat main behne lagjati hain.

Ubad khabad jamin ke liye 6000 ka bigha kam hota hai jisse kisan achchhi tarah se sammar nahi karwa pata hai.Jamin thodi nawar rahne se khad bahkar chali jati hai aur mitti ka katav chalu ho jata hai. Sanstha se jyada ubad khabad jamin ke liye 13 se 14 hazar parti bigha rakhna chahiye kyonki kisan bhi baniya se 3 rupye parti saikda se udhar lekar karwate hain jise vapas chukane main dikat aati hai.Sammar ke sath sath maidbandhi jaruri karna chahiye jisse pani bahkar bahar nahi jaye. Kheton ki samar ek patti ki ek sath karwani chahiye

Chhaydar podhon main Aru neem, Kikar, Shisham aur faldar podhon main nimbu, mosami, aur aonla lagna chahiye aur enko nil gay se bachne ke liye tarbandi karwana chahiye.

Bhumihino ke liye gay ki dairy, murgipalan ya unke bachchon ko factory main lagwana chahiye..

The rubble work on the paals should be spread perfectly and spread on the whole paal so that it will not erode in the rainy season. The paal starts eroding in rainy season due to imperfect compaction work. Rs. 6000 is very low for highly undulated land that's why the farmers could not level well. The lands remain some but slopy and manure goes with runoff and lands starts eroding. The project should fix for undulated lands the rate of 13 to 14 thousand per bigha because the farmer also borrows money from the money lender at 3 rupees per hundred/month which is difficult to repay. With the land leveling, the bunding should be essential so that the water may not flow outside the same field. In fodder plants- Aru Neem, Kikar and Shisham and in fruit plants- Lemon, Mousambi and Aonla should be planted and fencing should be done to protect from blue bulls. The landless families be helped to start dairy of cows or take up poultry farming and their children should be given job in the factory.

Fajru/ Surat: *Paal banane se evam jamin semar hone se barsat ka jo pani bahkar gaon ke bahar chala jata tha ab kheton main rukne laga hai. Pehle mera tube well pani chhodta tha ab paal banene se usme pani upar aa gaya hai jisse pani nahi chhodta. Ab 7-8 ghante lagatar sinchai ke liye chal sakta hai. Kheton mai pani rukne se jamin upjau ho rahi hai. 10 man ki jagah 15 man ki paidawari ho rahi hai. Pahle ghar ka rasta nale mai hokar jata tha to tractor jyada vajan nahi le ja pata tha. Pehle khet se saman lane ke liye 3-4 chakar lagane padte the ab 2 bar main le jate hain. Ab ghar tak poori trolly bharkar le jate hain pahle aadhi trolly hi le ja pate the. Gaon ka kuchh pani ab bhi bahkar jhiwana taraf nikal jaraha hai jisko ki Roshan wali kui ke paal bada bandh banakar rokna chahiye. Desi kikar aur desi neem ke paid jyada lagne chahiye.*

The water which was flowing outside the village is stopped due to the construction of Paals and land leveling. Earlier my tube well was not working regularly,but now after paal construction, tube well has started working regularly. Now my tube well can run regularly for 7-

8 hours. The land has become fertile due to water retention in the fields. The productivity has increased from 400 kg to 600 kg per bigha. The way to our home was through the gully and tractor could not carry more weight. Earlier we used to make 3-4 trips to bring produce from the fields but now the trips are reduced to only 2. Now we are taking full trolly load up to our house which was carried by half filled trolly before the paal construction. Still some water of the village is going outside towards Jhiwana village which should be stopped by constructing a Paal near Roshan wali kui. The desi neem and desi kikar should be planted in more numbers.

Kalu/ Bhura: *Hamare paas thodi thodi jamin hai jo aise hi padi rehti thi. Barsat main nale ke as paas kheti nahi kar paate the. Kyonki barsat main nale meinpani ane se fasal nasht ho jati thi. Ab upar ki taraf Dihi wali paal aur niche ki taraf Karilwali aur Ghamandiwali paal banjanese pani ruk gaya hai. Ab aasani se fasal ho jati hai aur nale ki jamin bhi upjau ho rahi hai. Karilwali paal banjanese rasta bhi achchha ho gaya hai. Paidawari badne se ghar karch ke liye paisa mil jata hai. Chara adhik hone laga hai to maine bhains kharid li hai. Jamin level hone se 2 bigha jamin par kheti karne laga hun jiske liya engine kharid liya hai.*

We are having small land holdings and these remained as fallow. In the rainy season, around the nala we were not able to cultivate crops. Because of flood water flow in the nala, the crops were damaged. Now in upper side, Dihiwali paal and in downside Karilwali and Ghamandiwali paals are constructed, so flood water has stopped flowing. Now, crops can be grown easily and the land in the nala is becoming fertile due to water retention. The cart track has becomes good due to the construction of Karilwali Paal. Due to increase in productivity, we can get some money to meet domestic needs. I have purchased buffalo due to more production of fodder. After land leveling, I am cultivating 2 bigha of land and engine was purchased for the new dug well.

Hazi Mahmood/Aasin: *Pehle hum humare kheto main pani rokne ke liye chhote chhote dol bandhte the. Jyada barsat hone se aur khet ubad khabad hone se chhote dol footkar beh jate the. Pani ke sath sath hamre kheton se khad bhi behkar chali jati thi. Khet katav hokar bekar ho jate the. Ab paal banene se aur jamin sammar hone se pani kheton main he rukne laga hai. Meri kheti karne layak jamin badh gayi hai jiske liye main ek tube well lagwaya hai. Paal banene se raste ki suvidha ho gayi hai. Sukha chara aur hara chara jyada hone se ab 3 bhains aur kharid li hai. Doodh ki paidawar main badhotari hui hai pehle ek bhains 7-8 litre doodh deti thi ab 10-12 litre doodh deti hain.*

Hazi Mahmood telling the benefit of watershed project

We were making small bunds in our fields to stop rain water. Due to more rains and undulated lands, the small buds were damaged by flood water. The amount of manure was also lost with rainwater. The fields used to become infertile due to erosion. Now the rain water is stopped in our fields due to the construction of paal and land leveling. My cultivable area has increased and I have installed a new tube well. The facility of common path has improved. I have purchased 3 buffaloes due to increase in dry and green fodder. The production of milk has also increased. Earlier one buffalo was giving around 7-8 liter per day which has increased to 10-12 liters per day.

Interaction with Gram Pardhan and Ex MLA

Mr Asgar a young man of about 30 was elected as Gram Pardhan of village Gualda. Incidentally, his father Mr. Din Mohamad remained Gram Pardhan of Gualda and then became MLA of the area. We had a meeting with both of them on April30, 2011 at their residence in Tapukhra town. The views expressed by both of them are summarized as under.

- The construction of Paals and land leveling work done in the village is extremely useful and it should be continued to cover all waste lands and remaining Paals should also be constructed. Mr Hazi Mohamad who was present in earlier meetings held in the village also joined and briefed the duo about the pending works in the village.

- They suggested that Roshan ki khui wali Paal should be constructed as it would store lot of water and would be most useful. When their attention was drawn to some objection by one or two villagers about the construction of this Paal, both of them assured that any problem about such works be discussed with them and they would resolve the problem if any.

- Emphasizing the need of some community welfare activities, it was suggested to take up the work of excavating the village pond to increase its capacity and also the need of raising the embankment of Kholiwali Paal to augment the storage capacity of the pond commonly used by villagers in summer.

- A bauli called Chandan Sidh wali Bauli need renovation and a hand pump should be installed on the bauli to extract water. There is no source of water in that area and hence the need of renovation.

- It was suggested to construct an earthen bund behind the school which would help to level the school play ground where a hand pump needs to be installed for school children. Some shade trees sould also be plantd around the play ground.

- Both of them assured all help and assistance from Gram Panchayat in smooth implementation of project activities. They informed that Gram Panchayat could not capitaze the funds available under MNREGA because of low wage rates provided in the scheme.

  It appeared from discussions that Gram Panchayat was not much involved in project activities but they assured to be pro-active and would provide help when contacted by the SST.

Summary and Wayforward

Chapter - 12

Includes :-

- ★ Brief highlights of the study
- ★ Suggestions for effective implementation of the project

Chapter 12

Summary and Way Forward

This report brings out very clearly that the Paal consruction and reclamation of waste lands was very well received by the beneficiary farmers and has put them on a trajectory of economic growth. The economic analysis also proved that both of these activities are cost effective and initiate the process of production improvement, gainful employment, and made positive changes in the live stock due to the increased availability of green and dry forages. The farmers indicated much more scope of about twenty Paals and hundred hectare of waste land development. The farmer's precieved the benefits to such an extent that they ploughed back all the cash generated on farm development and installation of irrigation system, purchase of sprinklers and farm implements.

The promotion of increased production packages on own reclaimed lands, resulted in 30 – 40% increase in grain and forage production. However, the introduction of new crop verieties largly failed and performed poorly against the verieties already raised by the farmers.

The introduction of fruit plants on reclaimed lands ended with very low survival percentage and farmers were not provided requisite back up support and technical knowhow. Some of the fruit plants like Mangoes were entirely washed out in the first year of plantation. The selection of plant species was basically wrong and not suited to the climatic condition of this area. Similar was the fate of fodder tree species out of which only few like Aruneem survived with a low rate of almost 20%. The selection of interested farmers, promotion of only Citrus, Guava and Ber, adequate back up support and regular training of the farmers, are some of the suggestions to improve the plantation programs.

The organization of women self-help groups did not receive very high success because large number of groups became non-functional due to one or the other reasons and those which were functional, their activities remained limited to interloaning and did not persue different income generation activities. The SST as an implementing agency suffered from inherent problems of staff turnover and lack of technical knowledge about horticulture and agriculture programs, which they were supposed to promote in participation with the farming communites.

The expansion of the program to new villages at the cost of neglecting old villages resulted in thin spread of attention and financial resources. The compact area approach would have been better to effectively provide goods and services in view of man power limitations.

There is a clear need of effective monitoring mechanism and strong interaction of SST staff with beneficieries so that distortions/discrepencies are immediately attended to.

It would be better to saturate the existing area with Paal construction after duly improving the design norms and planting Aruneem and other suitable plants on the slopes of the Paals.

Land development initiatives should be continued both upstream and downstram of Palls, thus promoting Paal Wadi Concept. However, in view of cost escalation, the provisions for expenditure on all the four types of land needs to be revised so that the farmers are not burdened with personal expenditure incurred by taking money at high rates of interest.

No plantation work should be carried out during the first year of land development. Only interested farmers who are willing to undergo training should be selected for taking up horticulture program. It must be ensured that healthy plants from reliable nurseries are supplied at the appropriate time.

Annexure 1: Caste wise composition of the respondents, their mainand secondary occupation, education level, type of house and status of electric supply (Gualda)

S. No.	Name of Respondent	Caste	Primary Occupation	Secondary Occupation	Education Level	Type of House	Elec. Supply in House
1	Amin Khan	Meo	Farming	Dairy	Matric	Kucha	Yes
2	Hakam Ali	Meo	Farming	Dairy	Illitrate	S-pucca	Yes
3	Ash Mohammad	Meo	Farming	Dairy	Matric	Pucca	Yes
4	Supeda	Meo	Farming	Dairy	Illitrate	S-pucca	Yes
5	Basir	Meo	Farming	Dairy	Illitrate	Pucca	Yes
6	Fatun	Meo	Farming	Dairy	Illitrate	Pucca	Yes
7	Rishal	Meo	Farming	Dairy	Illitrate	Kucha	Yes
8	Sadiq	Meo	Farming	Labour	Matric	Kucha	Yes
9	Nasaru	Meo	Farming	Labour	Illitrate	Pucca	Yes
10	Jamil	Meo	Farming	Labour	Illitrate	Pucca	Yes
11	Ratan Lal	SC	Farming	Labour	Primary	Pucca	Yes
12	Om Prakash	SC	Farming	Labour	HSc	Pucca	Yes
13	Vishnu Dutt	SC	Farming	Service	H.Sec.	Pucca	Yes
14	Mange Ram	SC	Farming	Labour	Matric	Pucca	Yes
15	Lal Chand	SC	Farming	Service	Graduate	Pucca	Yes
16	Kallu	SC	Farming	Labour	Illitrate	Kucha	Yes
17	Jaleba	SC	Farming	Labour	Primary	Kucha	Yes
18	Goonga	SC	Farming	Labour	Illitrate	Kucha	Yes
19	Ishan	SC	Farming	Labour	Illitrate	Kucha	Yes
20	Puran	SC	Farming	Labour	Illitrate	Kucha	Yes
21	Pyarelal	SC	Farming	Labour	Primary	Pucca	Yes
22	Chhaga	Meo	Farming	Labour	Primary	Pucca	Yes
23	Hanif	Meo	Farming	Labour	Middle	Pucca	Yes
24	Muhin Khan	Meo	Farming	Labour	Illitrate	Kucha	Yes
25	Usman	Meo	Farming	Labour	Primary	Pucca	Yes
26	Mattoo	Meo	Farming	Labour	Illitrate	Kucha	Yes
27	Shamsher	Meo	Farming	Labour	Middle	Kucha	Yes
28	Ummar	Meo	Farming	Labour	Illitrate	Kucha	Yes
29	Noor Deen	Meo	Farming	Labour	Primary	Kucha	Yes
30	Mumtaj	Meo	Farming	Labour	Illitrate	Pucca	Yes
31	Jamil	Meo	Farming	Labour	Ilitrate	Pucca	Yes
32	Noor Hasan	Meo	Farming	Labour	Illitrate	Pucca	Yes

S. No.	Name of Respondent	Caste	Primary Occupation	Secondary Occupation	Education Level	Type of House	Elec. Supply in House
33	Nabia Karim	Meo	Farming	Labour	Middle	Pucca	Yes
34	Abdul Rahman	Meo	Farming	Labour	Illitrate	Pucca	Yes
35	Salman	Meo	Farming	Labour	Primary	Pucca	Yes
36	Lukeman	Meo	Farming	Labour	Primary	Pucca	Yes
37	Suleman	Meo	Farming	Labour	Primary	Pucca	Yes
38	Hifjur Rahman	Meo	Farming	Labour	Primary	Pucca	Yes
39	Attaulah	Meo	Farming	Labour	Illitrate	Kucha	Yes
40	Balwand	Meo	Farming	Labour	Illitrate	Pucca	Yes
41	Kullu	Meo	Farming	Labour	Illitrate	S-pucca	Yes
42	Sher Mohmmad	Meo	Farming	Labour	Illitrate	Kucha	Yes

Annexure 2: Status of the cultivated land in village Gualda

S. No.	Name of Respondent	In Command area (acres)					
		Irrigated	Unirrigated	Total	Leveled	Unleveled	Total
1	Amin Khan	3	--	3	-	3	3
2	Hakam Ali	2	-	2	-	2	2
3	Ash Mohammad	4	-	4	-	4	4
4	Supeda	8.75	-	8.75	-	8.75	8.75
5	Basir	3.75	-	3.75	-	3.75	3.75
6	Fatun	1.5	-	1.5	-	1.5	1.5
7	Rishal	2	-	2	-	2	2
8	Sadiq	3		3	-	3	3
9	Nasaru	4	-	4	-	4	4
10	Jamil	2	-	2	-	2	2
11	Ratan Lal	1	-	1	-	1	1
12	Om Prakash	2.5	-	2.5	-	2.5	2.5
13	Vishnu Dutt	1	-	1	-	1	1
14	Mange Ram	1.25	-	1.25	-	1.25	1.25
15	Lal Chand	1.25	-	1.25	-	1.25	1.25

16	Kallu	1.25	-	1.25	-	1.25	1.25
17	Jaleba	1.25	-	1.25	-	1.25	1.25
18	Goonga	1.25		1.25	-	1.25	1.25
19	Ishan	1	-	1	-	1	1
20	Puran	1.5	-	1.5	-	1.5	1.5
21	Pyarelal	1	-	1	-	1	1
22	Chhaga	1	-	1	-	1	1
23	Hanif	1.25	-	1.25	-	1.25	1.25
24	Muhin Khan	1.5	-	1.5	-	1.5	1.5
25	Usman	4	-	4	-	4	4
26	Mattoo	1.5	-	1.5	-	1.5	1.5
27	Shamsher	0.75	-	0.75	-	0.75	0.75
28	Ummar	2.5	-	2.5	-	2.5	2.5
29	Noor Deen	0.5	-	0.5	-	0.5	0.5
Total		**61**		**61**		**61**	**61**
Average		**2.1**		**2.1**		**2.1**	**2.1**

Annexure 3: Cropping pattern, number of irrigations and yield/acre in rabi season in command area in village Gualda

S. No	Name of Respondent	Area under different crops (acre)				No. of irrigation		Yield (Q\acre)				
								Wheat	Gram		Mustard	
		Wheat	Gram	Mustard	Total	Wheat	Mustard	I	U	I	U	I
1	Amin Khan	1.5	-	1.5	3	6	2	35	-	-	-	14.5
2	Hakam Ali	0.75	-	1.25	2	6	2	34	-	-	-	15.0
3	Ash Mohammad	2	-	2	4	6	2	32	-	-	-	16.0
4	Supeda	3	-	6.75	8.75	6	2	38	-	-	-	12.3
5	Basir	1.75	-	2	3.75	6	2	36	-	-	-	14.6
6	Fatun	1	-	0.5	1.5	5	2	32	-	-	-	15.2
7	Rishal	1		1	2	6	2	35	-	-	-	16.0
8	Sadiq	1.5	-	1.5	3	6	2	31	-	-	-	15.5
9	Nasaru	2	-	2	4	5	2	32	-	-	-	14.0
10	Jamil	0.5	-	1.5	2	5	2	35	-	-	-	12.5
11	Ratan Lal	0.5	-	0.5	1	5	2	38	-	-	-	14.2
12	Om Prakash	2	-	0.5	2.5	6	2	36	-	-	-	13.5

S. No	Name of Respondent	Area under different crops (acre)				No. of irrigation		Yield (Q\acre)				
								Wheat	Gram		Mustard	
		Wheat	Gram	Mustard	Total	Wheat	Mustard	I	U	I	U	I
13	Vishnu Dutt	0.5	-	0.5	1	6	2	32	-	-	-	16.2
14	Mange Ram	0.75	-	0.5	1.25	6	2	33	-	-	-	15.4
15	Lal Chand	0.5	-	0.75	1.25	6	2	34.5	-	-	-	15.0
16	Kallu	0.5	-	0.75	1.25	6	2	35	-	-	-	12.5
17	Jaleba	0.5	-	0.75	1.25	6	2	34	-	-	-	12.6
18	Goonga	0.5	-	0.75	1.25	5	2	36	-	-	-	15.4
19	Ishan	0.5	-	0.5	1	6	2	36	-	-	-	14.2
20	Puran	0.5	-	1	1.5	5	2	37	-	-	-	14.7
21	Pyarelal	0.5	-	0.5	1	6	2	38	-	-	-	12.8
22	Chhaga	0.5	-	0.5	1	5	2	32.5	-	-	-	15.6
23	Hanif	0.5	-	0.75	1.25	6	2	32	-	-	-	16.2
24	Muhin Khan	1	-	0.5	1.5	6	2	33	-	-	-	16.0
25	Usman	2	-	2	4	6	2	34	-	-	-	15.8
26	Mattoo	1	-	0.5	1.5	6	2	36.5	-	-	-	15.0
27	Shamsher	0.5	-	0.25	0.75	6	2	37	-	-	-	15.5
28	Ummar	1	-	1.5	2.5	6	2	38	-	-	-	16.0
29	Noor Deen	0.25	-	0.25	0.5	6	2	35	-	-	-	15.5
30	Mumtaj	0.5	-	0.75	1.25	5	2	35	-	-	-	15.2
31	Jamil	1	-	1	2	5	2	35	-	-	-	14.6
32	Noor Hasan	0.5	-	2	2.5	6	2	34	-	-	-	14.4
33	Nabia Karim	0.5	-	0.5	1	6	2	36	-	-	-	14.5
34	Abdul Rahman	0.5	-	0.75	1.25	6	2	37	-	-	-	15.0
35	Salman	0.75	-	0.5	1.25	6	2	28	-	-	-	15.5
36	Lukeman	0.5	-	0.75	1.25	5	2	38	-	-	-	15.8
37	Suleman	0.5	-	0.75	1.25	5	2	36	-	-	-	16.0
38	Hifjur Rahman	0.5	-	0.75	1.25	6	2	32	-	-	-	16.5
39	Attaulah	0.5	-	0.75	1.25	6	2	30	-	-	-	16.0
40	Balwand	0.5	-	0.75	1.25	6	2	32	-	-	-	15.8
41	Kullu	0.25	-	0.5	0.75	6	2	34	-	-	-	15.5
42	Sher Mohmmad	0.25	-	0.5	0.75	6	2	35	-	-	-	14.8
	Average	**0.85**	**-**	**1.04**	**1.89**	**5.7**	**2**	**34.51**	**-**	**-**	**-**	**14.9**

Annexure 4: Survey of tube wells for studying groundwater pattern in village Guwalda

Sr. No.	Name of farmer (Sh./Smt)	Father's name (Sh.)	No. of tube wells	Year of tube well installation	Water table (ft)	Electric motor/ diesel engine	H.P.	Area (ha) irrigated
1	Nanu Ram	Mangtu Ram	2	1992	45	Engine	10	4
2	Ali Mohammad	Maida	1	1992	42	Motor	5	1.75
3	Ashiya	Maluk	2	1992	50 & 80*	Engine	8	2.5
4	Muhar Khan	Mangal	1	1995	50*	Engine	8	1.75
5	Rasid	Malhad	1	1995	30	Engine	8	1.5
6	Mubin	Maluk	2	1995	45	Motor	5	1.75
7	Iliyas	Chhanga	1	1995	40	Engine	8	0.75
8	Asaru	Ashi	2	1995	55*	Motor	5	1.25
9	Khursid	Ishab	1	1998	30	Engine	8	2
10	Aslam	Subba	1	1998	52*	Engine	8	1.75
11	Naseeb	Juma	1	1998	50*	Engine	8	1.75
12	Islam	Rudar	1	1998	88*	Engine	10	0.75
13	Dula	Mulla	1	1999	50	Motor	5	2.5
14	Islam	Gurmal	1	1999	35	Engine	8	3.5
15	Jume Khan	Himmat	1	1999	78*	Engine	8	0.5
16	Barkat	Amin	1	2000	51*	Engine	8	1.25
17	Bimbar	Amin	1	2000	50*	Engine	8	2.5
18	Iliyas	Subba	1	2000	50	Engine	8	1.75
19	Yakub	Jumma	1	2000	38	Engine	8	2
20	Sher Mohammad	Sirdar	2	2000	58*	Motor	5	2
21	Mahmud	Rahman	1	2004	40	Engine	8	1.25
22	Fajaru	Bullu	1	2004	40	Motor	7.5	3.75
23	Hari Ram	Thawaria	1	2005	58*	Motor	7.5	2
24	Kursid	Rahmata	1	2005	42	Motor	7.5	3.75

Sr. No.	Name of farmer (Sh./Smt)	Father's name (Sh.)	No. of tube wells	Year of tube well installation	Water table (ft)	Electric motor/ diesel engine	H.P.	Area (ha) irrigated
25	Chanderbhan	Pyare Lal	1	2005	41	Motor	7.5	1.5
26	Ismal	Sirdar	1	2005	42	Motor	7.5	3.75
27	Balli	Phoolu	1	2005	38	Motor	7.5	2.5
28	Faruk	Chab Khan	1	2005	50	Motor	7.5	1.5
29	Juber	Basir	1	2005	70*	Motor	7.5	2.5
30	Ishak	Mangal	1	2005	52*	Motor	7.5	2
31	Fajjar	Phool Singh	1	2005	78*	Motor	7.5	3
32	Jom Khan	Mota	1	2005	72*	Motor	7.5	3.5
33	Rajaudin	Jiroji	1	2005	45	Motor	7.5	2.5
34	Hijjar	Ashi	1	2005	70*	Motor	7.5	1.25
35	Idaris	Gurmal	1	2005	60*	Motor	7.5	4
36	Deenu	Sirdar	1	2005	58*	Motor	7.5	2.5
37	Nasaru	Jamal	1	2005	55*	Motor	7.5	1.5
38	Kusad	Ishab	1	2006	58*	Motor	7.5	2.5
39	Ayyub	Ishab	1	2006	62*	Motor	7.5	3
40	Kalu	Phool Singh	1	2006	52*	Motor	7.5	2
41	Nasaru	Phoolu	1	2006	40	Motor	7.5	2.5
42	Deenu	Munsi	1	2006	41	Motor	7.5	2
43	Israel	Jiroji	1	2006	55*	Motor	7.5	1.75
44	Ishu	Ashi	1	2006	60*	Motor	7.5	1.5
45	Nanu Ram	Mangtu Ram	2	2006	60*	Motor	7.5	4
46	Pappu	Munja	1	2006	78*	Motor	7.5	1.25

* denotes position of tubewell on height

Annexure 5: Livestock pattern and milk production with land owing respondents in village Gualda

Sr. No	Name of Respondent	No. of Buffaloes						No. of cows						Draft	Goats/	Average Milk per day				Total Milk Per Day	Mode to Sale	
		Young		Adult		Total		Young		Adult		Total		Animals	Sheeps	Buffalo		Cow			Locally	Local Vendor
		L	I	L	I	L	I	L	I	L	I	L	I	-	-	L	I	L	I		-	-
1	Amin Khan	3	0	3	0	6	0	0	0	0	0	0	0	0	0	26	0	0	0	26	0	16
2	Hakam Ali	2	0	3	0	5	0	0	0	0	0	0	0	0	0	20	0	0		20	0	12
3	Ash Mohamad	2	0	4	0	6	0	0	0	0	0	0	0	0	0	18	0	0	0	18	0	10
4	Supeda	3	0	3	0	6	0	1	0	1	0	2	0	0	0	28	0	0	0	28	0	18
5	Basir	3	0	3	0	6	0	0	0	0	0	0	0	0	0	24	0	0	0	24	0	14
6	Fatun	0	0	0	0	0	0	10	0	20	0	30	0	0	0	22	0	0	0	22	0	12
7	Rishal	2	0	10	0	12	0	2	0	2	0	4	0	0	0	20	0	4	0	24	0	16
8	Sadiq	2	0	3	0	5	0	0	0	0	0	0	0	0	0	16	0	0	0	16	5	0
9	Nasaru	1	0	3	0	4	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
10	Jamil	1	0	1	0	2	0	0	0	0	0	0	0	2	15	9	0	0	0	0	0	0
11	Ratan Lal	1	0	1	0	2	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0
12	Om Prakash	0	0	0	0	0	0	2	0	3	0	5	0	0	0	5	0	0	0	0	0	0
13	Vishnu Dutt	2	0	2	0	4	0	0	0	0	0	0	0	0	0	16	0	0	0	16	6	0
14	Mange Ram	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	Lal Chand	1	0	1	0	2	0	0	0	0	0	0	0	2	0	9	0	0	0	9	0	0
16	Kallu	1	0	1	0	2	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0
17	Jaleba	1	0	1	0	2	0	0	0	0	0	0	0	0	0	8	0	0	0	8	0	0
18	Goonga	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
19	Ishan	1	0	1	0	2	0	0	0	0	0	0	0	0	9	0	0	0	0	9	0	0
20	Puran	1	0	1	0	2	0	0	0	0	0	0	0	2	0	8	0	0	0	0	0	0
21	Pyarelal	1	0	1	0	2	0	0	0	0	0	0	0	2	35	8	0	0	0	8	0	0
22	Chhaga	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
23	Hanif	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Sr. No	Name of Respondent	No. of Buffaloes						No. of cows						Draft	Goats/	Average Milk per day				Total Milk Per Day	Mode to Sale	
		Young		Adult		Total		Young		Adult		Total		Animals	Sheeps	Buffalo		Cow			Locally	Local Vendor
		L	I	L	I	L	I	L	I	L	I	L	I	-	-	L	I	L	I		-	-
24	Muhin Khan	0	0	0	0	0	0	5	0	10	0	15	0	0	0	0	0	12	0	12	0	0
25	Usman	1	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	10	0	10	0	0
26	Mattoo	1	0	2	0	0	0	3	0	0	0	0	0	0	0	0	0	10	0	10	0	0
27	Shamsher	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
28	Ummar	0	0	0	0	0	0	5	0	15	0	20	0	0	0	0	15	0	0	0	0	0
29	Noor Deen	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	Mumtaj	1	0	2	0	3	0	0	0	0	0	0	0	0	0	9	0	0	0	9	0	0
31	Jamil	1	0	1	0	2	0	0	0	0	0	0	0	0	0	10	0	0	0	10	0	0
32	Noor Hasan	0	0	0	0	3	0	3	0	4	0	7	0	0	0	8	0	0		8	0	0
33	Nabia Karim	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Abdul Rahman	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
35	Salman	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
36	Lukeman	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
37	Suleman	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
38	Hifjur Rahman	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
39	Attaulah	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
40	Balwand	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
41	Kullu	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
42	Sher Mohmad	0	0	0	0	2	0	3	0	5	0	0	0	0	0	9	0	0	0	0	0	0
Average		**0.8**		**1.2**	**0**	**1.9**	**0**	**1.5**	**0**	**2.4**	**0**	**0**	**0**	**0**	**2.31**	**8.7**	**0**	**0.9**	**0**	**9.55**	**0.26**	**2.33**