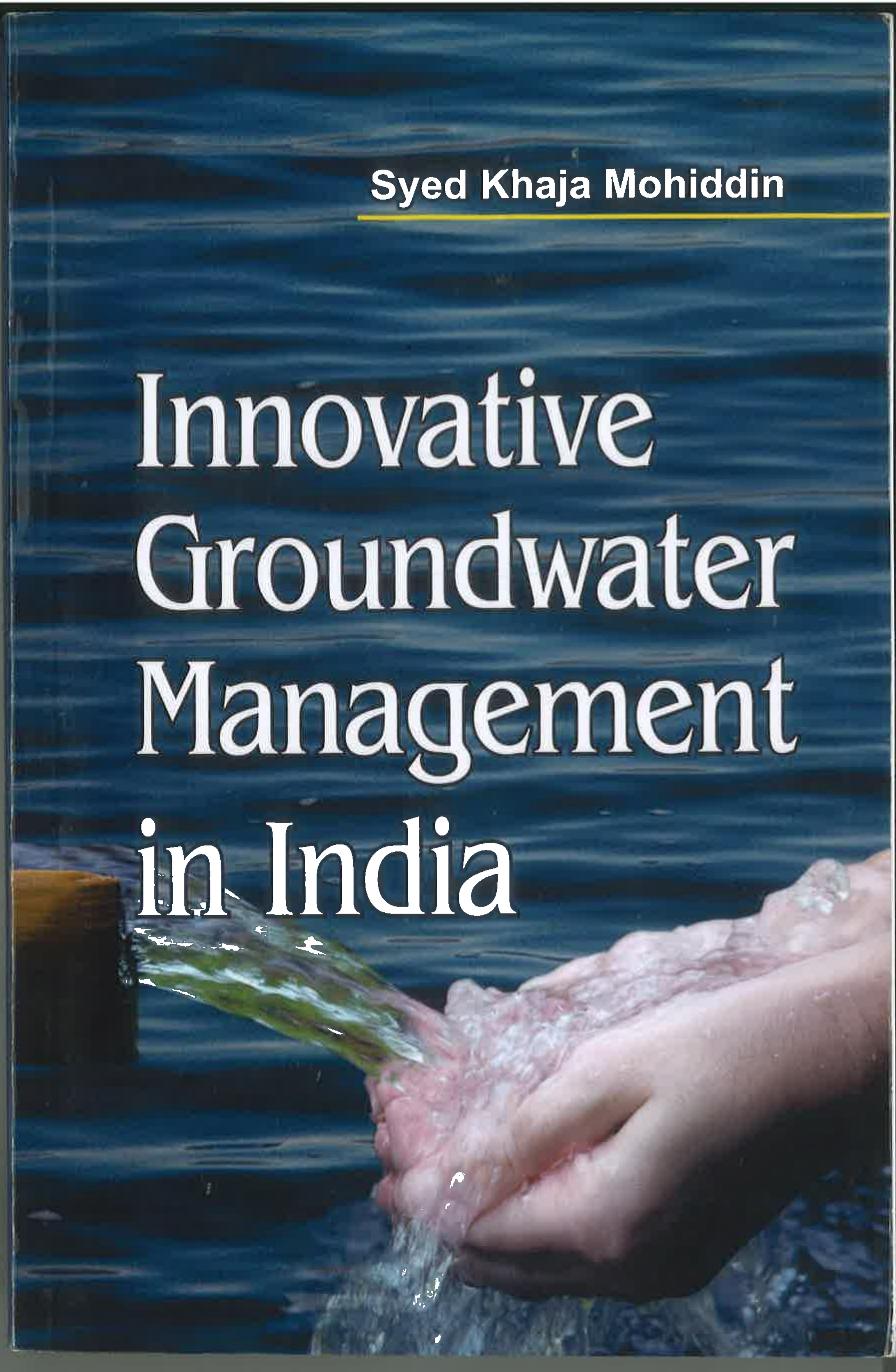
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Water Management in Villages of Mewat, Haryana: An Approach for Integrated Water Resource Management

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1.0 Introduction

Mewat is a region which falls partially in Haryana and in Rajasthan, with the Aravali hill range across it. Aravalis are the oldest hill ranges in India and have become mostly denuded. The soil cover on the hills has been eroded and flora is found only in small patches, the rest being barren rock. During summer, dust storms from Rajasthan desert hit the Aravali hills resulting in sand dunes at the foot hills, which also adversely affect the flora. Underground sweet water is found only in the foothills of the Aravalis, otherwise it is mostly brackish.

Mewat takes its name from Meos, a muslim peasant caste that converted from Hinduism to Islam, however they preserve many Hindu customs. Agriculture and wage labour (30% of population) is the dominant occupation. As many as 40% households are landless and 40% have marginal land holdings. The agriculture is primarily rainfed with mustard and pearl millet being the main crops. Due to water constraints, farmers can mostly cultivate only one crop a year and the second crop is possible only if there are timely rains. The availability and quality of water is of primary concern in Mewat as only 63 villages have fresh water out of 503 villages, rest having saline water. A tailor made, integrated water management plan is needed for each village, with the first step being the study of topography, water flow, soil characteristics and traditional knowledge. Subsequently, high impact interventions can be chosen. Sustainability of interventions is also a function of equity, as a critical mass of people will come together if all are going to be benefited.

In Ghaghas the quantity of available groundwater was inadequate and fast depleting, its quality too was poor with high content of nitrates[1] and fluorides[2]. Since the groundwater of Ghaghas is an important water source for several neighbouring villages, they are also adversely affected. This scenario is now improved with the interventions.

As in many villages of India, here too the domestic waste water flows into the streets, creating dirty puddles which are a breeding ground for pathogens and their carriers. This water is a medium by which the groundwater gets contaminated due to open defecation, open composting and excessive use of chemical fertilizers and pesticides in the agriculture. To address the high nitrate and fluoride contents found in the drinking water, it was decided to adopt the dilution method where fresh rainwater is mixed with groundwater and reduce the concentration of contaminants bringing it closer to recommended standards by World Health Organisation (WHO) and at the same time the groundwater is replenished.

1 High level of nitrates is due to agricultural chemicals.
2 High level of fluorides is due to concentration of natural fluorides because of depleting water quantity.

2.0 Major Problems of Mewat Region

Mewat is earmarked by presence of Aravali hills that are continuous on one side and intermittent on another side. These hill ranges have high slope and are mostly denuded. The soil cover on the hills has been eroded leaving thin vegetation cover in patches. It provided high velocity for rainwater runoff and rainwater is immediately drained off the site without providing much time for percolating into the ground. Underground sweet water is found only in the foothills of the Aravalis, otherwise it is mostly brackish (Fig. 1).

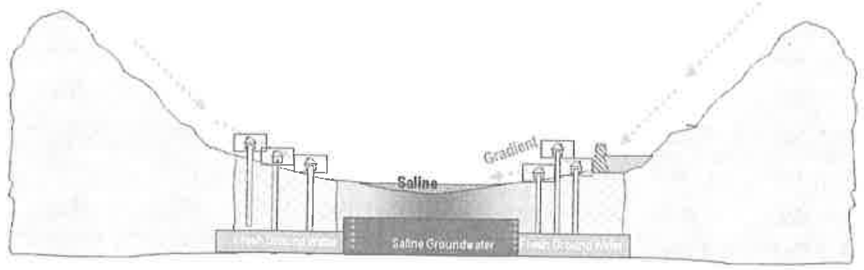

Fig. 1: Typical topographical setting and groundwater situation of Mewat region

The major issues to be addressed in Mewat region include:

1. Rapid depletion of fresh groundwater
2. Advancement of saline groundwater towards fresh groundwater pocket
3. High pressure on freshwater zone supplying water to neighbouring villages.
4. Conflict between villages on water sharing
5. Poor water quality due to presence of Iron, nitrate, fluoride etc
6. Lack of waste water disposal system

7. Degraded ecology and denuded hills all around
8. Community sensitization and empowerment

3.0 Methodology

3.1 Working with the Community

As a first step, the requirements of the people are identified at community meetings followed by survey of the region together with some villagers, their knowledge is solicited, experts are brought in and S M Sehgal Foundation's engineer works out a draft blueprint. The blueprint has details of design, material, timelines and costs which is presented to the community. The villagers often modify it and also decide on what they can contribute, since some contribution from them is mandatory by the Foundation's policy. In this whole process the Village Level Institution[3] Village Champion[4] & Panchayat are involved.

3.2 Cost effective technology

It is very important to keep the cost of the structures very low so that they can be easily implemented. It also increases the possibilities of replication by local communities or other people having similar conditions. The structure like soak pits, recharge wells, check dams etc have been modified in design to minimize the construction material, labour and the cost.

3. Village Level Institution is a local peoples' association, inspired by the Foundation, which is dedicated to the benefit of the whole community, based on the needs of the people, and is impartial to the socioreligiouseconomic dynamics of the village. The Panchayat also works for village development but is a political body and is mostly handed down funds for highly specific actions, as decided by the higher Government authorities, often without consulting the local people.
4. A Village Champion is a respected local person with leadership qualities, who acts as a development cheer leader and has natural altruism in her/his personality to work for the benefit of the whole village.

3.3 Ridge to valley approach

The execution of project was based on ridge to valley approach where rainwater is stored for direct use as well as for groundwater recharge in entire watershed, right from ridge to the valley (highest elevation to lower level). A large number of structures were implemented in the villages of Mewat (Fig. 2).

a. Contour trenches

Contour trenches are used both on hill slopes as well as on degraded and barren waste lands for soil and moisture conservation and afforestation purposes. The trenches break the slope, length and reduce the velocity of surface runoff. The water retained in the trench help in conserving the moisture and provides advantageous sites for sowing and planting. Large numbers of trenches were constructed on Aravali hills.

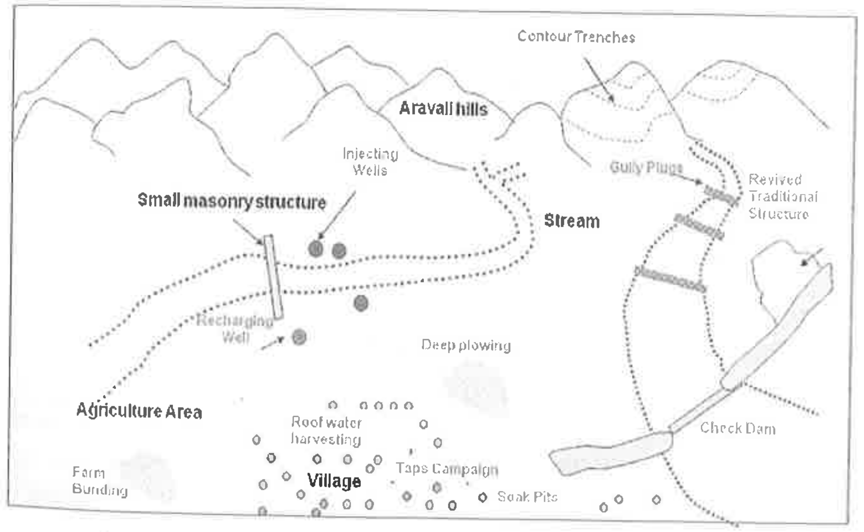

Fig. 2: Illustration of ridge-to-valley approach adopted in villages of Mewat

Fig. 3: Nallah bund

b. Loose stone structure

A loose stone structure help in slowing down the velocity of runoff and also induces some sedimentation before it leaves for the downstream structure. Their main function is acting as a barrier for water flow providing more time for sediment settlement and percolation into ground. Sometimes they are also packed in wire mesh and often called as gabion structures (Fig. 3).

c. Gully plugs

They are constructed across small gullies or nallahs to check the rapid flow of water and minimise soil erosion. They can also facilitate reclamation of broad and shallow gullies for agricultural purpose, provided the runoff discharges are within limits. It also encourage vegetative growth because of favourable moisture situation created by impounding water.

d. Check dam

Two check dams were constructed across the drainage channels along the Aravalli foot hills. This has helped in

minimising the soil erosion, property damage, soil moisture apart from improving the groundwater levels. It also provides water for direct use as water remains impounded for shorter duration before percolating into the ground (Fig. 4).

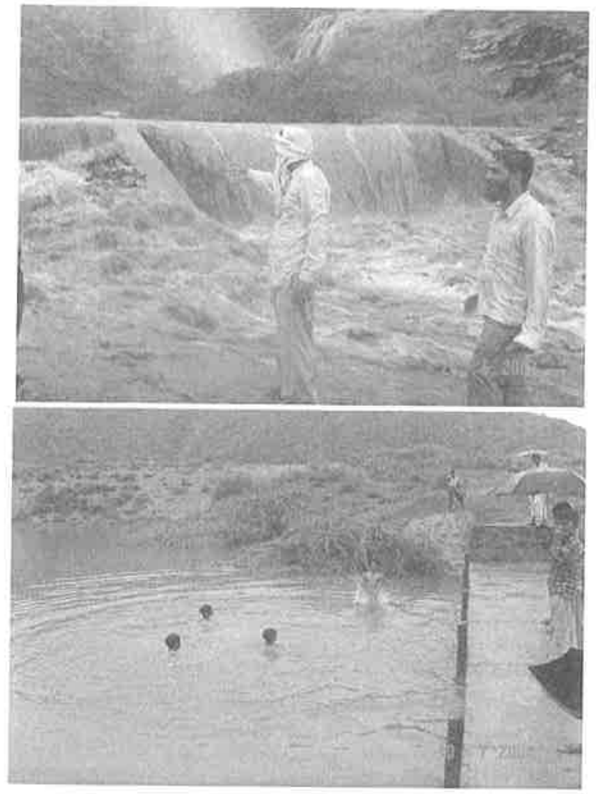

Fig. 4: Check dam during monsoon season

e. Recharge well

Recharge wells are simple structures that facilitate movement of rainwater into the ground. It helps in delivering water to such a depth so that it gets cut off from the atmosphere and minimises the water losses including evaporation and loss of soil moisture.

Through recharge wells we have been able to create fresh water pockets within saline water zones. It has increased the availability of fresh water within the saline water areas (Fig. 5).

f. Injection wells

Injection wells are similar to recharge wells but with a deeper recharge bore. They ensure that water is recharged at deeper levels of aquifers. They can handle a large quantity of water.

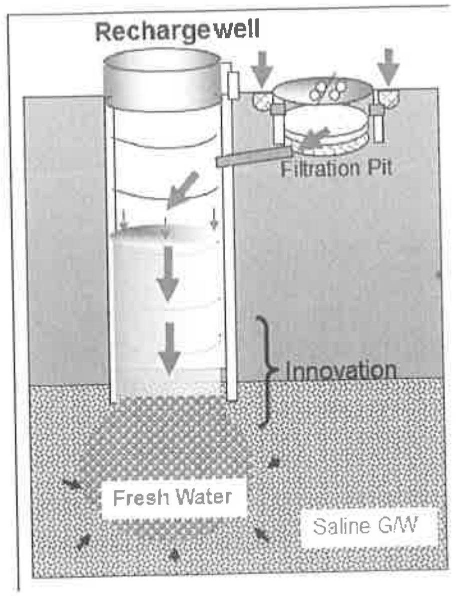

Fig. 5: Creation of fresh water pocket within saline water zone

g. Culvert treatment

There exists a road along the foothills of Aravali passing through many villages. This acts as a barrier for water hence there are large numbers of outlets crossing the road to bypass the water without damaging the road. These drains are equipped with culverts, the crescent shaped walls were

constructed at several places to collect water and provide enough time for percolating it into the ground. Excess water could overflow from the structure (Fig. 6).

h. Rooftop rainwater harvesting

Rooftop rainwater harvesting was implemented at public places like school buildings. Rainwater stored in tanks provided water for direct use as well as excess water was used for groundwater recharge. The main objective of implementing it in school was larger dissemination of the concept so that more and more people implement rainwater harvesting system (Fig. 7).

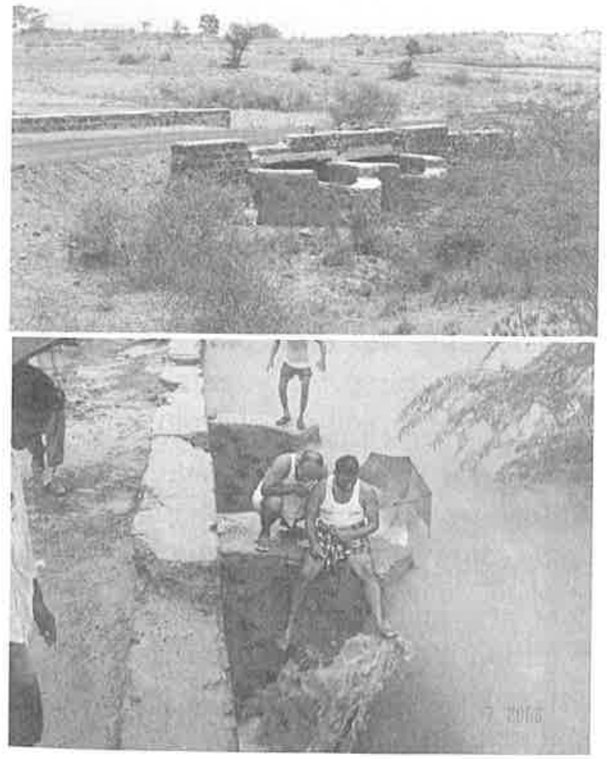

Fig. 6: Culvert treatment to facilitate groundwater recharge

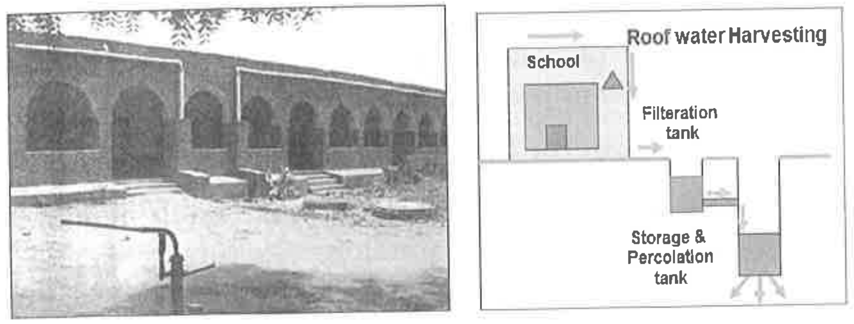

Fig. 7: Rooftop rainwater harvesting in school

i. Revival of traditional water harvesting structures

Many ponds were desilted in the villages to facilitate groundwater recharge apart from increasing availability of surface water for direct use both for humans and cattle.

j. Deep ploughing

Due to excessive use of chemical fertilizers and salts deposited by rainwater a hard pan of salt is formed at aproximately 10-15 inches below the ground surface. It reduces the percolation of rainwater into the ground and also affecting the crop productivity. In order to break this hard layer, deep ploughing was done using chisel (an equipment allowing deep ploughing). It substantially increases the recharge rate from the soil apart from increasing the crop production.

k. Bed making

Farmers practice flood irrigation in the region which required lots of water. Bed making was promoted as an alternative option in the village and it resulted in reduction of irrigation water requirement upto 40% as compared to conventional method. It also helps in retaining soil moisture for longer duration.

l. Checking leakages

The leakages in the water supply system were rectified with the help of community and water supply department (PHED). It helped in saving of fresh water and increased the reach in larger areas.

m. Stand post and tap campaign

There is water supply network in the village but lack the proper stand posts which was resulting in wastage of fresh drinking water. Proper stand posts were constructed at places where public water supply was flowing unregulated (Fig. 8).

n. Soak pits

Every household generates approximately 800 litres of waste water every day in these villages. In absence of any disposal system domestic waste water flows unregulated and accumulates in streets. It acts as a source of mosquito breeding ground apart from creating filthy and unhygienic environment. Soak pits are small structures that help in getting rid of waste water at the same time recharging the groundwater. They were constructed in individual houses. For cluster of houses, soak wells serve the same purpose by absorbing the waste water in large quantity.

o. Plantation

Soil erosion from the catchment area was a major issue as the hills were denuded and having thin vegetation. It was resulting in heavy silt load along with runoff and posing threat for all recharging structures. Plants like babool (*Acacia nilotica)*, dhak (Butea monosperma), keekar (Prosopis juliflora), amla or Indian gooseberry (Emblica officinalis), neem (Azadirachta indica), papri (Holoptelia integrofolia) were planted on the catchment areas and grasses like vetiver, doob grass (Cynodon dactylon) were planted on earthen embankment, check dam etc.

p. Water literacy campaign

Meo Muslim community which is majority population in Mewat, is considered as highly backward financially, educationally, socially and culturally. There is very little understanding about the importance of water conservation. They do not think about consequences of degradation of water quality they may face in near future. Series of awareness programmes and meetings with focus groups, panchayat members, leaders, key persons, school children and teachers, men and women were carried out in each village numbering 12 to 14 per year.

4.0 Case Study: Ghagas Village, Mewat, Haryana

Ghaghas is one of the villages where water interventions were implemented by S M Sehgal Foundation to solve the water problems in Ghaghas as well as neighbouring villages (Fig. 9 to Fig. 13). The check dam receives runoff from approximately 2.75 square kilometre catchment area, which percolates about 100,000 kiloliters (KL) of water per annum. The fifty six soak pits of Ghaghas also contribute 4,088 KL into the ground. In Ghaghas, 90 acres of land was deep ploughed by chisel and contributing 202,500 KL (4500 sq. meter x 0.5 average rainfall x 90) of water into the ground per year. Following table shows the structures implemented in Ghaghas and its potential:

Table 1: Water management interventions in Ghaghas village and Figure: Soak pit design

S. No	Interventions	Annual harvesting potential (KL)
1	Check dam - 3	357000
2	Recharge well - 3	6360
3	Rooftop rainwater harvesting - 3	900
4	Soak pits – 104	7592
5	Deep ploughing – 90 acres	202500

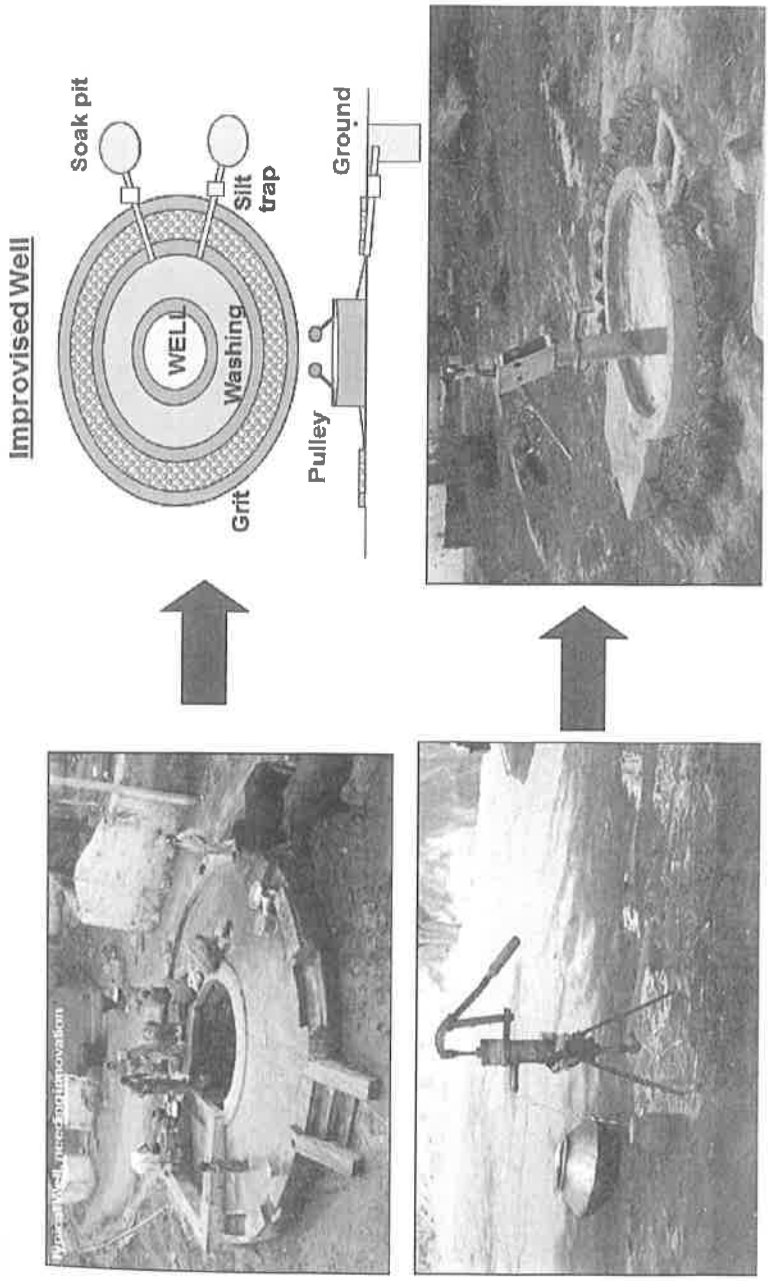

Fig. 8: Improved sanitation and hygienic environment through innovative design
Case study: Ghaghas village, Mewat, Haryana

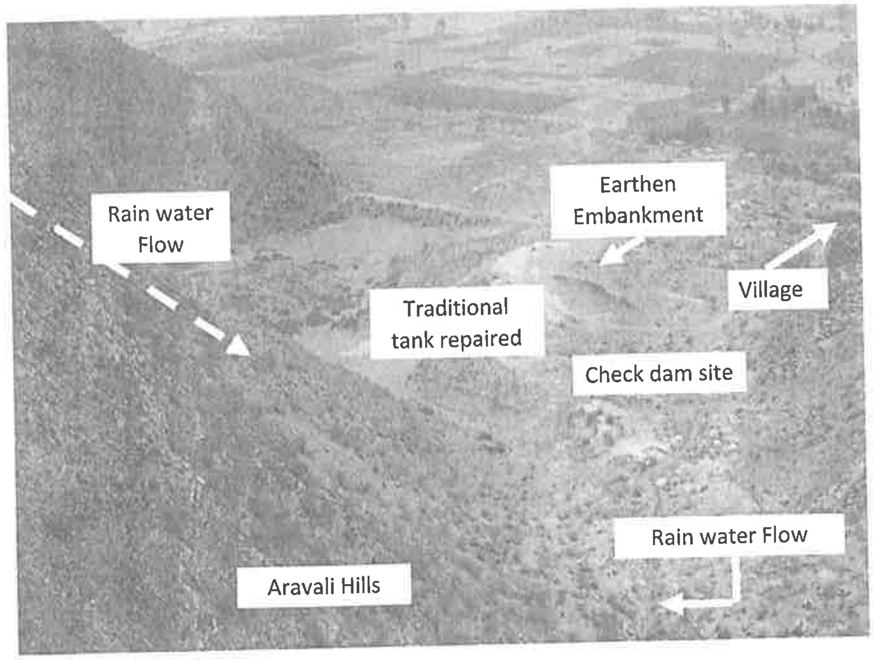

Fig. 9: Integration of new structures with revived traditional ones.

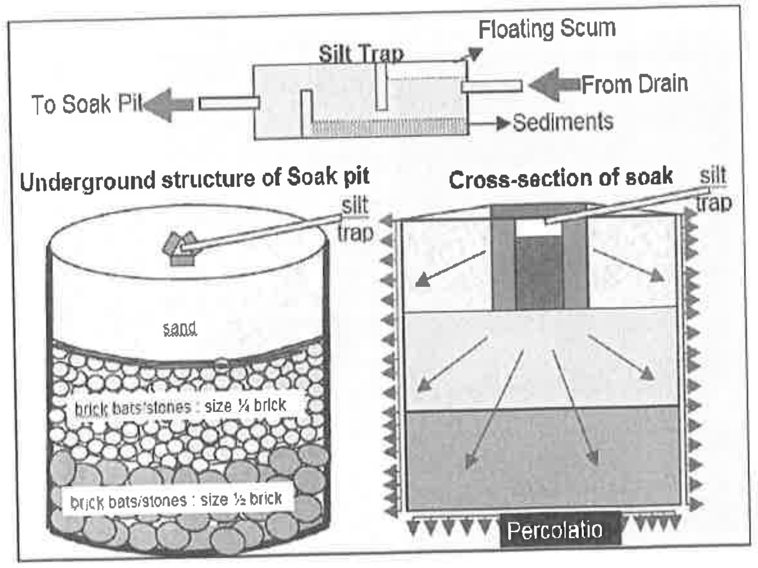

Fig. 10: Percolation of stream water before it gets contaminated

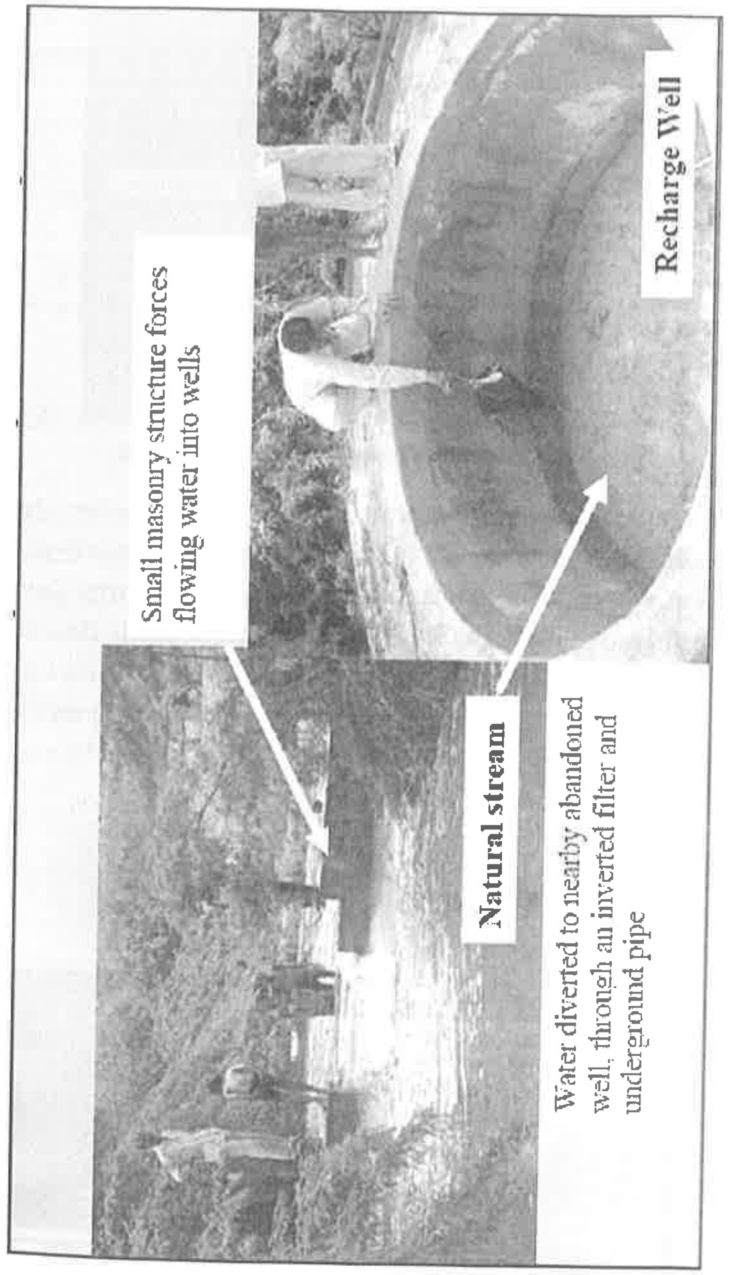

Fig. 11: Ground-water recharging through well in Ghaghas

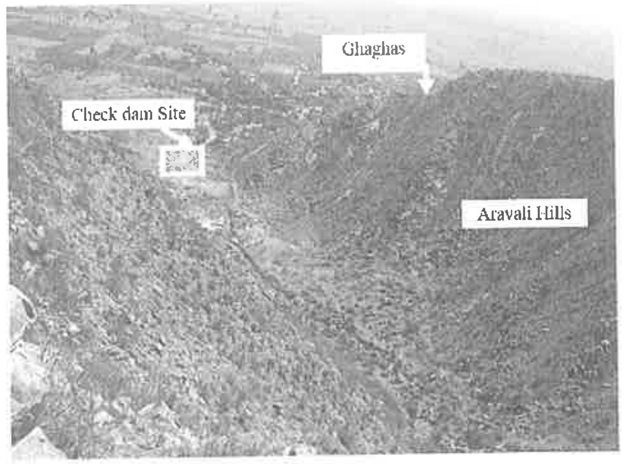

Fig. 12: Check dam sites in Ghagas Village

To counter the contamination of groundwater due to open defecation, the Foundation promotes several models of latrines which it has customized[3] for different economic backgrounds of villagers, with a cost range from Rs. 500 to Rs. 3000.

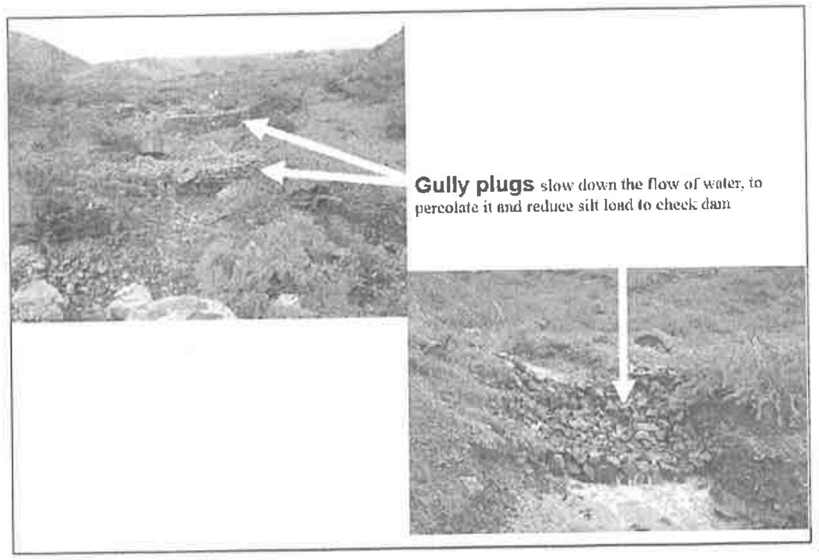

Fig. 13: Integrated Ridge to Valley Approach in Ghaghas

The groundwater was tested over a period of one year between June-03 to July-04, shows the encouraging trend of improvement in groundwater levels (Fig. 14).

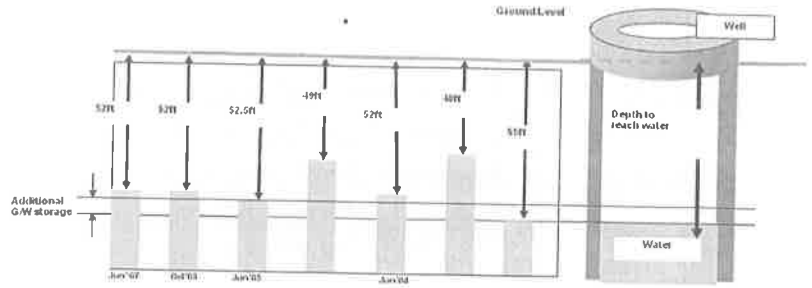

Fig. 14: Trend from water levels in Ghaghas village from rainwater harvesting

Apart from improving the water levels, it resulted in increased water availability to villagers for different uses including domestic, cattle and irrigation. It also diluted the undesirable salts and other contaminants present in the groundwater to even below the recommended figures by the WHO/BIS (Table 2). The villagers too noticed the change in the taste of water (Fig. 15).

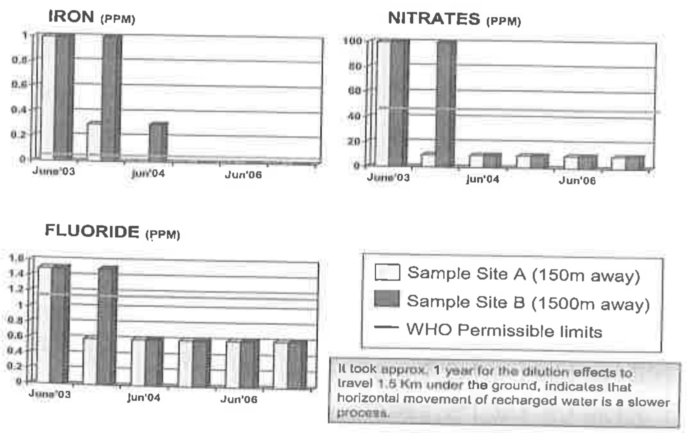

Fig. 15: Water quality improvement in Ghaghas village from rainwater harvesting

Table 2: Change in ground water quality, due to check dam

Parameter	Standard permissible Limits	Sampling Site - B Parts per million (ppm)			Sampling Site – A Parts per million (ppm)		
ampling on		Jun-03	Dec-03	Jun-04	July-03	Dec-03	Jun-04
pH (units)	6.5-8.5	8	8	8	8	8	8
Coliform	Nil	Nil	Nil	Nil	Present	Nil	Nil
Fluoride	1	1.5	1.5	0.6	1.5	0.6	0.6
phosphorus	-	< 0.1	< 0.1	< 0.1	-	< 0.1	< 0.1
Nitrate	45	100	100	10	100	10	10
Iron	0.3	1	1	0.3	0.3	< 0.3	-
Hardness	300-600	288	288	320	336	320	220
Chlorides	250-1000	269	248	88.6	267.35	159.5	152.4
Ammonia	-	0.2	0.2	< 0.2	0.2	< 0.2	< 0.2
Turbidity (NTU)	5	25	10	< 10	< 10	< 10	< 10

The high concentration of nitrates and fluorides reduced to levels less than permissible limits, within a period of 6 months after the 2003 monsoon, at Site A (Fig. 16). However for this effect to reach 'Site B it took another 6 months. In case of iron, in a period of one year the concentration reduced to zero at Site A, which is the permissible limit, whereas at Site B the concentration of iron is still 0.3 mg/lt. though it reduced from the baseline which was 1 mg/lt. These dilution results in one season of rain are encouraging and will continue further in successive seasons.

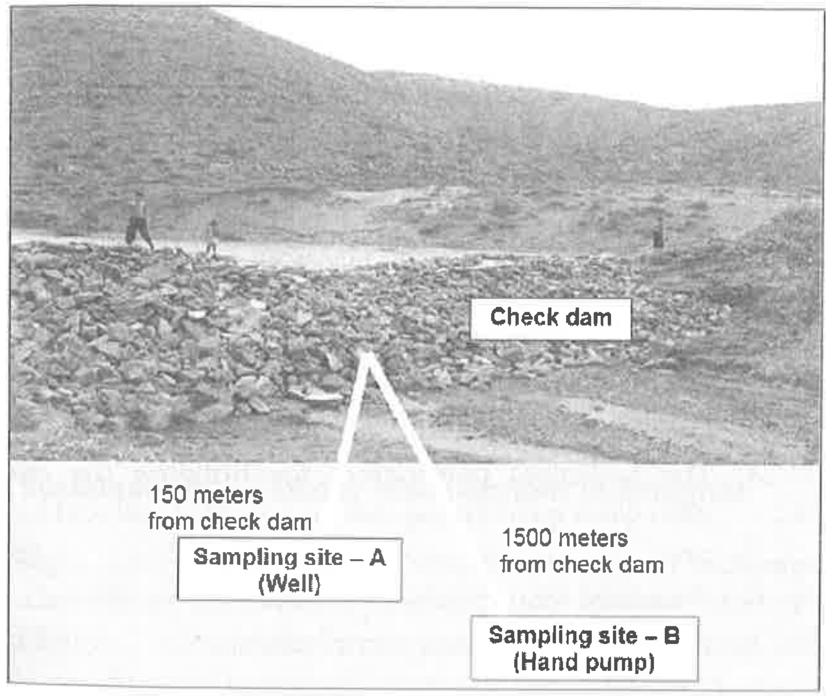

Fig. 16: High Nitrate & Fluoride levels reduced due to check dam

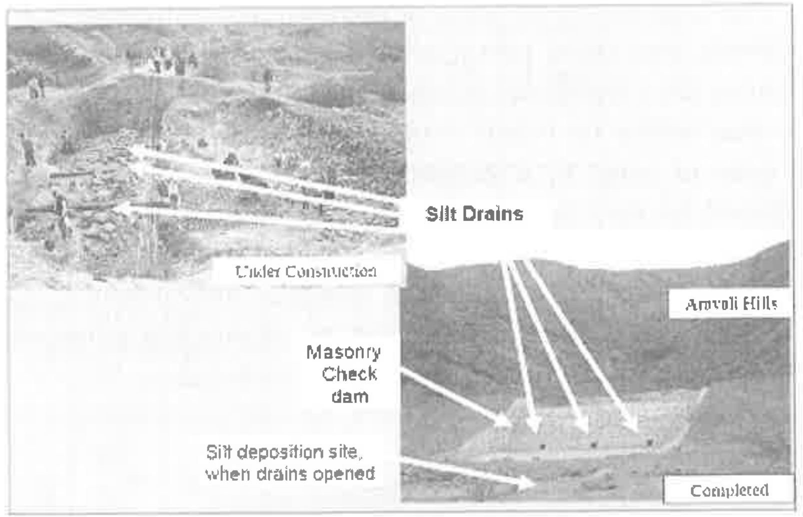

Fig. 17: Silt Drains of Check dam

4.1 Summary & Discussion

a. What worked in Ghaghas

1. Involvement of the community during planning and getting their commitments in advance.
2. High need for the intervention (Fig. 17).
3. The technical parameters for building the check dam were good for e.g. permeability of soil and basin area.
4. Financial transparency won respect.
5. Affordable costs and contributions.
6. Consistent and regular communication by all staff members

b. Difficulties faced in Ghaghas

1. Community contribution and collection happened only at the last minute for timebound projects like check dams, which had to be built before onset of monsoon.
2. The village task force in charge of supervising the construction was not up to mark in its involvement.

c. What would the Foundation do different

1. Women would be involved more, particularly for supervision of projects. They are more sincere and take more pride in community work
2. Before starting the projects, the Foundation would spend more time with all sections of community including school children and youth on Water Literacy, through a curriculum.
3. Village communication would be improved using proven IEC tools like newsletter to inform of project progress and acknowledge role models.
4. Even if it means slowing down the work, the Foundation would limit its assistance to only a technical advisory role and joint financial management. Thus villagers would handle the projects much more independently from the beginning itself in supervising the work, procuring material and organizing labour.

4.2 Sustainability of Water Management in Ghaghas

Right from the beginning, Sehgal Foundation facilitates discussions on the urgency of taking development into one's own hands, talks of the partnership mode of working and declares that its handholding would be only for 4 years, within which period sustainability has to be achieved. An Executive Committee member of the Village Level Institution becomes incharge of water management. For all the work, labour is from the village, so the people automatically get trained and their confidence increases. Selected individuals are provided training on maintenance. 'Who is incharge of what', is well communicated within the village.

Some panchayat members are part of the Village Level Institution and Sarpanch is an automatic nominee. Thus, whenever possible synergies will be made using Government funds.

Conclusion

This paper highlights ways in which groundwater can be managed. When the community participates and has to contribute financially, there is pressure to innovate. Lot of credit goes to a few progressive villagers who are willing to try out new things and subsequently become demonstrators for others. The Foundation's model depends a lot on volunteerism in the village and believes that further research on this is needed.

The Foundation uses the principle that 'success builds success', and focuses on small interventions which can make big impact. When the Foundation came to Ghaghas about 1.5 years ago, there was much resignation, however in a relatively short time this has got converted to enthusiasm after the villagers saw the water filling up in the check dam and percolating into the ground ten times, during the intermittent monsoon showers. The Foundation believes that rural development need not be as expensive as often perceived and trust building need not be too time consuming either, if the organization walk sits talk and plans properly in terms of benchmarks, timelines and deliverables. Though the Foundation has had its share of problems both technically and in community mobilization, in general the villagers' patience, trust and welcome has been rewarding.

References

1. Village Ghaghas is in Nagina Block, Gurgaon District. This is the Mewat region of Gurgaon, populated predominantly by Meomuslims. The social indicators of Mewat region are low. The population of this village is about 2000 people i.e. 300 families.
2. The Bureau of Indian Standards: WHO guidelines on water quality, (desirable and permissible limits of substances (contaminants)

   (a) http://www.webhealthcentre.com/expertspeak/indianstandards.asp

   (b) http://www.webhealthcentre.com/expertspeak/indianstandards.asp