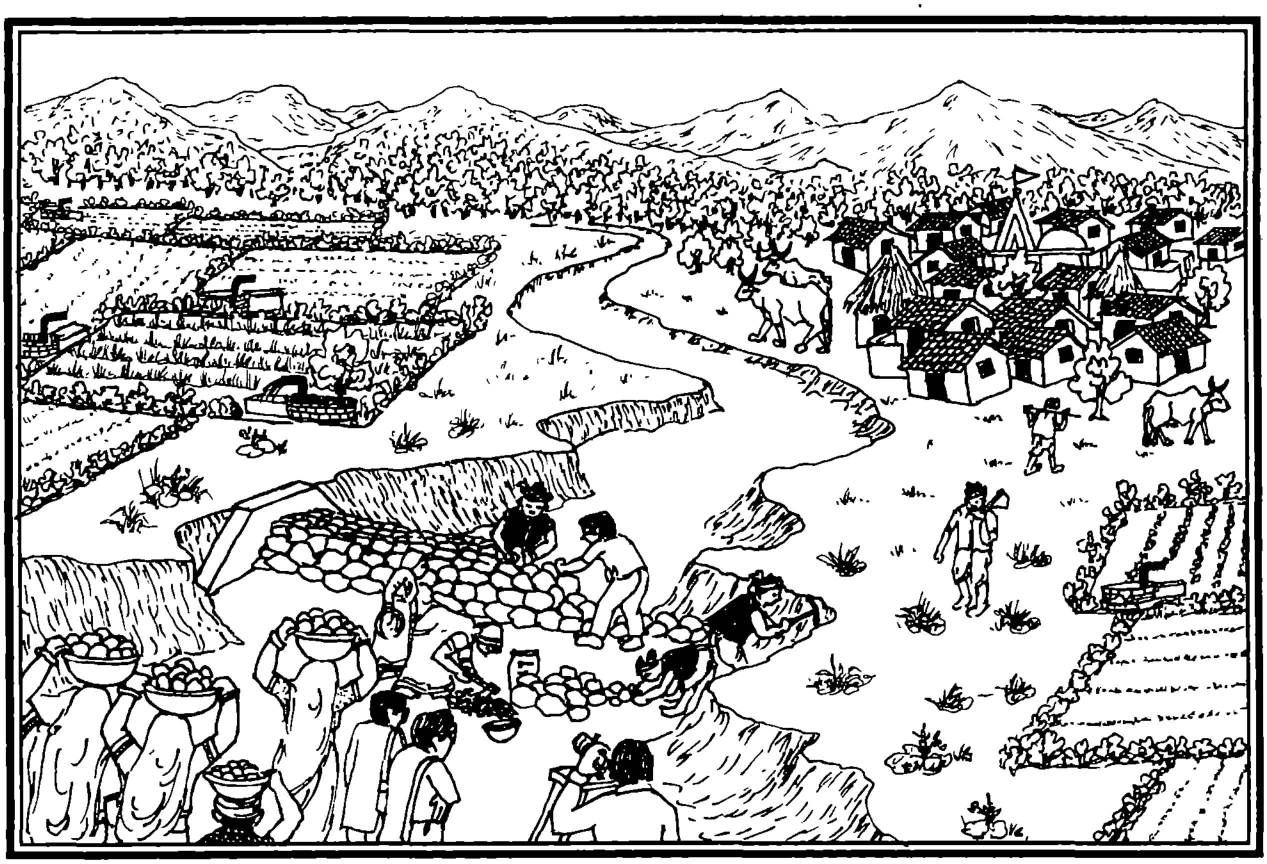
Local Water Management Initiatives: NGO Activities in Gujarat



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Preface

The articles collected in this monograph are by a range of Non-Government Organizations (NGOs) and deal with their activities in the water management, particularly groundwater, area. They were prepared as background material for a meeting to initiate coordinated NGO research and support activities. The meeting was held at VIKSAT on February 18th, 1993.

NGOs have been involved in a wide variety of activities across Gujarat to try to help communities address groundwater availabiltiy and quality problems. The monographs written by individuals from AKRSP, SVRTI, MAHITI, and VIKSAT indicate both the depth of effort being devoted to groundwater problems and the complexity inherent in developing solutions.

Reading through the monographs, the range of issues NGOs face in developing appropriate water management approaches becomes evident. Basic hydrological data are often lacking. As a result, it is often unclear exactly what benefits are present from recharge activities. The distribution, magnitude and economic value of benefits are also generally unclear. Economic as well and hydrological research are be required to determine how much local communities can benefit from groundwater recharge -- and therefore how much they might be expected to contribute to management efforts. Furthermore, while most NGOs focus on increasing supply (via groundwater recharge), end-use patterns and efficiency may ultimately be the most important factors determing groundwater resource condition. This factor is mentioned in almost all the NGO articles submitted for this publication.

Beyond the question of basic hydrologic and economic information, many NGOs face issues in the acceptance of their project results. Mahiti's experience working in the Bhal area of Gujarat illustrates this issue particularly well. Groundwater in the Bhal area is saline and can't be used for drinking or other domestic uses. As a result, Mahiti developed a water supply approach based around the construction of lined tanks. This approach was not accepted by the state government -- despite the lack of alternate water supply sources -- because the tank water did not meet potability standards. Local people, however, found the tanks invaluable as a source of water for livestock, household use, and (in times of great scarcity) drinking. In the absence of alternative sources of supply, even moderate quality water can have very high value from the perspective of local communities. As in the case of Mahiti, NGOs often encounter resistance from the professional water management community to the results and value of local experiments.

The meeting at VIKSAT on Febuary 18th, 1993, ended in a decision among individuals from the attending NGOs and Academic/Research Institutions to initiate networking activities in the groundwater management area. Participants from academic and research institutions will be writing short notes on the range of research issues they view as critical to identify effective avenues for groundwater management. NGOs will be examining their own programmes and needs to identify action research activities that could both benefit them and have wider significance. There was a general agreement that a working group on groundwater including high level government representation should be formed. Mr. Anil Shah from AKRSP agreed to initiate activities in this direction. VIKSAT itself agreed to coordinate initial network meetings, link academic and NGO activities, and assist NGOs in defining a viable action-research strategy.

Marcus Moench

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Alternative Sources of Drinking Water:

The Mahiti Experiment

Nafisa Barot

Background

In 1981 UTTHAN initiated work on the process of rural development in the Bhal region of Dhandhuka Taluka, Ahmedabad District, Gujarat. This was done through helping to develop a local organisation named Mahiti. The Mahiti team, which consisted mainly of local members, helped in the identification of major problems, their causes and possible alternative solutions. This was done through an intensive interaction with the village communities.

Drinking water scarcity was identified as one of the most crucial problems affecting very large sections of Bhal, including the four Districts of Ahmedabad, Bhavnagar, Kheda and Surendranagar. It rapidly became clear to the Mahiti team that unless drinking water problems were solved, no other development initiative would prove to be successful.

Approach :

Once drinking water was identified as the single most important problem facing development in the Bhal region, MAHITI decided to focus first on developing an in-depth understanding of existing water supply systems. Working with local people UTTHAN- MAHITI examined the existing official water supply systems (pipeline & tankers) as well as unofficial ones such as ponds, small dug wells in dry ponds, and the widespread practice of collecting water from broken points in the main water supply pipeline.

It rapidly became clear that major problems existed in attempting to improve water supply through pipeline systems and that efforts to strengthen these systems would probably be wasted. Problems are inherent in the nature of long-distance piped water supply systems under the conditions prevailing in rural Gujarat. In the Bhal case, the pipeline runs for roughly 100 kms through numerous villages. Those villages close to the head of the pipeline system are often 'better off' and more powerful than those at the end. They have more control over the water than villages at the tail end of the pipeline system. Since many villagers high in the system obtained extra water via breaking the pipe this left little -- if any -- for villagers at the end. Ultimately, the tail-end villagers were just fighting amongst themselves to obtain even a pot of water in summer.

Given the inherent problems in the pipeline system, MAHITI initiated a search for other alternatives. Solar Distillation Reverse Osmosis, roof water collection and harvesting rain water in LDPE lined ponds were tried out. Amongst all the alternatives, rain water harvesting in LDPE lined ponds found the widest acceptance. This was due to several factors: 1) the idea was put forward by the local people and was based on their traditional systems; 2) it was technically feasible in the highly saline tracts characterizing the Bhal area; and 3) the local communities were confidant that they could develop and maintain pond based systems without much outside support. This last factor was particularly important. Local communities had little confidence in the viability of systems dependent on the continuous availability of technical or other support from external sources.

Hydrology :

Salinity is the most significant problem facing the development of local water supply systems in the Bhal area. The Bhal area is hydrologically distinct. Water from four different sources (rainfall, river inflow, the sea, and groundwater) mixes at different points across the area.

Sr. No.	Source of water	Characteristics
1.	Direct precipitation	The water accumulates in shallow depressions and spreads extensively due to flat topography and low soil permeability. Rainfall is highly variable.
2.	River discharge	Rivers flowing from the uplands of north Gujarat and Saurashtra discharge into the Bhal plains and cause inundation during the monsoon.
3.	Sea water	Monsoon storms and regular high tides cause sea water to spread extensively over coastal low lands. It flows through rivers and creeks up to several kilometers inland. This adds to inundation and salinity.
4.	Ground water	The phreatic aquifer gets recharged from surface water sources. Due to proximity to the ocean, much of the groundwater in unconfined aquifers is saline. Deep artisian aquifers are also present but saline.

Water resources in the Bhal area are abundant but often saline. The extreme climatic conditions and peculiar terrain render create an imbalance with the water requirements. In the monsoon even very low rain fall causes inundation in many areas. During post monsoon period, the remaining water progressively turns saline. Observations by Mahiti indicated that even with minimum rainfall (200 to 300 m.m.occurring over short durations) the village ponds would fill and overflow at times. Even when rainfall levels were low, however, a large part of the area would get water-logged. Slowly all sweet the rain water would turn into saline water. Groundwater, although abundant, could not be used as a drinking water source. The underground water table is not only too high, but extremely saline. It is not useful for any purpose other than producing salt. As a result no potable water is left in summer which can be used for domestic purpose.

Despite the problems, the flat topography and low permeability soils present an opportunity. Estimates made by MAHITI suggest that 50 to 60 percent of the run off water could be harvested in tanks excavated in appropriate locations. In order to serve as sources for drinking water the catchment area of tanks has to have soils with a relatively low salinity. In addition, water must be isolated from salinity in the soil and near-surface groundwater if it is to remain usable over the long dry season. It was found that almost every village had sufficient catchment area containing low salinity soils to generate the necessary water for village requirements. Lining ponds with LDPE served to isolate the water from contamination with salinity over the long seasonal storage period. Catchment details for the villages Mahiti worked in initially are given below.

Village	Volume of water required for village needs in CM	Catchment needed to generate water by rainfall level	
		* 100 mm	**250mm
Zankhi	11,000	11	4.4
Rajpur	11,000	11	4.4
Mahadevpura	16,000	16	6.4
Vihnu	16,000	16	6.4
Rahatalav	20,000	20	7.0
Bhangadh	26,000	26	10.4
Mingalpur	40,000	40	16.0

* Run off corresponding to 200 mm rainfall

** Run off corresponding to 500 mm rainfall

Intervention Strategy :

The observations made by Mahiti supported the idea of harvesting rain water in LDPE lined ponds. Mahiti's goal was to supplement the piped water supply and create water sources that could be used for a range of community needs (such as washing and livestock) in addition to drinking. To demonstrate the viability of this strategy a crude demonstration was initiated in 1985-86 in a village called Rahatalav. This demonstration was intended to show that water supplies could successfully be supplemented by local communities through simple structures such as the LDPE lined ponds. It was also intended as a basis for forcing decision makers to discuss the possibilities of improving the pond approach so that the results could be replicated on a wider scale. Based on the demonstration Mahiti assisted seven local communities in approaching the District Rural Development Agency and circulating a proposal for a wider pond lining project to the government.

The State's response (GWSSB) to the demonstration and proposal by Mahiti was not good. They claimed an inability to take up pond lining projects due to lack of funds for such experiments. In addition, the water was not accepted as "potable" under the definitions used by the GWSSB. As a result, the government could not justify the fund allocation or even put forward the request for the funds to either the Central Government or the World Bank. Due to interventions from the drinking water technology mission in 1987, funds were eventually obtained from CAPART for lining ponds and purchasing the necessary components in the seven villages discussed above. The State government (but not the GWSSB) cooperated by giving funds from RLEGP for excavation of the ponds. This was done because it was a drought year and the funds could be shown as part of a drought relief package.

At the same time as the project was beginning to move ahead, steps were made to improve relations with the GWSSB. Women's groups, a strong force supporting the project, were able to make some `friends'in GWSSB along with UTTHAN - Mahiti. By doing this they managed to find out ways of protecting the water collected in ponds so that it would remain sufficiently clean to meet the standards for `potable' water as per GWSSB norms. The key step to doing this was the development of a slow sand filter -- an idea introduced by one of the engineers of GWSSB.

Originally, Mahiti proposed purchasing a diesel pump to lift water from the pond and feed to a simple sand filter. Women in the villages suggested a gravity pipe. Ultimately, a fairly simple, pump based, system was devised. Raw water from the pond is pumped out by a centrifugal pump of having discharge capacity of 3 CM/hr. This water is allowed to pass through a leaf filter having a filtering capacity of 3 CM/hr for primary filtration. Final filtration is done by a sand filter of capacity 2 CM/hr. The clean and potable water is then collected in a FRP tank of 4 CM capacity. Water is withdrawn from this using a hand pump.

In the end, 8 ponds were constructed in 1987 in 7 villages of Bhal. Each of these made use of the sand filter. They contribute substantially to drinking water availability in the villages.

The Impact :

The impact of the above demonstration was widespread. Several villages involved in the tank lining project started sharing their water resources rather then quarreling. With increased water availability, the whole migration pattern changed since people no longer had to leave during the dry season. In addition, the women`s groups who had been so influential in initiating the project, gained confidence and started initiating a wide range of activities such as wastelands development, road building, lights, schooling of the children, piloo seed collection for sale, gobar gas exposure to other groups and most importantly training in community health. This list hardly could express the rise in their own self esteem, their changing status in their own communities and their solidarity and exhibition of strength against breaking the money lending systems of the most feared Darbars.

Despite the success of the LDPE lined tank project, it proved difficult to convince the GWSSB that there was any reason for them to include this type of alternative in their own programmes. They seemed indifferent to the role they could play to improve the quality of water. They were also unresponsive to the idea that local people had useful knowledge for the development of water supply systems and could take care of their own resources rather then GWSSB doing it !

As a result of government indifference, a number of activities were initiated to publicise project results. A combination of video documentation, photos/slides, written articles in newspapers and an effort to generate closer interaction with GWSSB and the World Bank did ultimately generate a great deal of publicity for the LDPE lined tank alternative. The range of reactions evoked by this pressure went from indifference ("ok we only need to do a pilot project") to sincere enthusiasm in some of the officials in the GWSSB to see how the alternative could be made successful on a larger scale. Outside of the government, the response to publicity was much greater. In the end, a combination of external pressure and the slow growth of governmental interest in the pond projects led to the generation of a proposal for constructing ponds in a much larger number of villages.

In addition to replication of the previous project results, the new proposal had two important components: (1) it included the cost for experts to design, monitor and document project efforts; (2) it also included funding for the total cost for generating peoples awareness to ensure their full

(2) it also included funding for the total cost for generating peoples awareness to ensure their full participation in the programme. These components were put up by UTTHAN - Mahiti and forwarded by GWSSB to World Bank. Ultimately, about 40 villages of Bhal applied for the construction of lined ponds in their villages. Of these, 14 villages were selected on a priority basis by GWSSB and the World Bank for rapid implementation.

NEEDS :

Mahiti's work in the Bhal has led to the identification of a wide range of issues that need to be considered in attempting to address local water problems.

* There is a great need to understand peoples own perception about water and their systems for managing it. These perceptions and systems need to be well documented and then communicated to designers, planner, and policy makers. Different groups often have different perceptions regarding their water "needs" from those of typical decision makers. They say, for example, "we want good drinking water' for human beings (which could be high quality), we want sweet water for cattle and for cooking (even if it is not very good quality water according to water supply norms) and we want water for washing, bathing & other uses (which again need not be `excellent' quality). These uses are often ranked by decision makers as of greater or lesser importance. The villagers view, however, is that they "need all this water for survival and know that it will never come from the pipeline." Simply supplying high quality drinking water may not be a solution to water "needs." It is also a fact that people use bad quality water-even if officials do not recognise it when their pipelines fail. Reliability is as essential a component of supply as quality.
* An effective system for systematic monitoring & documentation needs to be evolved that allows accurate evaluation of water supply programs such as those initiated by Mahiti. Often the only groups with scientific capacity are those with a vested interest in the continuation of existing water supply approaches. NGOs often have the capacity to assist communities in the development of innovative systems but they lack the capacity to document their results in technically acceptable ways.
* Systems need to be evolved so that new alternatives can be evaluated and brought into standard water management policy. At present, most of the groups involved in the development of alternatives are excluded from access to most policy forums.
* It might be useful to establish a platform where innovative ideas could be tried out and scientific and financial support could be obtained. Our group, for example, requires some technical support in working out some of the ideas that have recently been put forward for reducing evaporation. These ideas include distilling saline water and adding it to the pond water as a way of not only meeting some of the loss of water through evaporation but also to maintain low salinity levels in the water. Another approach could be to reduce the surface area by dividing the ponds and then transferring water. Evaluating these approaches requires not only finance but efficient scientific back up in order to get accurate results and analyze the costs and benefits.
* There is a need to assist local communities to evolve their own maintenance and management systems. A few scientific inputs (such training local communities in how to do simple water testing or maintain handpumps) could greatly assist this process.

GROUNDWATER RECHARGE ACTIVITIES OF THE SHRI VIVEKANAND RESEARCH AND TRAINING INSTITUTE

K.C.B RAJU

I INTRODUCTION

Shri Vivekanand Research and Training Institute (VRTI) began Rural Development activities in Kutch in 1976. Initially it was mainly engaged in animal husbandry, artisan training, and a variety of rural support activities such as social forestry, the promotion of smokeless chulhas, gobar gas, solar energy, compost improvement, souchalaya, and The Indira Gandhi house building schemes.

In 1987, Kutch faced famine when there was no rainfall in many places and thousands of cattle died. VRTI played a significant role in arranging cattle camps and fodder distribution. At this time, crores of rupees were donated by Kutchis in Bombay to alleviate famine and related problems caused by the drought. In addition, the drought initiated long-term thinking among Bombay based Kutchis and well wishers of the VRTI on the range of problems facing Kutch. Many thought that if the growing water problems could be solved, associated problems would disappear by themselves. Development of adequate water supplies that can be stored for use in times of shortage is an essential pre-requisite for any long term solution to the problems associated with drought.

The following section presents case-studies of VRTIs' work to address water problems in Rataria and Rayan villages. These case studies illustrate the progress that has been made and some of the issues that have been encountered in the work since 1987.

II Case Studies

A) Rataria Villages

Following the 1987 drought, The Society For Promotion of Wasteland Development (SPWD) in collaboration with VRTI initiated work in Mota and Nana Rataria villages. The villages are inhabited by Gadhvis and Rajputs with a few Patels and members of other communities. Both villages have a common revenue unit. They lack drinking and irrigation wells because the area is underlain by marine Gaj formation which contains saline water. As a result, the availability of both irrigation and drinking water depends on rainfall. Due to successive droughts since 1984, many people have to migrate to neighbouring villages in search of work either in relief projects or as agricultural labour.

The goal of SPWD and VRTI in Rataria was to improve water supply by constructing check dams and treating the watershed and surrounding wastelands with gully plugs, contour trenches and afforestation. As a first step, in order to provide supplemental irrigation to the rainfed agriculture, it was envisaged to construct check dams at suitable places in the streamlets crossing the villages. To facilitate this and establish direct contact with the local people, a unit office was opened at Rataria by the VRTI. Villagers agreed to contribute 20% of their labour wages towards the construction of check dams. They could not afford large cash contributions in advance as their survival is dependent on the wages earned through labour.

During 1988, six check dams were constructed at a cost of Rs.3,32,545/-. These can give supplemental irrigation to 248 acres, and have a storage capacity of 3,27,359 M3. In 1988 there were good rains and all the dams filled completely. The beneficiaries in the command of these dams, however, never utilised the water for irrigation. They did not believe that the earthen dams would remain intact or that the water would remain sufficiently long to be useful for irrigation. So 1988 storage went unutilised except for minor amounts used for Social Forestry by the VRTI at Rataria village and in afforestation near dam sites. Unutilized water remained until the next monsoon. This convinced farmers that the dams could retain sufficient water for irrigation. As a result, in 1989, a few farmers ventured to take loans, purchase pumps and seeds and then irrigate their fields. These farmers not only got a good crop but were also able to pay back their loans.

A survey conducted by VRTI indicated that each farmer got Rs.1000/- extra per acre when compared to returns under rainfed conditions. This established confidence in the people and more farmers came forward in 1990. Seeing the new awareness in Rataria village, the SPWD and VRTI thought that there should be an organisation of the farmers for maintenance of the dam, water distribution and collecting water rates. In 1990 a village Co-operative Society was registered and formed. Since then, it has been working but not to the extent expected by SPWD and VRTI. Two factors seem to limit success of the co-operative society: 1) the nature of the majority Rajput and Ghadvi communities; and 2) poverty.

When an attempt was made to obtain bank loans,it was found that many village members are already defaulters and not eligible. Only a very few villagers succeeded in obtaining loans. In addition, land holdings were highly unequal. Roughly 10 families did not own any land while the remaining holdings were quite large -- generally more than 10 acres. In addition, several landless women with no other means of support lived in the villages. VRTI and SPWD arranged for land to be allotted to these women by the Government. This land was near the check dams built with the assistance of SPWD. Tree seedlings for plantation on these lands were distributed freely after villagers dug the pits and made farm bunds. Since there was limited water in the dams in 1991 it was planned to irrigate the plants through the drip method by providing pitchers for each plant. Wages were paid for filling these pitchers every week. Despite free allotment of land and seedlings, many plants died because of non-watering or pitchers being broken by cattle. Many of the new land owners were used to being paid higher wages than those provided by VRTI and SPWD. As a result they did not give proper attention to land and plants provided to them. Overall, the efforts to uplift the poorer section by voluntary organisations encounter numerous difficulties. The main cause is that the Government subsidies and other populistic measures have made the villagers not easily amenable for adopting socialistic measures being envisaged by the voluntary organisation.

The success of voluntary efforts depends on the receptiveness of the local community. This in turn depends on their social patterns, economic status, inbuilt nature of hard working and desire to become more progressive farmers. Such types are seen in the villages which are dominated by the Patel Community.

The experiment in Rataria is not a failure but it takes more time and much more effort by the voluntary organisations to make it a successful venture.

B) Rayan Village

Groundwater problems in Rayan village are different from those in Rataria. In Rayan, groundwater was initially fresh but over extraction has led to falling water tables and saline intrusion. As a result of these problems, a pilot artificial recharge project was taken up.

Rayan village is on the bank of river Rukavati about seven km from Mandvi. It has an area of 749 Ha. and population of 2533. There are 200 farmers and 125 landless people. Rainfall in the area averages 400 mm. There is no surface water irrigation facility available and irrigation is mostly through wells. There are 84 wells in the area which are being used for irrigation. Most of the pumps are submersible and the water level varies from 21 to 30 m. Crops grown include millet, sorgum, groundnut, cotton, sugarcane and horticultural crops such as dates, mango, chikoo, pomogranate, bear, and papaya.

Forty years ago Rayan was flourishing village with good agricultural output. Due to increases in the withdrawal of groundwater and recurring droughts since 1976, water levels and quality have declined dramatically. During the last three decades the levels have dropped by about 20 m and quality of ground water has deteriorated. Many good agricultural fields have been affected by salinity and the land has become hard-pan. No crop is taken from such fields. Even ploughing is very difficult in the salt affected soils. Agriculture has declined as a result of these water related problems and many of the youth have been forced to migrate to Bombay in search of work.

In order to address the groundwater problems affecting agriculture in Rayan village, VRTI decided to attempt artificial recharge of the depleted aquifers on a pilot project basis. As a first step, VRTI conducted meetings with farmers at Rayan village and also at Bombay with the Kutchi business community. In the meeting at Bombay, one of the Kutchi businessman who hails from Rayan, Shri Amarchand Gala of Navneet Prakashan, agreed to support the recharge programme. A meeting was called by him of all the villagers at Rayan village and the purpose of the water harvesting and artificial recharge project was again explained to the villagers by the Kutchi businessman. In addition, the villagers were informed that, although Shri Amarchand Gala was ready to contribute financially to the project, the beneficiary farming community also had to contribute. Village contributions were seen as important to establish village ownership of the project and as an example for other villages. Despite the meetings, very few people showed a willingness to contribute directly to the project. Many indicated that their inability to contribute was due to continuous drought over the last four years. As a result of the drought, their economic condition did not permit direct financial contributions to the project. Despite these problems, after great deal of deliberation, it was decided to undertake the project.

There are four streamlets traversing the area on which the check dam and percolation tanks were proposed to be constructed in Rayan village. Initially, a survey was carried out by the VRTI and possible sites were fixed for the various structures. Later a meeting of the villagers was called and they were shown the sites selected by the VRTI. The villagers were asked for their comments on the sites selected. Most of the farmers agreed to the locations selected. The only objections came from farmers who's fields were near the proposed structures. One farmer demanded that no structure should be constructed near his field as the way to his farm would be submerged. Eventhough it was explained to him that water would remain in the stream only for a couple of hours or one or two days and that the water would be only about 25-50 cm deep (as the check dam proposed is only of 1.5 m height) still he was not convinced. In the end, since

VRTI did not want to create any opposition, construction on this checkdam was not taken up during 1989. Similarly, another farmer did not want a structure to built near his land since he felt that flooding could destroy the fields. It proved impossible to convince him even when his own brother -- whose field is also nearby -- agreed. He threatened that if VRTI constructed a dam near his field he would break it up. This location was also excluded for construction during the year 1989.

In 1989, results of the rain water harvesting and artificial recharge through recharge tubewells were very encouraging. VRTI monitored both water levels and the quality of the water before and after the monsoon. In a village meeting after the monsoon, a chart indicating farmer names and effect of artificial recharge on water levels in their wells and groundwater quantity recharged was shown and comments were solicited. Though the farmers agreed that some improvement was present, they did not openly come out saying that they got very good benefit. This is probably because of the fear that VRTI may ask them to contribute financially. However some elderly farmers -- including the brother of the farmer who opposed the construction of structure near his field -- clearly stated the benefits they received. One farmer indicated that for the first time percolation of the applied irrigation water from his well was good and as a result his crop yield was high. He stated that this was due to improvements in water quality. Another farmer indicated that the water level in his dug cum bore well had risen above the bore_hole for the first time in a long time, and the well was also yielding more and giving better quality water.

In the meeting, people who initially refused permission to construct check dams near their fields requested that these should now be constructed. They also indicated a willingness to contribute adequately to the construction of the new structures. Many other farmers wanted to construct additional new rainwater harvesting structures in the area. They stated their readiness to contribute to the construction either financially or, in the case of those lacking financial resources, via shramdhan by giving their tractors and bullock carts freely for two days.

Seeing this enthusiasm, VRTI undertook a survey of the places suggested by farmers for various percolation ponds, subsurface dykes, and other structures. The sites suggested for percolation ponds were wasteland. One site was within the Rayan village boundary and another was outside. Although the Rayan village Panchayat had no objection to the site falling within the village boundary, permission had to be obtained from another village Panchayat (Kodae village) for the second site. Villagers from Rayan along with the VRTI representatives, met with Kodae villagers and explained the benefits of constructing the percolation pond. After this meeting, permission to construct the pond was easily obtained from the Kodae village Panchayat.

In order to make the peoples participation more effective, VRTI insisted that villagers form a committee to supervise the construction. This committees' function was to ensure that the material used was good quality, that cement was used according to specification and that the farmers who agreed to provide their tractors and bullock carts without charge for two days actually did so. The committee was also responsible for scheduling farmer work contributions on specific dates so that the construction could go on uninterruptedly. It also arranged for villagers to store cement and keep a watch on it to guard against theft and rain. Finally, the committee was responsible for getting local masons and other labour. Only where these were not available locally, would VRTI arrange their supply from the neighbouring villages.

After construction was complete the village committee took on responsibility for de-silting the water harvesting structures following each monsoon and undertaking other maintenance work. In order to divide this work, subcommittees have been formed among the farmers along different stream courses to look after the structures coming on them.

The above committee was necessitated because, during the first year, complaints arose over misuse of cement. As a result tension was created over the project. After an enquiry by village elders, the complaint was found to stem from a personal grudge between two individuals. In the end, the complained had to apologise after the enquiry.

Although the village committee is not registered (there is already a farmers co-operative society) it functioned very well during the construction work. Subsequent maintenance work has also been satisfactory.

Following the experience in Rayan, VRTI has insisted on the formation of such committees by the villagers in all the projects undertaken by it. As a result, execution of water harvesting programmes has become very smooth.

Committees have not, however, been universally effective. In some cases both the committees and Panchayats have been unable to take suitable action against theft of tubewell caps, breaking of tubewell pipes and damaging the tubewells. The people responsible for the breakage are mostly cowherds and shepherds. They feel that the water stored has percolated too fast depriving them of water for their cattle and sheep. In other cases the theft is being done by a protected community like the scheduled castes. Any action by the committee or by the Panchayat will cause communal tensions. As a result, greater effort is required to convince all sections of the community of the benefits from the water harvesting structures so that damage can be prevented in the future.

Similar problems have emerged in areas where tree plantation has been done. Often plantations are destroyed by goats or cattle that belong to the village. This also requires the village committees or Panchayat to play a greater role to prevent such things.

III Government Co-operation & On-going activities

VRTI has obtained high levels of co-operation from Governmental Agencies. No difficulty has been encountered in getting sites for the rain water harvesting structures whether they are in Panchayat land, Revenue land or Forest land. Once sites were identified, they were cleared by the concerned Government departments and permission for construction was given. This high level of co-operation has been obtained mainly because all the activities of the Vivekanand Research & Training institute are complimentary to the activities of the Panchayat and the Government departments like minor irrigation and forestry. In addition, ownership of the structures built by VRTI rests with the concerned village committee or Panchayat. Due to the excellent co-operation with the Governmental Agencies, VRTI has been able to execute numerous water harvesting projects and there is a great demand for similar projects by many villages in the neighbouring areas and other talukas and districts.

By July 1992, 137 water harvesting structures had been constructed. During the year 1999 -'93 another 17 rain water harvesting structures are planned. In addition, SVRT has established a full fledged chemical laboratory for water and soil analysis. This laboratory is used to analyse water and soil samples in the projects undertaken by VRTI and also provides this service to the farmers. Using it, water quality is regularly monitored to assess the impact of recharge on salinity. The laboratory has been functioning since July 1989. Data collection is also underway in the field. Water levels are monitored before and after monsoon to assess the impact of artificial recharge through rain water harvesting structures on the ground water regime of the area.

IV Key Issues

In the course of its work, VRTI has encountered a range of key issues. These concern current water harvesting activities, larger issues on how water is used, and the data needed to develop effective management systems.

In some cases it has been difficult to get the whole hearted support of villagers for rain water harvesting. Concerns exist over the maintenance of rain water harvesting structures built by the voluntary organisation. High levels of peoples participation in maintenance are required for the structures to have a long life and perform effectively.

In addition to the problems of supplying more water it has become increasingly clear that emerging problems can not be solved unless water use patterns are managed. Farmers need to avoid giving excess water to the crops grown. They need to adopt crop patterns suited to the agroclimatic conditions of the area and water resource availability.

Finally, data are required for management of the water resources and the determination of suitable water management practices. Data are required on wells, bores, pumps, water levels, water quality, crops grown, and a host of other factors in order to assess the need for and effectiveness of different water management actions. As a result, effective systems for data collection, analysis and distribution need to be developed.

V Ways Forward

A range of actions could contribute to increasing the effective participation of villagers in water management, starting to address the use of water, and providing the necessary data to develop and evaluate management systems.

A) Participation

In order to increase peoples participation, one option would be to form co-operatives or Gram Vikas Mandals in villages and vest them with adequate powers to manage water resources of the area. These should have responsibility for assisting in the construction of structures and for their full maintenance once constructed. Depending on the water management needs, these institutions could cover one or several adjacent villages. In order to give individual villagers a direct stake, a water cess on the structures could be collected by the village institutions towards maintenance of the structures. VRTI feels that once somebody pays for a structure, whatever little the amount may be, he will take keen interest to see that the amount paid is utilised properly and he is assured of continuing benefit from such structures.

Another option to increase participation might be to encourage cooperative farming. At present there is competition over access to water. Rich farmers can extract more water while the shallow wells of poor farmers go dry. By removing this competition, cooperative farming could result in substantial improvements in the efficiency of both water and energy use.

B) Water Use

Farmers approach to water use has to be changed. At present there is very little understanding of the importance of efficient water use in the overall question of water availability.

Changing patterns of water use requires demonstration of the water savings that can be achieved while still retaining good financial returns. One way to do this would be through development of a very good extension service focused on demonstrating alternative cropping patterns. Demonstration plots under different agroclimatic zones could be developed that illustrate cropping patterns giving high financial returns and at the same time requiring less water than current cropping patterns.

In addition to demonstrating efficient water use practices, farmers could be encouraged to adopt them through a system of carefully directed subsidies. Subsidies could be particularly important for the adoption of capital intensive technologies, such as drip, field channel lining, or improved pumps, that result in high energy and water savings.

C) Basic Data

Collection of the basic data on well construction and pumping that is necessary for water management probably requires legislation. At present, no single authority collects the range of data necessary to really monitor groundwater development.

Data collection may be best done through the Electricity Board since farmers must obtain connections from them in order to use electric pumps. In addition, Electricity Board officials are in contact with farmers on a regular basis in order to collect electricity charges. Since data collection can be expensive, the Electricity Board may need to charge the GWRDC for obtaining and supplying the data annually. The GWRDC or CGWB can ascertain the correctness of the data by random checking.

The Electricity Board could require farmers having connections to fill out a proforma each year. This proforma would be supplied to the Electricity Board by the GWRDC. It would indicate acreage under different crops and different seasons. Data collected in this manner would go a long way toward assessing the correct draft. In addition to cropping patterns, farmers should indicate the depth of pump installation and the water levels in their wells/bores during May and December. At present it is very difficult for Government Departments to get accurate water levels in borewells fitted with submersible pumps since measurement requires removal of the pump. Farmers might be in a better position to get this data since they remove the pumps for servicing. To ensure accuracy of the data, a few random checks can be made by GWRDC.

Before providing new electricity connections, farmers should provide earlier details of the well along with water levels, pump settings, etc., to the Electricity Department. These would, in turn, be supplied to the GWRDC. It would also be good for the Electricity Board to check whether the farmer is using pumps with more horsepower than required and thus wasting the energy.

In addition to the Electricity Board, another potential source for data collection is the pump suppliers. They should be required to provide well data along with the type and horsepower of the pump supplied. Data collection responsibilities should apply in all cases - - even where old pumps are replaced. The details of wells in which pumps have been replaced including reduction in capacity , decrease in water levels, entire well failure, etc. would provide a substantial basis for evaluating condition of the existing stock of wells.

Collecting data indirectly from the Electricity Board and pump suppliers is likely to be more smooth than having the GWRDC obtain data directly from the farmers. In addition, it is much more feasible to pass a legislative measure that does not directly affect the farmers but makes it mandatory for the Electricity Board and Pump Suppliers to collect and supply the data.

In addition to legislation for the collection of basic data some sort of legislation will be required to control groundwater extraction. Efforts should also be made to harvest flood water in arid areas which is going as waste. This could be used either for supplemental irrigation or for recharging the ground water.

GROUNDWATER MANAGEMENT IN SURENDRANAGAR DISTRICT:

The AKRSP Case
Mitch Anderson

INTRODUCTION

Agriculture in the Surendranagar district depends on ground water. The annual rainfall here is highly variable with a yearly average of only 600 mm and there are typically no rains after the end of September. The majority of farmers in this area are irrigating their crops from dug wells and many of these wells run dry before end of the growing season. AKRSP has been working in this area for nine years, focusing a large part of it's efforts on the construction of percolation tanks. These structures consist of large earthen bunds built across a watershed to store seasonal rains in order to recharge the local water table.

AKRSP has constructed 12 of these tanks with several more currently under construction. The government of India has also been routinely constructing percolation tanks for over forty years and has recently allotted Rs. 500 crores for the renovation of tanks in the next five years. In spite of the large amount of resources committed to these schemes, at present there seems to be little research to assess to what extent these structures actually recharge the local water table.

This paper is an overview of a study conducted over the last six months at the Sayla SHT to determine how much of the water in these tanks percolates into the ground and the rate at which this water is being extracted by farmers. This study provided much useful information but also left many unanswered questions regarding the entire issue of ground water use and recharge. It is hoped that these questions will provide the basis for further research in this area.

HOW MUCH RECHARGE?

There can be little doubt that the tanks which have been constructed by the Sayla SHT have been technically sound and their construction has provided valuable employment for villagers especially during years of drought. However the primary reason for the construction of percolation tanks is not to provide employment but to increase the amount of ground water recharge. A well monitoring and evaporation study was conducted to attempt to determine how much additional recharge occurs as a result of these tanks.

WELL SURVEY

The depth to the water table was measured in all the wells in four villages which have percolation tanks for the months of Oct. to Dec., 1992. This data was to be used to map the water table in these villages to determine the benefit of the tank to the surrounding wells. However, until the positions and elevations of these wells are surveyed, this data cannot be used. It was also found during the course of this study that there was a large amount of variation in the data due to pumping from the wells. Correlating the well level data from year to year would also be difficult due to large variations in the annual rainfall. Finally, while it would be revealing to have a map of the local water table, it was found that this study was very labour intensive requiring a full-time surveyor.

EVAPORATION STUDY

A simpler method to determine the volume of recharge is to measure the evaporation losses and subtract these from the total water losses from the tanks. The total water losses were measured by monitoring the water level of the five tanks in this study over a period of two months.

Empirical evaporation formulae using climatic data estimated average evaporation losses of 6.6 mm/day. An evaporation pan built for this study estimated evaporation losses of 6.0 mm/day. The average of 6.3 mm/day was used for the following calculations.

Village	Total losses(cm/day)	Evaporation losses(cm/day)	% Evaporation losses	% Percolation
Hadala	1.65	0.63	38	62
Bhimora	1.45	0.63	43	57
Kansala	1.45	0.63	43	57
Rupavati	1.77	0.63	36	64
Sapar	0.98	0.63	64	36

As seen in the above table, most tanks have about 60% percolation and 40% evaporation losses. There were also some

large differences between tanks, particularly at Sapar which had over 60% evaporation and under 40% percolation. Villagers in Sapar report that the tank is underlain with a bed of impermeable shale indicating the importance of local geology in site selection. A recharge bore well is planned for this site to increase percolation.

To get a clearer picture of the benefits of percolation tanks, the estimated volume of water percolating from the tanks was compared to the natural ground water recharge and run-off.

This was done by:

Multiplying the average annual rainfall by the size of the catchment area to give the average annual volume of rainfall.

Comparing this to the capacity of the percolating tanks after evaporation losses (i.e. the volume of water that percolates).

This calculation was done for all the tanks in this study and is shown in the following table.

Village	Catchment area (sq. km)	Average annual rainfall (mm)	Average catchment rainfall (Cu. m)	Tank Capacity (Cu. m)	%Evap'n Losses from tanks	% Catchment rainfall perc. from tanks
Hadala	1.62	601	974000	340000	38	22
Bhimora	1.00	601	601000	212000	43	20
Kansala	3.50	601	2100000	567000	43	15
Rupavati	3.00	601	1803000	283000	36	10
Sapar	2.73	601	1640000	312000	64	6

It can be seen that the volume of water percolating from the tanks represents only a small proportion of the water which falls in the catchment area*. This is a problem common to all of the percolation tanks in this study and is particularly true of the Sapar catchment, area shown in fig.1

This study seems to indicate that there is a larger potential for increasing ground water recharge by watershed treatment than by the construction of artificial recharge structures. Watershed treatment techniques are well known and include the planting of shallow rooting tree species such as Desi Buval, Israeli Buval or Ganda Buval to reduce rainfall energy and slow run-off to allow for greater infiltration. Other treatments such as contour bunds, land levelling and increasing grass cover would also increase infiltration. How much these measures would increase natural recharge is disputed or remains unknown. Determining the benefits of watershed treatment, including a cost benefit analysis, would be a useful area of future research.

* It should be noted that this analysis assumes that tanks fill up one time only. If the rainfall was spread over a longer period of time there would be less tank overflow and greater percolation.

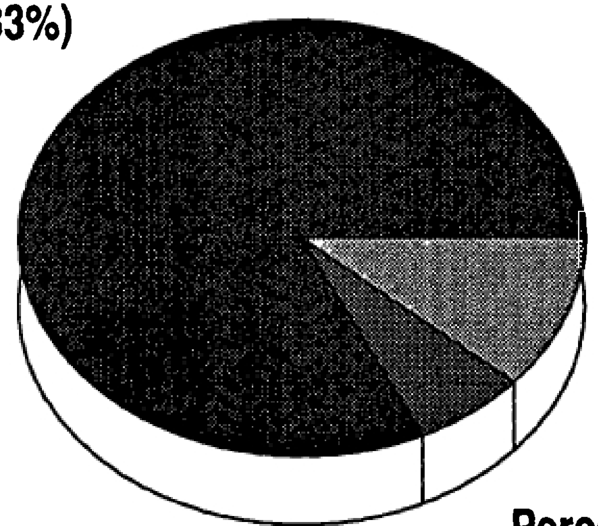
WATER USE STUDY

At present there is much attention focused on increasing recharge through the construction of artificial recharge structures such as check dams, percolation tanks and recharge bore wells. The other side of the issue of ground water availability is of course the rate at which water is being extracted from the ground. At present there seems to be little attention paid to this fundamental question. If it was found that there is a large potential to increase the efficiency of irrigation, this might prove to be a more cost-effective way of ensuring the long-term stability of the water table than either artificial or natural recharge schemes.

While more efficient irrigation technologies such as sprinkler or drip systems are available, for most farmers these systems remain prohibitably expensive and will remain so for the foreseeable future. Virtually all the farmers in the Surendranagar area are using flood irrigation from well pumps.

Fig. 1

Fate of Rainfall
40 year average (601 mm)



Sapar catchment area

At present there seems to be little knowledge as to how much water is being pumped by individual farmers. If ground water resources are to be sustainable in the long (or short) term it is vitally important to look at the rate at which ground water is being extracted in comparison to both recharge and crop use requirements.

The aim of this study was to measure the volumes of water being pumped by individual farmers and attempt to relate this to the types and areas of crops being irrigated to get an idea of the water use efficiency.

METHODOLOGY

The output of all well pumps in four villages was determined by measuring the vertical drop of water discharge from a horizontal pipe over a distance of 0.3 meters. This gives the velocity of the water leaving the pipe which is multiplied by the pipe diameter to give discharge in litres per minute. This was in turn multiplied by the frequency of irrigation to give an estimate of farmer's monthly water use.

The results of this study indicated two interesting points:

Farmers in all villages were pumping an enormous volume of water. This can be seen in fig. 2 showing the cumulative water use for the village of Kansala. By the end of November, farmers had already pumped 300 million litres of water which is just under the estimated contribution to the water table from the percolation tank after evaporation losses. By the end of December farmers had pumped over 600 million litres of water which exceeds the capacity of the Kansala percolation tank.

There is very little correlation between the volume of water pumped by individual farmers and the area of land under irrigation. Figure 3 shows the water use per hectare of individual farmers who were *irrigating only cotton* for the month of October in Kansala. If water was being used efficiently, farmers would be using about the same amount of water per hectare. It can be seen however that not only are farmers using very different rates of irrigation but that almost all farmers are using several times the recommended irrigation rate for even hybrid cotton.

Wasteful water practices can also be costly to the farmer. The running of a diesel well pump costs between Rs. 25-30 per day. Excessive water can also cause disastrous crop losses due to disease. Over 70% of the cumin crop in the Surendranagar taluka has failed this year as a result of black blight, with a likely cause being over watering. The economic costs of this crop failure are estimated to be Rs. 10 crores.

The results of this water use study are either very interesting or very wrong, and remain to be double checked in the field. If these measurements are correct we must then find out from farmers why they are irrigating with so much water. It seems unlikely that farmers would be so wasteful with well water considering the costs of extracting it from the ground. The challenge now seems to be to get harder data on the rate of extraction while at the same time developing a dialogue and awareness with farmers about water use issues.

Fig. 2

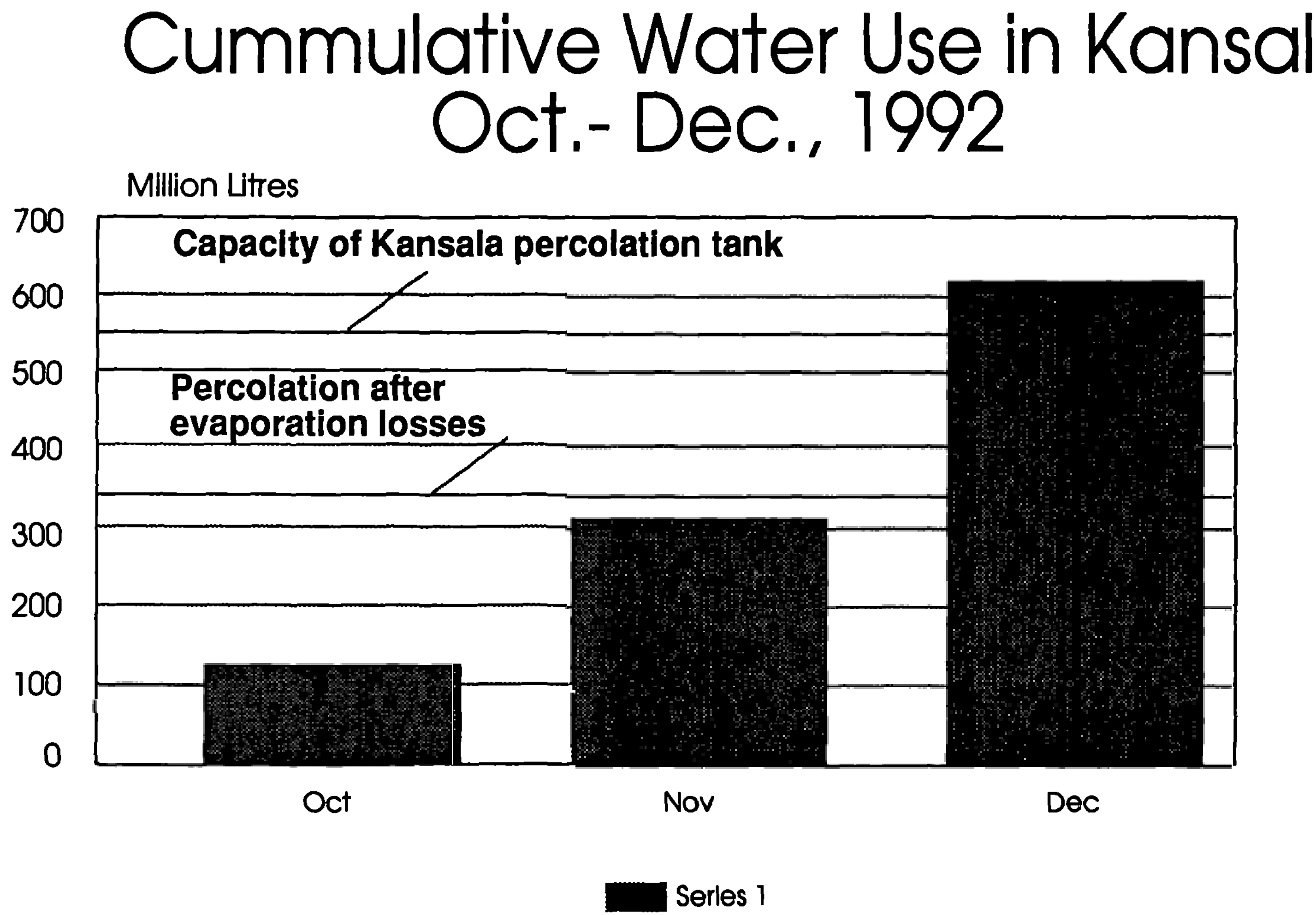
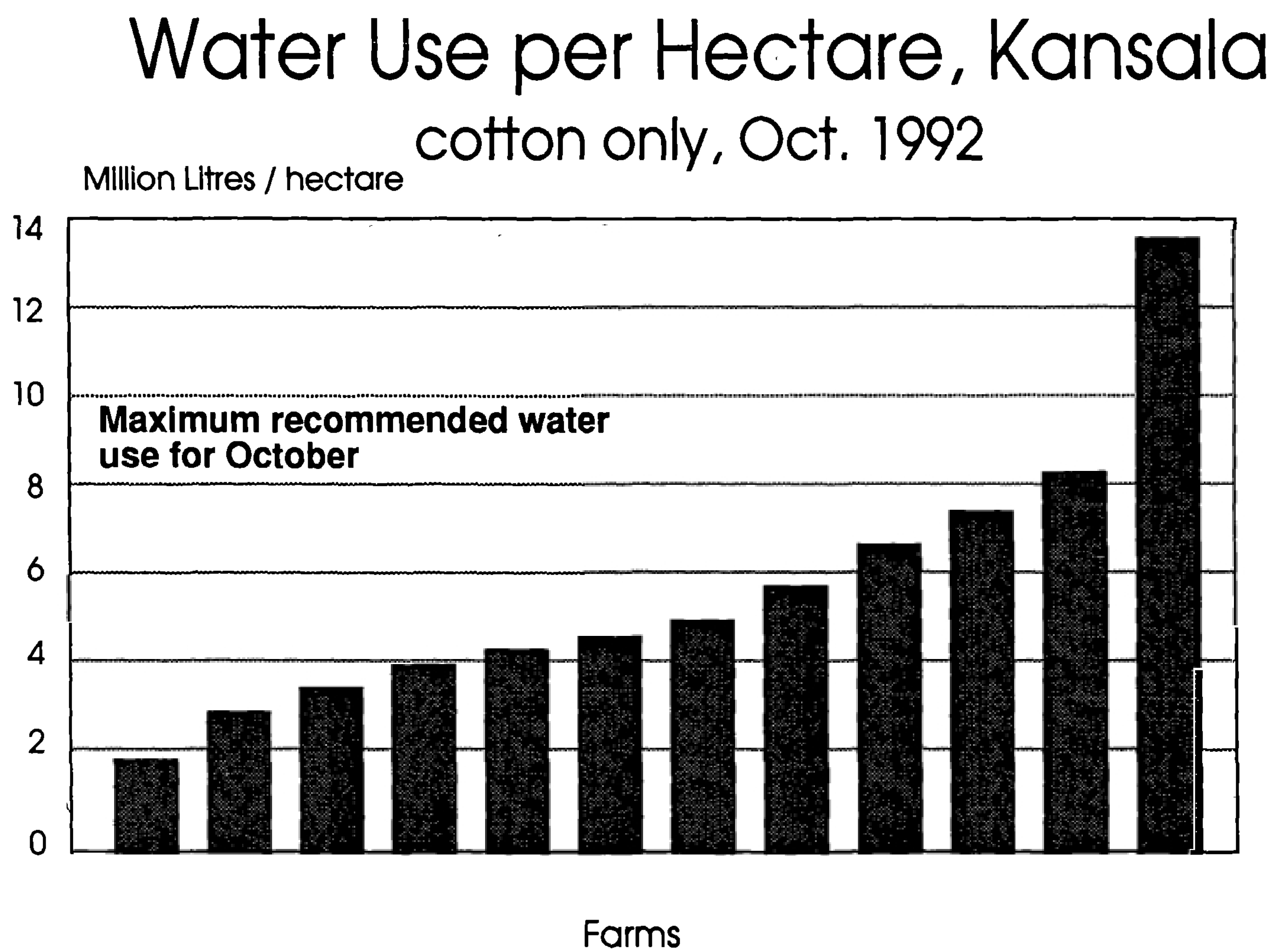

Cummulative Water Use in Kansal
Oct.- Dec., 1992
Million Litres
700
600
500
400
300
200
100
0
Capacity of Kansala percolation tank
Percolation after evaporation losses
Oct
Nov
Dec
Series 1

Fig. 3



Water Use per Hectare, Kansala
cotton only, Oct. 1992
Million Litres / hectare
14
12
10
8
6
4
2
0
Maximum recommended water use for October
Farms

The installation .of water meters on several well pumps would seem to help solve both these problems and is being planned for the near future. If many farmers are agreeable to this it would be then very interesting and simple to:

- Compare the water use between farmers.
- Compare the water use of individual farmers to the recommended irrigation rates.
- Compare the water use of different farmers to their crop yields or incidence of disease and conduct a cost-benefit analysis.
- Estimate the rate of ground water extraction for an entire village.
- Conduct extension or awareness training regarding water use and easily assess the effectiveness of this training.

From the farmer's point of view this would allow:

- Conducting research which is directly relevant to their needs.
- For more accurate irrigation of high risk crops such as cumin to maximize yields and prevent disease.
- For the exchange of farmer knowledge about irrigation with other farmers and with development agencies.

Again, this study has produced many unanswered questions which it is hoped will form the basis for future research.

MONOGRAPH ON LOCAL WATER CONSERVATION ACTIVITIES OF AKRSP(I) IN JUNAGADH PROGRAMME AREA

By Rajiv Bhagwat
AKRSP

Aga Khan Rural Support Programme (India) is a non-communal, non-governmental and non-profit making organization.It was set up in 1983 to serve as a catalyst for water and land resource management and the initiation of village level income generation activities. It focuses at the grass root level and places a strong emphasis on community participation. Work is currently underway in three districts of Gujarat -- Junagadh, Surendranagar and Bharuch. The Junagadh Spear Head Team office is based at Gadu and works in Maliya, Mangrol and Talala talukas.

INTRODUCTION

Junagadh District of Gujarat lies in the coastal Saurashtra region. Agriculture is the principal occupation. Out of District's 2.1 million population 1.46 million live in rural areas. The main crop is groundnut. Cropping is intensive, with most farmers trying for at least two seasons a year. In addition to its reputation as the "groundnut bowl" of India, Junagadh produces substantial quantities of sugarcane, coconut, bananas, kesar mangoes and winter wheat. Since barely 20% of the farmland is irrigated, agriculture is still constrained by dependence on the annual Monsoon rains. This insecurity is further compounded by excessive groundwater exploitation and periodic drought. In one of the three blocks where AKRSP(I) is working (Mangrol Taluka), sea water ingress and increasing salinity of the soil have caused a drastic decline in groundnut yields . In the second block (Maliya Taluka), groundwater levels are declining in farmers' wells. In the third block (Talala), the Hiran, a perennial river, recharges groundwater and provides an adequate surface water source. As a result, major water problems are not present.

The Meghal river in Maliya, the Noli river in Mangrol and the Hiran river in Talala are the three major rivers of Junagadh District. In years of good rainfall, the rivers run full and abundant. To conserve this water, the government has constructed a series of large and small check dams since the 1950's. In theory, the reservoirs were created with a dual purpose of providing support irrigation and increasing groundwate r recharge. In practice, poor construction, leakage and unchecked pumping by farmers have blunted the impact of recharge and irrigation efforts.

SUMMARY OF WATER CONSERVATION ACTIVITIES

Begining 1985, AKRSP(I) focussed on the repair or construction of check dams to store water in small reservoirs, and recharge to the groundwater. By June, 1992, 18 check dams and one recharge tube well were completed in 12 villages. One recharge tube well is presently under construction. The cost of constructing these check dams varied from Rupees 1 Lakh to Rupees 4 Lakhs. Government subsidy provides 75% of the cost, AKRSP(I) contributes 20% and the beneficiaries (those whose wells fall in the "command area" of the dam) contribute the remaining 5%. Recently, the financial contributions from the beneficiaries have been raised to 10%. Once the construction of recharge structures is completed, village institutions (Gram Vikas Mandals (GVM)) are expected to manage the maintenance and repair work. To do this they are provided with technical support by AKRSP(I) as required.

COMMUNITY PARTICIPATION IN WATER CONSERVATION PROJECTS:

At the outset, the watersheds in a particular block are identified using a toposheet. Possible sites for construction of water harvesting or recharge structures are demarcated. Preliminary feasibility surveys are conducted at these sites by the staff of AKRSP. AKRSP also initiates discussions with the villagers to determine their views and perceptions of the water problems faced by them. An enthusiasm is built up in the villagers by advocating the principles, objectives and mission of AKRSP. Thereafter, a PRA (Participatory Rural Appraisal) is conducted to get knowledge of village level resources and needs and also to obtain information about surface and groundwater resources in the area. Villagers are also told to identify sites which they think have potential for building water harvesting structures such as check dams and percolation tanks. Detailed surveys are carried out at the proposed sites and suitable sites are selected. After this, discussions are held with the villagers regarding their participation in financing and providing labour for construction. Necessary changes in design and location of structures are made if desired by farmers to account for high flood levels and submergence. The same procedure mentioned above is followed in cases when demand for building a recharge structure comes from the villagers.

Beneficiaries are identified for the purpose of obtaining farmers' contributions toward the cost of recharge structures. Usually beneficiaries of the recharge structure are considered to be those farmers who have wells within a radius of 1 Km. from the proposed recharge structure. Beneficiaries are required to pledge 10% of the total estimated cost of the recharge structure in the form of cash or labour of transportation.

A Gram Vikas Mandal comprising the beneficiaries is established before construction. The members elect the President and the Secretary and form a committee. The committee is responsible for the following activities :

1. Collection of beneficiary's cash contribution.
2. Identifying suitable construction materials available in the nearby areas.
3. Employing labourers (usually weaker sections of village).
4. Supervision during construction of the recharge structure.
5. Payment of wages to the labourers.
6. Maintenance of the structure after completion (repair, de-silting etc.).
7. Solving local village level issues.

EXPERIENCES IN WATER CONSERVATION ACTIVITIES:

At various times AKRSP has made efforts for conservation and budgeting of groundwater in order to optimise its availability for irrigation. AKRSP has devoted considerable effort toward increasing awareness of water conservation among farmers by initiating dialogues with them. But the efforts have not lead to reduction in water use due to number of reasons. Despite government subsidies, farmers are unwilling to invest in efficient water use systems such as drip and sprinklers. They fear that those who don't use water conservation techniques will capture or share in the benefits from their own investments (unutilized water will be drawn out by other farmers who have not invested in water saving technologies). Sometimes geohydrological factors also adversely influence the community water management solutions. In Amrapur village, for example, water collected during the monsoon doesn't remain in the wells for a long time. As a result, any water saved is not available for use in the following season. Hence, farmers feel that they should make maximum use of available water as early as possible, even if there is considerable wastage in the process.

Husseinabad village, the northern part is safe from saline water ingress and groundwater quality conditions have remained unchanged. The southern part of the village area has, however, been salinized for the last 15 years. AKRSP has been trying to educate farmers in this village about the need to control groundwater extraction in order to check further intrusion of seawater. Farmers in the northern part of the area are skeptical about any benefit they might accrue through controlling pumping. They have survived a three year drought period (1985-87) without experiencing major water problems. It is very difficult to persuade farmers in the northern part of the village to act for the benefit of farmers in the southern part by curtailing pumping. It is even more difficult to demonstrate any benefit to either party. We have also found that social heterogeneity hampers community water management solutions. It is difficult to organise communities in villages containing people from different castes and religions as they often have different water use priorities.

AKRSP hopes that under the ongoing groundwater project in Amrapur (Maliya Taluka) and Husseinabad (Mangrol Taluka) water conservation objectives can be accomplished partially, if not fully. The organization feels that if budgeting of the available groundwater is done effectively, it can lead to reduction in the use of water and more efficient water use. If farmers know what water availability is likely to be they can plan the acreage to cultivate in each cropping season. Correct estimates of groundwater recharge are, however, difficult to arrive at. Also the "recharge" available for extraction is much less than the actual recharge taking place. Particularly in Amrapur village, the water remaining in wells at the end of one season (June, 1 to May, 31) is not available for use in the following season due to groundwater outflows. It is also difficult to calculate the volume of groundwater recharge after each monsoon, as the net recharge is a balance between outflows into Dadhichi Reservoir and groundwater inflow from upstream areas. In addition, available figures on rainfall, specific yield of the aquifer and infiltration are not very reliable. Since the whole recharge estimates are based on these figures, recharge estimates are very uncertain.

Recharge estimates are not the only data problem. In Kankasa Village, an area affected by saline intrusion, AKRSP undertook the work of well monitoring after the construction of a check dam and recharge tube well. Water samples collected from wells after the monsoon showed TDS values (total dissolved solids) which were higher, unchanged or had no explanation in relation to pre-monsoon samples. Later on, though interaction with the villagers, it was realized that the samples that are collected by pumping would naturally be saline. They are from lower sections of wells. Fresh water that is recharged, because of its lower density, overlies the dense, saline water layer. Villagers felt that samples should only be collected from the top of wells by lowering a bucket. In pumped wells, mixing takes place at the contact of fresh and saline water. This zone of mixing expands as more pumping continues. The rate of pumping determines the location of the upper zone where fresh water remains. More information and guidance on how to monitor the impact of recharge on saline intrusion is welcome.

PLANS FOR FUTURE

In the Junagadh programme emphasis for the future will be on construction of recharge structures like check dams, recharging tube wells, percolation tanks and open dug wells (as recharging wells) for increasing groundwater recharge in inland areas and for pushing the saline water seawards in the coastal areas. AKRSP has decided to carry out economic evaluation of recharge structures. Studies are underway and the results are expected within 2-3 months. In one of the villages (Kankasa) in the coastal area where a check dam and a recharging tube well were constructed this year, farmers are demanding construction of an open dug well to be used only for recharge. The farmers believe that more water will be recharged this way. They are not concerned that silt will clog aquifer spaces because of the cavernous nature of the rocks (limestone). AKRSP has this project in mind for the future.

For coastal areas; (Kankasa & Husseinabad) the plan of action, in addition to constructing new recharge structures, is to motivate the farmers to divert the runoff from fields into their existing wells. This will increase recharge and capture water which otherwise would flow into the sea. This practice is followed by about 600-700 farmers in Vanthali taluka of the Junagadh District. They got the inspiration from the `SWADHYAYA' gatherings, in which farmers were told about the need for water conservation and the importance of recharge structures. The `SWADHYAYA' has been romoting water conservation ethics among farmers . It is promoted by Pandit Pandurang Shastri.

In addition to recharge activities, emphasis will be given to reducing end-use. The scope for increasing water supply is limited and all efforts will be a waste if we are unable to maintain a balance (in favour of recharge) between recharge and extraction. AKRSP proposes to initiate work on changing end-uses under the ongoing groundwater project in Amrapur and Husseinabad villages.

AKRSP also has plans for de-silting the reservoir of Bhadrecha dam, which was constructed by the Nawab of Junagadh. The silting of this reservoir has considerably reduced its water storage capacity. The de-silting activity is likely to benefit a large number of Villages, including Husseinabad as it will increase the storage capacity and thereby irrigation potential of the dam.

In sum, for the future emphasis will be on constructing as many recharge structures (check dams, recharging wells, percolation tanks) as possible. This will be done upstream of villages affected by saline water ingress in order to prevent further salinization and, where possible, to mitigate existing salinity problems. Since constructing one or two structures does not contribute much towards pushing the salinity seawards, a large number of structures will be constructed. In addition, a major thrust will be on persuading farmers to adopt efficient budgeting of the available ground water.

KEY ISSUES

For AKRSP the following key issues have come up during planning and execution of water management activities.

1. Identification of beneficiaries of groundwater recharge structures such as check dams, percolation tanks and recharge tubewells is extremely difficult. At present beneficiaries of any water conservation activity are identified as those who are having wells falling within one kilometer radius of the recharge structure. This norm often does not reflect the actual physical situation.

2. Farmers are still not ready to adopt water conservation measures -- such as drip or sprinkler systems -- because they are not sure of the individual benefits. This is a particular problem because individual benefits may only come if the technologies are adopted on a wide scale.
3. Social heterogeneities often hamper community based water management activities in villages. It is often difficult to work with different communities due to the fact that each community may have different water use priorities. Organising them is, however, is a pre-requisite for any community water management action.
4. Differences in resource condition also affect community efforts towards water management. Within one village, farmers in localities free from groundwater problems have little interest in community water management. Their cooperation may, however, be required in order to address problems experienced by people in other localities.
5. Estimating groundwater recharge is difficult due to the incorrectness of values of geohydrologic parameters and the complexity of groundwater behaviour. This makes groundwater budgeting difficult.
6. Problems exist in devising accurate monitoring systems for measuring groundwater quality changes. Due to the variation of salinity of groundwater depthwise, samples collected for analysis are often unrepresentative. This often leads to misinterpretation of results of analysis.

WATER ISSUES IN MEHSANA

M.Dinesh Kumar
VIKSAT

I Introduction

Mehsana district is one of the intensively cropped districts in Gujarat state. The net sown area constitutes nearly 65 percent of the geographical area. Out of the gross cropped area of 7.50 lac hectares, the net area irrigated is 2.64 lac hectares. Since there are no major surface irrigation schemes in the district,most irrigation water needs are met by groundwater. Hence groundwater plays a vital role in the district's economy. During past thirty to forty years, exploitation of groundwater has been taking place uncontrollably, with the annual abstractions from aquifers far exceeding yearly replenishment from rainfall. This has resulted in large and continuous drops in water levels over wide areas. District-wise surveys conducted by CGWB in 1988-'89 highlight the large scale groundwater exploitation during the last two decades.

Due to water scarcity, there have been major shifts in cropping patterns throughout the district. Farmers now grow less water intensive crops than previously. This however has not reduced the rate of drop in water levels. Farmers are forced to deepen their wells every year to sustain their agricultural output. During the last few years the over-extraction of groundwater compounded by droughts has resulted in mining of aquifers in many parts of the district. The average depth of wells in these areas has increased to 300 metres. Increased pumping depths have increased the energy consumption per unit volume of pumping substantially.

The problem is not limited to dropping water tables only. Saline water from aquifers of Saurashtra and Kutch are being drawn into alluvial tracts of Central Gujarat including Mehsana. The salinity ingress from deeper saline aquifers and western saline area bordering Rann of Kutch is due to the progressive decline in water levels over the last two decades.

The state government has passed legislation to check the over- development of groundwater. This legislation has never been enforced. The regulatory approaches include denial of electricity connections in cases where spacing regulations are violated.

Attempts have also been made to recharge groundwater artificially. Gujarat Water Resources Development Corporation has undertaken UNDP funded pilot projects for groundwater recharge in some parts of Mehsana. Large scale implementation of such projects could not take off due to the shortage of funds. The availability of water for recharge is also limited.

The government has proposed water conservation projects in Saraswati and Rupen river basins. These include construction of 88 percolation tanks all over Mehsana. Out of this work of 17 are in progress and 42 are likely to be taken up. Out of the 10 check dams proposed 8 are to be constructed during the 8th plan period.

In addition to this, a high level committee was appointed to study the possibility of rainwater harvesting during the monsoon through building check dams , percolation tanks and recharge tube wells. The committee has proposed construction of 18 check dams,17 percolation tanks and

61 underground heck dams in the north-eastern part of Mehsana. Changes in crop pattern and advanced irrigation practices were also suggested by the committee. The estimated cost of completing the project is 650 lacs. So far no funds have been made available to this project. Clearly availability of finance has become a big issue for government to address depletion problems.

Given the inability of the government to address emerging problems,local management strategies are receiving increasing attention. Government does not have huge amounts of resources needed to support these. Government agencies also do not know local problems and needs. As a result,it becomes essential for local communities to participate in the implementation and management of projects to be carried out in their respective localities.

NGOs can play a major role in addressing local water problems. They have organisational skills and experience in working among local people. They can also develop water management strategies suited to local conditions. They can assist communities in planning water management projects effectively as they have experience regarding the various social and resource factors influencing management solutions.

Gujarat provides a unique chance of knowing the possible role of NGOs in local water management. There are many NGOs working on local water management in different parts of Gujarat. They have been successful in developing local management options and implementing them. But there is a growing recognition that NGOs cannot become a substitute to government. This is in view of the fact that the resources available with them such as institutional strength, technology and funds are limited. Also they do not have adequate legal strength for tackling the issues, which may crop up during their activities. Hence there is a need for local people themselves taking initiative to address their water problems. NGOs can work with government agencies and local communities to help in organising communities and increase their access to the resources available with government agencies. This will in turn strengthen the capacity of village level institutions to address local water problems.

II VIKSAT's Objective

In VIKSAT's view,the first step to initiate a community based water management activity will be to facilitate community organisation. This community organsation can undertake water management activities in their area. VIKSAT does not want to become a primary implementing agency but rather intends to act as a catalyst. The goals of VIKSAT's efforts towards water management will be i. To facilitate the creation of village level institutions for water management activities ;ii. To help communities obtain access to concerned government agencies for technical, financial and legal supports so that they become capable of carrying out water management actions and iii.To facilitate government organisations in project implementation. Another objective is assisting regional institutions in developing water management strategies. Integrating the efforts of regional level institutions working on water management with the ongoing village level activities by communities will be a part of the objective. The goal is to link existing technical and financial support programmes such as those carried out by GWRDC and GSLDC with village level initiatives. For this VIKSAT will try to attract government sponsored projects for which funds are already available to the areas where local communities are sincerely interested in water management.

In order to identify potential areas for undertaking field project,VIKSAT has undertaken field surveys in thirty three villages of Kheralu in Mehsana. The villages selected are spread across the Taluka in the north-south direction. Of these thirty three villages,some are falling in the recharge area in the Aravally ranges. Other villages are located in the centre of Kheralu Taluka. A few villages are located far away from the Aravally ranges and near the Taluka boundary. One of the criteria for selecting the villages is variation in geohydreological and geo-hydrological conditions. Primary findings from the survey are presented below.

III Kheralu Taluka

i. General Features of the Taluka

Kheralu Taluka is located in the northern side of Mehsana District. The Taluka is comprised of 169 villages. Out of the total geographical area of 953.20 Sq. km., 818.52 sq. km area is alluvial and is suitable for groundwater exploitation. The remaining area of 134.68 sq.km is rocky. The Taluka has got a total population of 24.6 lacs as per 1981 census. It has semi-arid climatic conditions existing.

The taluka has medium level of rainfall and alluvial sandy soils. The average annual rainfall of the Taluka is 636.23 mm. Maximum and minimum rainfall recorded are 1274.60 mm and 199.20 mm.respectively during the period from 1955 to 1990. The taluka has got a widely varying topography.

The major communities in the taluka are Takores, Chaudhay, Chauhan, Darbar, Rabary, Patel, Prajapathi, Harijan and Muslim. Takore is the most dominant community in the taluka. Out of the 33 villages surveyed, Takore community was found to be present in 28 of them. The people's main dependence is on agriculture and labour for their livelihood. Dairy is also one of the sources of income.

ii. Geohydrology & Emerging water problems

The aquifers exist in phreatic conditions in upper part of the Taluka with hard rock found at a depth ranging from 8 m. to 20 meters. Towards the lower parts both phreatc and confined aquifers are found. The depth to hard rock is nearly 200 m in the lower parts. The depth to water levels in open wells ranges from 3 to 10 m in hard rock areas where maximum depth of open wells is 20 metres. The depth to water levels in the case of dug cum bore wells found in central part of taluka ranges from 10 to 15 meters.The depth to piezometric levels in tube wells found in the lower part of taluka is 60 to 70 metres.

The survey has indicated large scale depletion of groundwater over the whole taluka. The depletion problems have affected the availability of water even in the villages falling in the main recharge area near the Aravally hills. In this area,where hard rock is found at a shallow depth all wells are open dug wells. Due to over-exploitation, the water levels have gone down and well yields have reduced considerably. As a result the average yield hours is limited to 2 to 4 hours in winter and 1 to 2 hours in summer. The general features in many of the villages in the area are 1. Due to the poor yield of wells the farmers are not able to run the pumps continuously leading to poor fuel efficiency; and 2. Due to the seasonal drop in water tables and reduction in yield the farmers are forced to leave a large chunk of their land uncultivated. In many of the villages due to the continuous declining of water tables the farmers are forced to deepen their wells every year to sustain the agricultural output. If the exploitation continues at the current rate, a grave situation will arise in near future in which the whole upper phreatic aquifer gets exhausted leading to drying of wells in the upper areas of the taluka.

Away from the Aravally ranges,towards the centre of the taluka depth to hard rock is found to be varying from 12 m to 80 m. Dug cum bore wells are mostly found in these areas. The average yield hours range from 8 to 10 hours in winter to nearly 6 hours in summer.

In the extreme south of the taluka,the depth to hard rock is an average of 200 m. Only tube wells are found in this area. They are high yielding wells. The depth of these wells range from 90 m to 150 m. These wells can be pumped continuously if electricity is available.

The graphical representation of variation of well depth (for both Elect & Diesel wells) with distance from Aravallies is shown in fig.1

iii. Patterns of water use & Crops grown

The crops grown mainly are castor,wheat,mustard,bajara,groundnut and jowar. Wheat, and mustard are the major crops grown in Rabi season. Bajara is the major crop grown in summer. Groundnut is grown in Kharif alongwith castor which is a two season crop . While bajara is found to be grown in all villages surveyed, castor,wheat and mustard are found to be major crops in twenty five villages.

Water is mainly used for irrigation, domestic purpose and cattle drinking. The water from farmers'wells is completely used for irrigation in winter and summer. In some cases a few irrigations are given to Kharif crops in the absence of good monsoon. The domestic water demands are met by panchayat wells.

iv. Changes in water use and Crops due to water scarcity

Due to the scarcity of water in many areas there had been a major shift in crop pattern throughout the Taluka. The water intensive crops like groundnut,maize, sugarcane and cotton which had been grown ten to thirty years back are now replaced by less water intensive crops like castor bajara and mustard.

Out of the thirty three villages surveyed, in twenty four villages a significant change in crop pattern is found. While in eighteen villages sugarcane and groundnut were major crops grown 20 to 30 years ago, in eleven villages cotton was a major crop Rice was also found to be grown in seven villages.

While the change in crop pattern is a general feature of all the villages falling in the recharge area, near the Aravally hills, the villages far away from the Aravallies have not observed significant shift. The farmers in these Villages are still growing the same crop which they have been growing before 20 to 30 years (Bajara, Wheat, Mustard and Jowar).

The graphical representation of the change in crop pattern w. r. to distance from Aravallies is given in fig.2

Fig-1

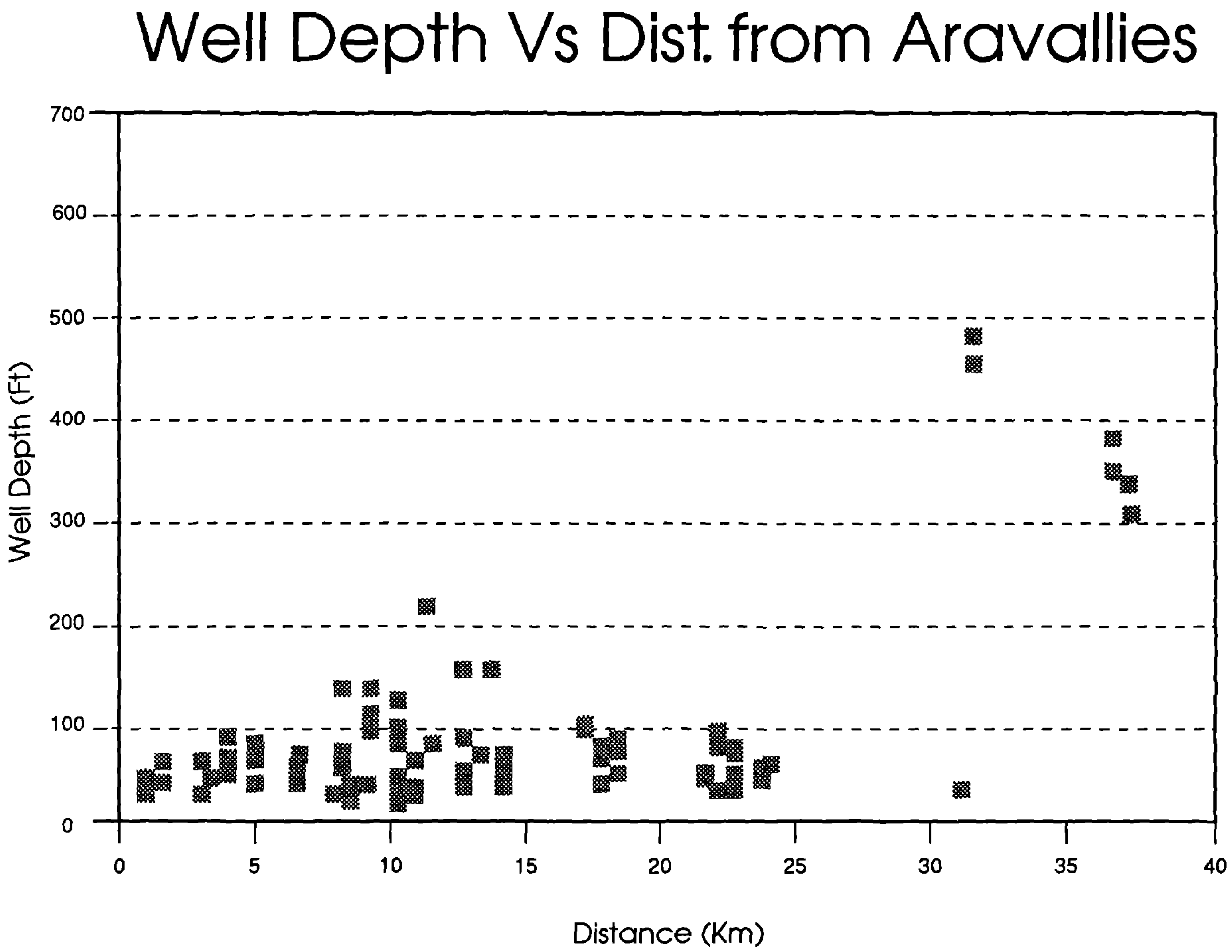
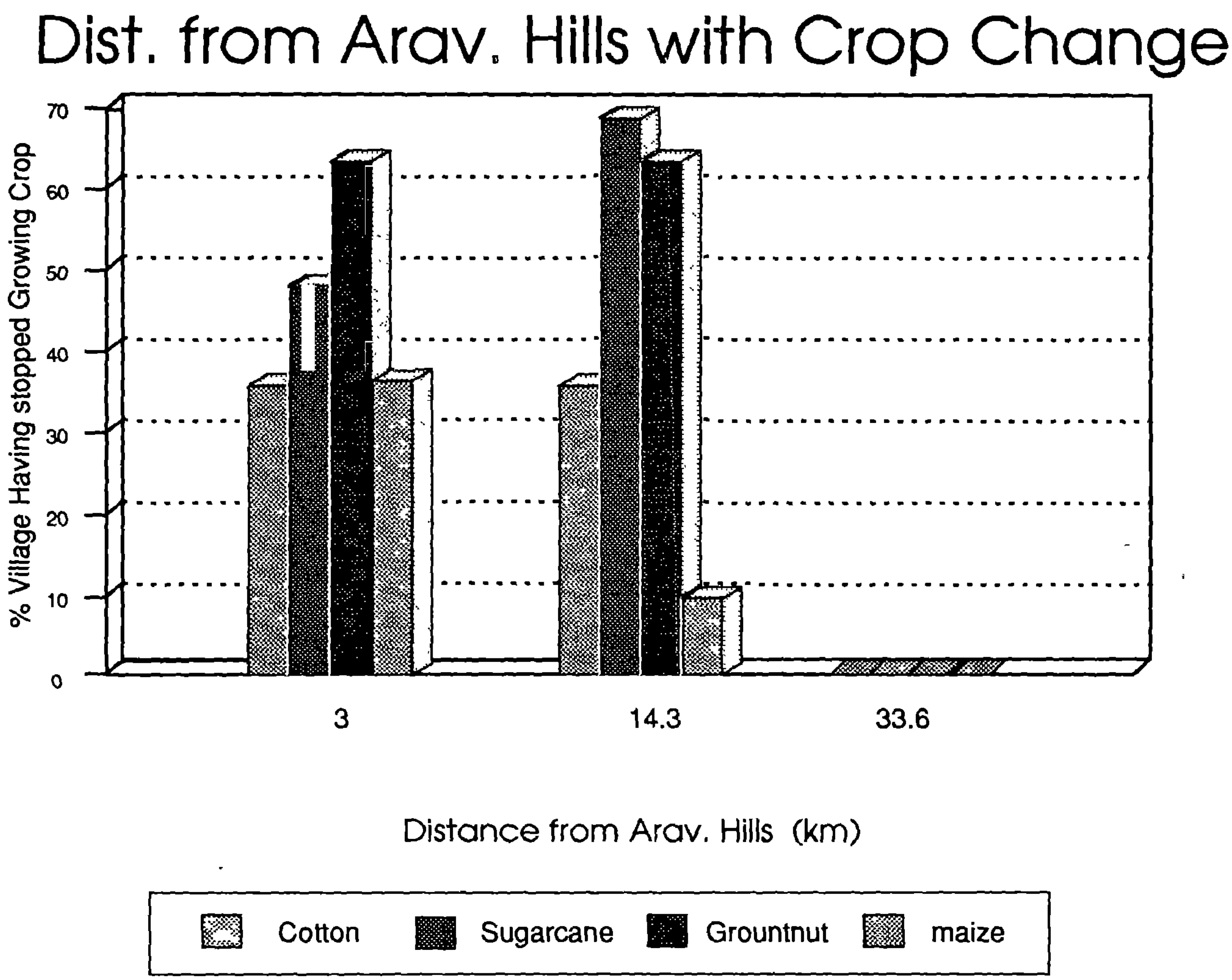

Well Depth Vs Dist. from Aravallies
Well Depth (Ft)
700
600
500
400
300
200
100
0
0
5
10
15
20
25
30
35
40
Distance (Km)

Fig-2


Dist. from Arav. Hills with Crop Change
% Village Having stopped Growing Crop
0
10
20
30
40
50
60
70
3
14.3
33.6
Distance from Arav. Hills (km)
Cotton
Sugarcane
Grountnut
maize

v. Difference in Water use & Social Organisation with Cost

Analysis of survey data has shown that there is a significant difference in water use and social organisation with cost of irrigation water and cost of well construction respectively.

1. It was found that the depth to water table has a bearing on type of well ownership. In areas where water table is at shallow depths all wells are open dug wells. These wells are owned by individuals or 'bhagidars. Bhagidhars are members of the same family who have ownership over the family properties. Away from the Aravallies ,as the depth to water table increases and there is a gradual transition from dug wells to dug cum bore wells and tube wells . In this case the type of well ownership was also found to be changing. In the case of dug cum bore wells and tube wells, well partnerships between farmers of different families and communities were found to be very common.(See fig.3) This is due to the very high cost of well construction which is difficult for an individual farmer to afford.
2. It was also found that the farmers having diesel wells have more incentive to save water as compared to those having electric wells. For the same type of crop farmers with diesel wells give lesser number of irrigations. (See Table 1 and fig.4) .This may be due to the differences in pump energy costs. In the case of diesel wells the fuel cost directly depends on hours of pumping. In the case of electric motors, pricing is based on pump horse power and does not change with the actual amount used.

Table.1

Type of crop	Avg. No. of irrigations	
	Diesel	Electric
Groundnut	2.40	4.60
Wheat	8.80	10.00
Castor	10.00	10.58
Mustard	5.70	6.70
Bajara	8.00	8.35
maize	9.50	11.00

Table.2 and Fig. 5 shows that there is a substantial difference in the percentage of the command area irrigated under different crops between diesel and electric wells.

Table. 2

Type of well	% command area irrigated under			
	Castor	Wheat	Mustard	Bajara
Diesel	20.9	19.8	17.0	25.9
Electric	22.5	24.8	19.6	34.0

Fig - 3

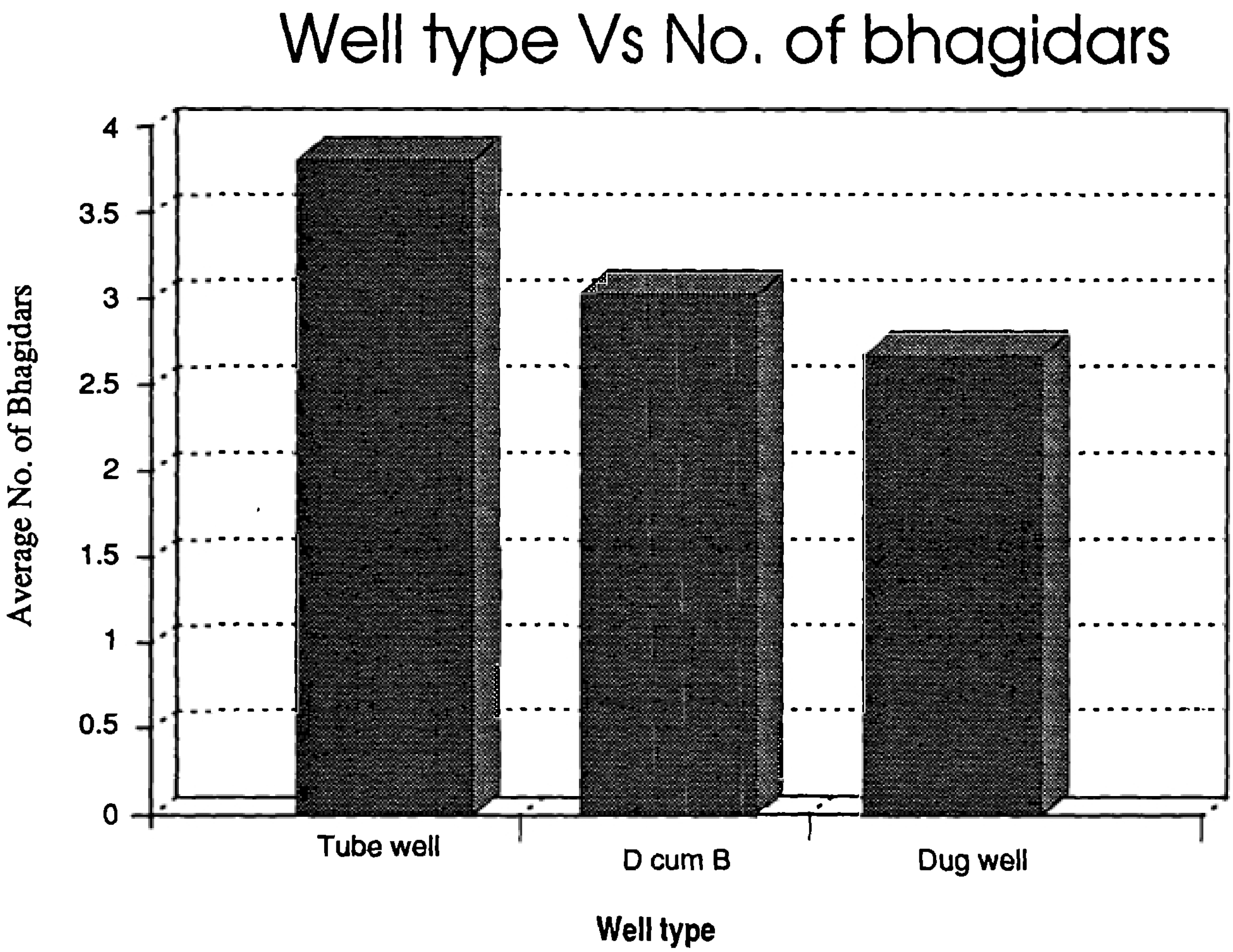

Well type Vs No. of bhagidars
Average No. of Bhagidars
4
3.5
3
2.5
2
1.5
1
0.5
0
Tube well
D cum B
Dug well
Well type

Fig. 4

Average Irrigations

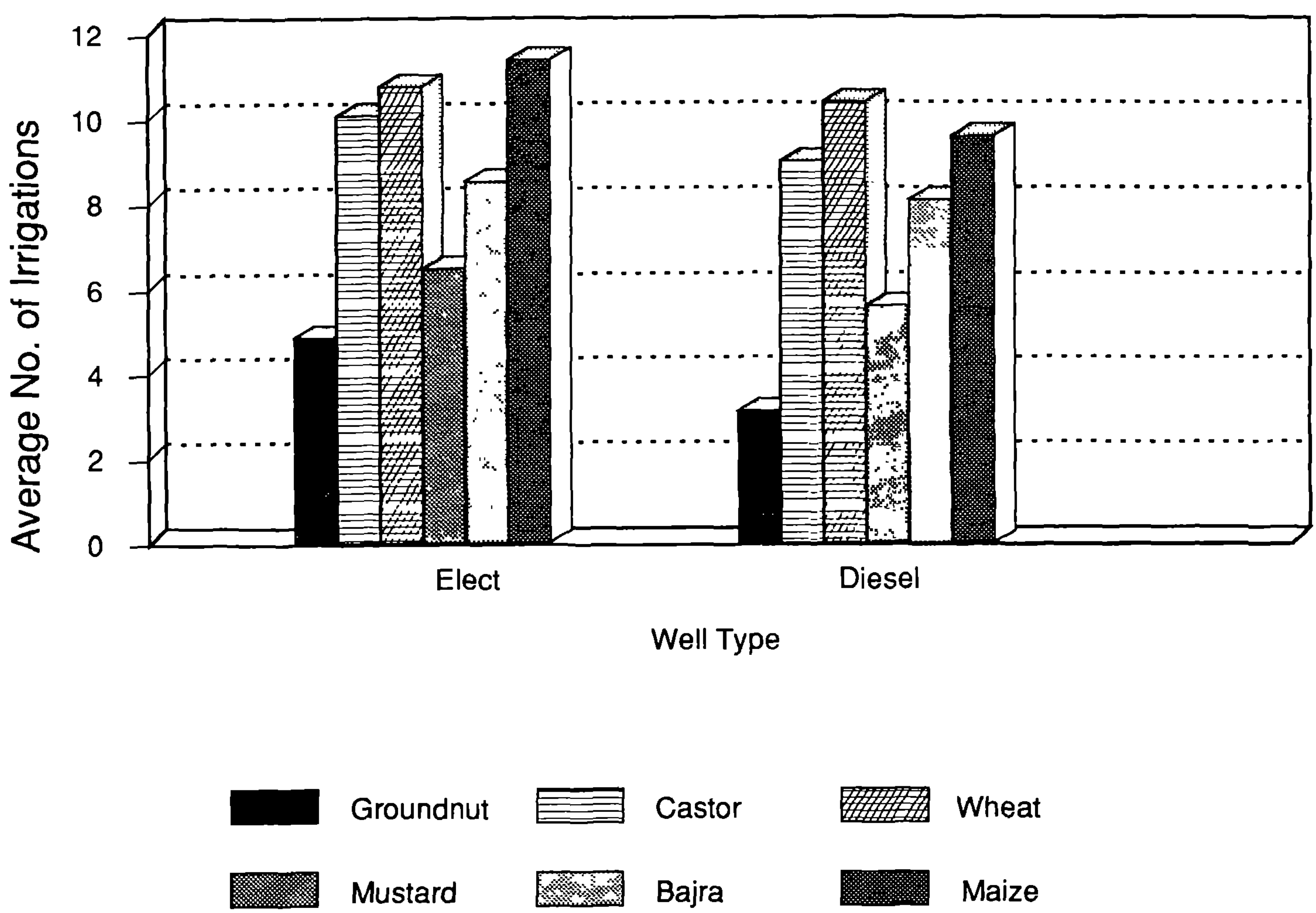
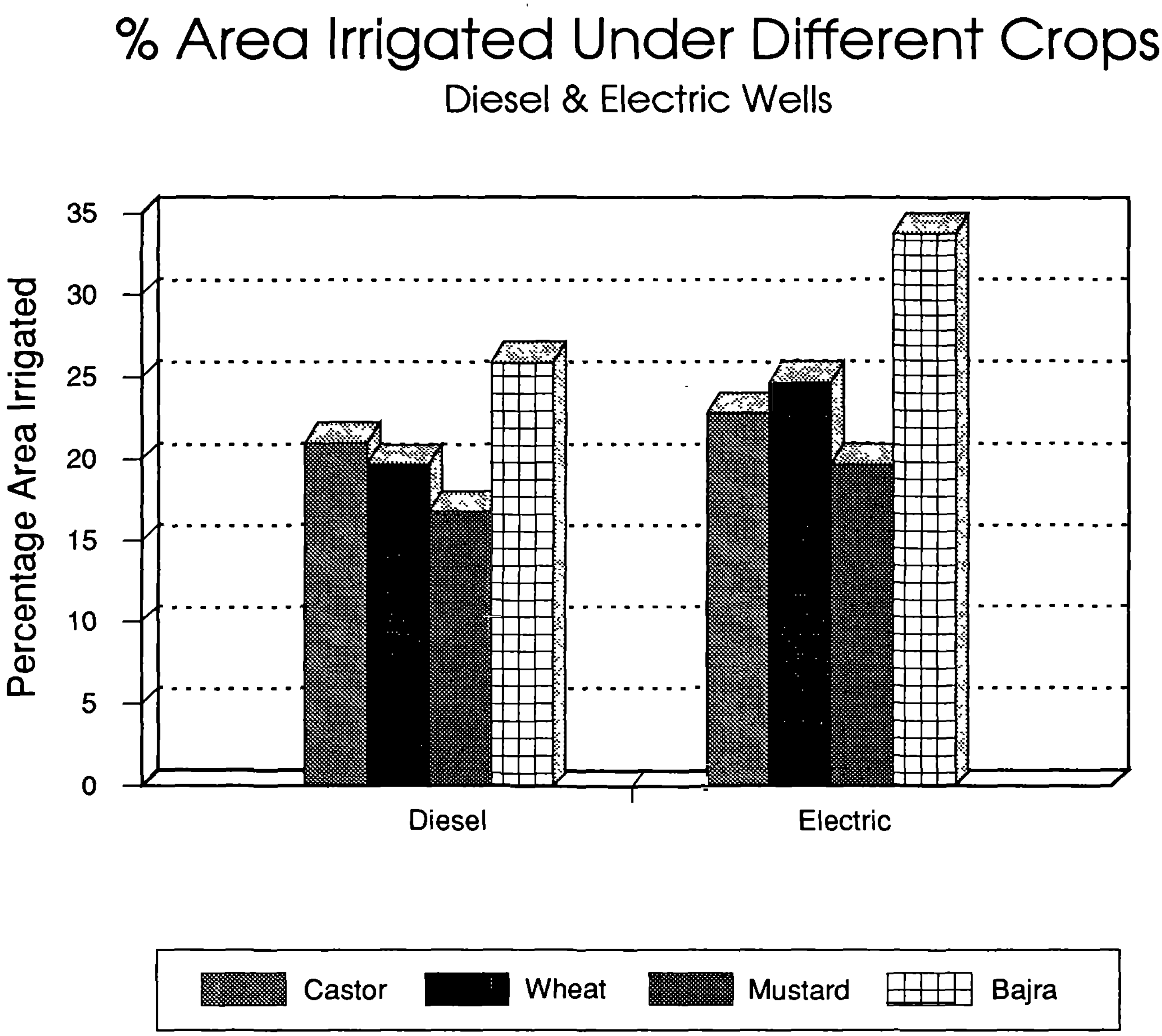


Fig. 5


% Area Irrigated Under Different Crops
Diesel & Electric Wells
Percentage Area Irrigated
0
5
10
15
20
25
30
35
Diesel
Electric
Castor
Wheat
Mustard
Bajra

It could also be noticed that in the case of bajara which is a hot season crop there is a significant difference in the percentage area irrigated in summer by diesel well owners is much less as compared electric well owners.ie Diesel well owners keep larger fraction of their land uncultivated as compared to electric well owners due to higher cost of water.

3. The percentage of electric well owners selling water to the neighbouring farmers are more than that of diesel well owners. At the same time less percentage of them purchase water as compared to diesel well owners. Another finding is that big farmers having deep tube wells sell water to those neighbouring farmers who do not have their own wells as compared to shallow well owners. All the tube well owners were found to be using concrete pipes for conveyance of water to their fields in order to avoid huge seepage losses. The difference in water markets with respect to well type can be seen from the table 3 & 4 and Fig.6 & 7 respectively.

Table.3

Well type	% of well owners	
	Purchase	Sale
Diesel	8.0	4.0
Electric	5.0	13.0

Table.4

	% of well owners	
	Purchase	Sale
Tube well	0.0	100.0
D cum B well	2.0	5.8
Dug well	9.4	5.2

IV. Points of Leverage

There are a few points of leverage, to address the depletion and water scarcity problems, on both supply and end use side.

Supply

On the supply side, there are physical activities which could be carried out to increase the groundwater recharge. This include construction of structures like recharge tube wells,check dams, and percolation tanks. The technical feasibility of any type of recharge activity in an area will depend on many factors like geology,topography,Geohydrology and water availability. For example, in an area with a very good water shed with large number small and large streams and highly permeable soils, construction of a series of check dams will be viable. If the area has got deep confined aquifers, recharge attempts will be effective only if recharge tube wells are constructed in conjunction with check dams.

Fig - 6

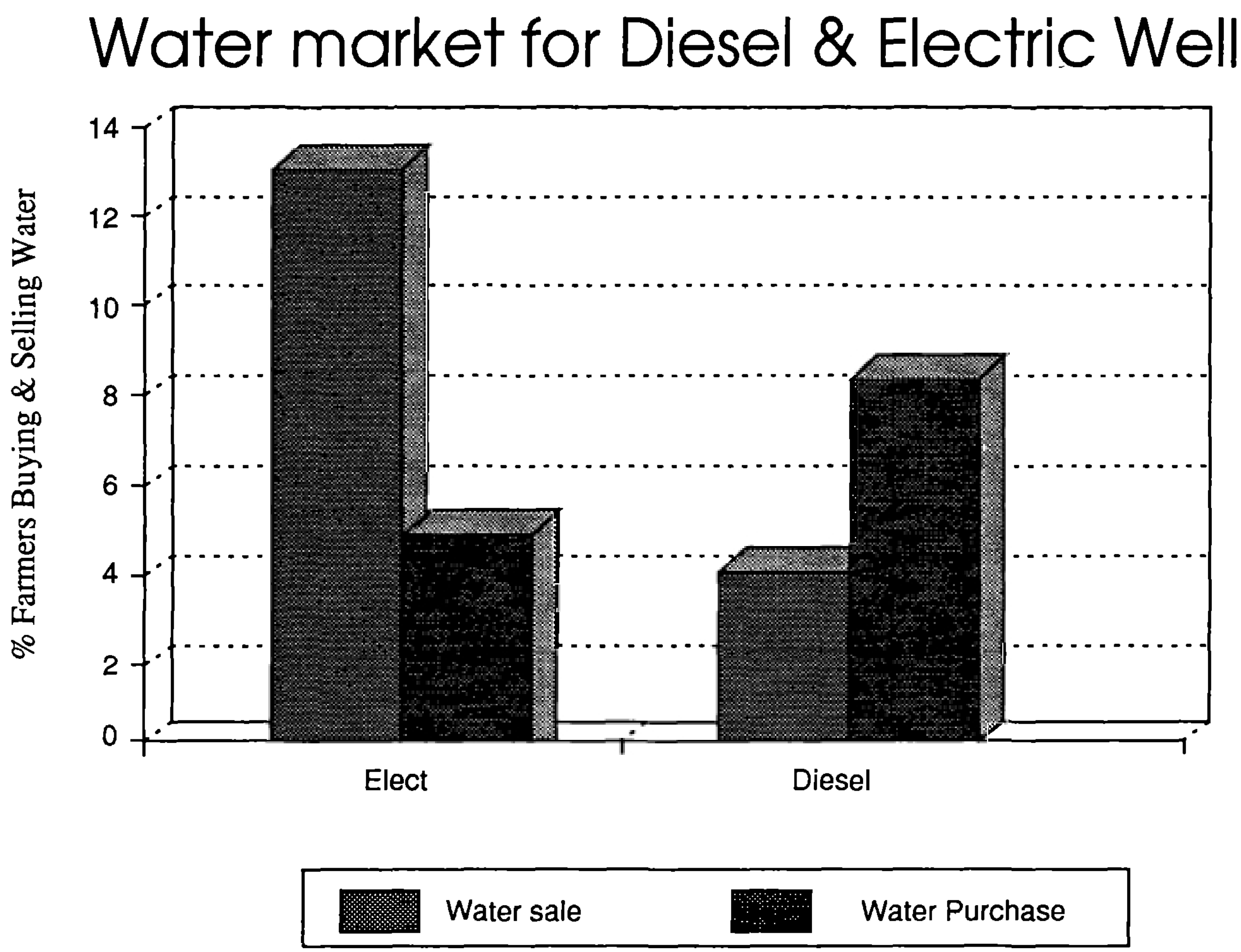
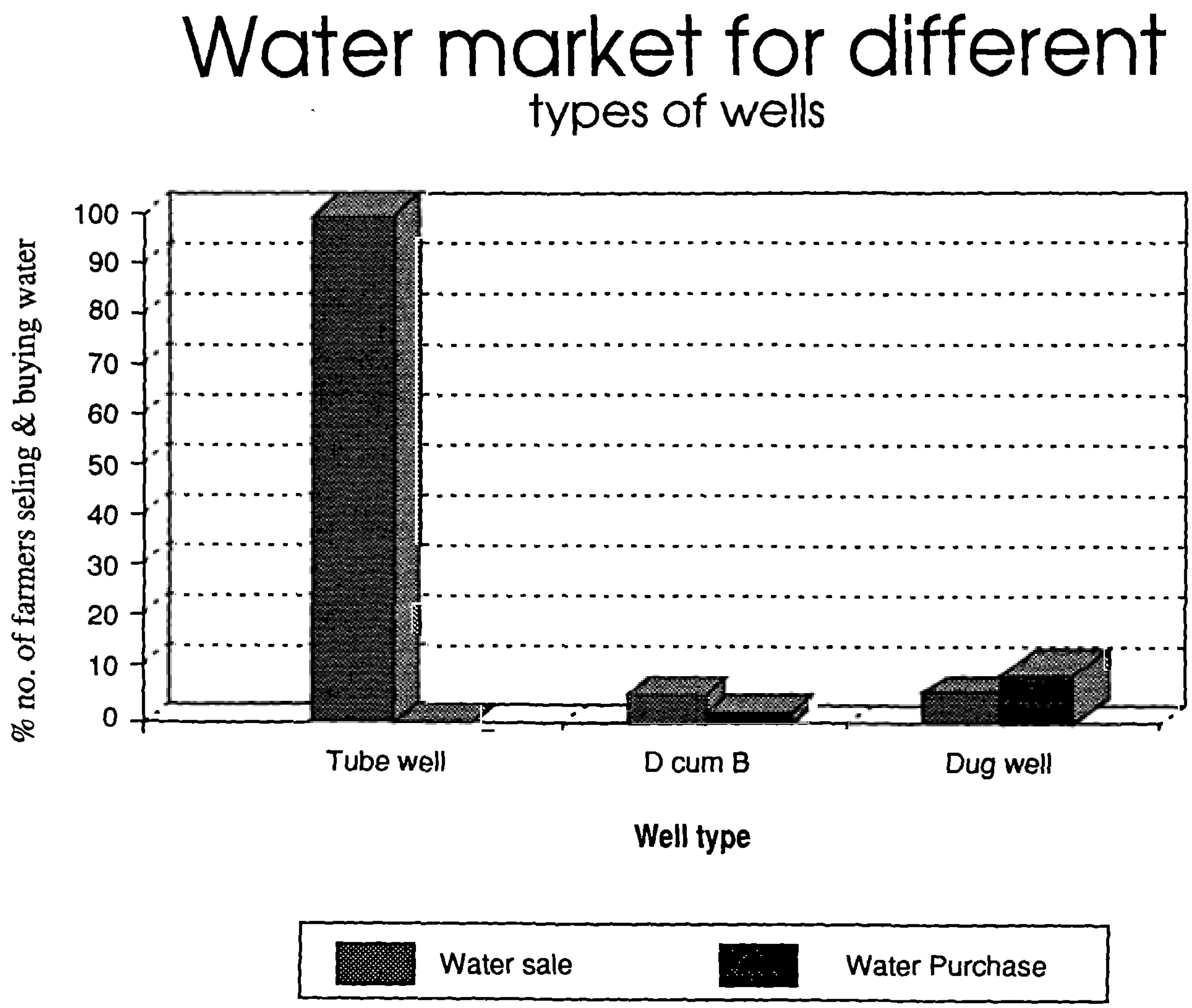

Water market for Diesel & Electric Well
% Farmers Buying & Selling Water
14
12
10
8
6
4
2
0
Elect
Diesel
Water sale
Water Purchase

Fig - 7


Water market for different
types of wells
% no. of farmers seling & buying water
100
90
80
70
60
50
40
30
20
10
0
Tube well
D cum B
Dug well
Well type
Water sale
Water Purchase

Overall, there is limited scope for increasing the supply due to the technical issues associated with recharge and lack of available water for recharging.

End- Use changes

In view of the limited scope for supply side interventions,there is a need for reducing the use of water. In Mehsana,though the shortage of water has forced the farmers to adopt less water intensive crops,the efforts in this direction are still limited. End use changes offers a wide scope for addressing the demand- supply imbalance. Significant reduction in total water use could be brought about through crop changes and adoption of efficient water use technologies.

i. Crop changes:

As mentioned early the shortage of water has resulted in farmers shifting from water intensive crops like cotton, groundnut and maize to less water intensive crops like castor, bajara and mustard. But for these crop changes to affect any substantial reeducation in the total water use there need to be a wider adoption of less water intensive crops on a larger scale. Out of the 157 farmers from all over the 33 villages, 128 are still growing wheat in Rabi season. This shows the scope crop changes has got in addressing the problems.

ii. Technology changes :

Changes in technology can also bring in major changes in end-use. the use of efficient irrigation technologies can save substantial amount of water which otherwise will go as wastage. It was found during the survey that all the farmers in the area are using conventional method of irrigation thereby resulting into huge wastage. They may also be applying far more water than what is really necessary for good crop growth. If the farmers could be motivated to implement modern water application techniques,it could result in large reductions in water requirements for irrigation. The additional water available through saving could be used for supplementing irrigation or to reduce the overdraft. Avenues need to be found out through which crop changes and adoption of water conservation technologies can be affected. The various possible avenues are

A. Subsidies :- The government can provide subsidised loans to farmers through nationalised banks to purchase efficient water application equipments such as drip and sprinkler systems. Loans could also be provided for installing plastic pipe lines for conveyance of water in the fields. This will give an incentive for farmers to act towards the saving of irrigation water.

B. Extention activities :- Field visits could be arranged for farmers to see the areas where water conservation technologies are already adopted. Such visits can help farmers to know about the advantages of advanced water application techniques there by giving them an incentive to adopt them, in their own fields.

C. Education : Farmers' education is a pre-requisite for bringing about any change in the conventional methods of water use. Because unless farmers themselves realise the scarce any precious nature of water,they will hardly put in any effort to conserve them. This is also important in view of the fact that many farmers in the area have no idea about the latest water conservation techniques. Training shall be imparted to the farmers on ethics of water conservation and new water conservation technologies.

D. Regulations : The power -pricing linkage existing at present gives the electricity well owners an incentive to pump as much water as they like. There are a few points of leverage available with the government at present. It can change the electricity prizing structure so that electricity could be charged according to the actual power consumed.

Target groups:

It was found that the diesel well owners have the incentive to save water due to the prohibitive fuel charges. They could be the target groups for advocating water conservation technologies provided enough resources are made available to them through subsidies. The deep tube well owners who are found to invest in water conservation measures (pipe lines for conveyance of water) could be another target group as they can sell the additional water saved through water conservation techniques.

V. VIKSATs' Strategy :

VIKSAT is planning to take up a field project on groundwater management in a few of the villages where the survey is carried out. The villages will be selected on the basis of results of thorough analysis of data collected from survey. Detailed diagnostic surveys will be carried out in the selected villages to understand the real problems people are facing. This will be followed by feasibility studies to know what kind of management actions are possible to be carried out in the village.

At the village level,VIKSAT will work towards facilitating community organisations in the selected villages through working with the communities. Then it can help these village level organisations to get support from government organisations and other resource rich institutions both in terms of technology and finance for carrying out the field project. The ultimate aim will be to get GWRDC or other government agencies playing the major role in implementation.

Regional level strategies will be; 1. Assisting regional level institutions in developing water management strategies (For example the newly formed water management trust in Mehsana) through training and 2. Integrating their efforts with the management programmes undertaken by village level institutions.

Strategies at state level includes liasoning with the government organisations to channel the resources from on-going programmes (such as those of GWRDC, GSLDC and FD) into the management activities initiated at village level. Also efforts will be on to bring into the policy agenda of state level institutions some of the factors influencing management of groundwater resources. The aim will be to affect changes in electricity pricing structure and to introduce subsidised credit facilities for water use technologies.

The project will be probably started in the beginning of next year.

SUMMARY

The following paragraphs give a brief summary of the issues of NGOs in their perspective and their needs which are relevant in the research point of view.

Technical Issues :

1. Difficulty in a) Estimation of groundwater recharge due to a large number of factors influencing it and b) Identification of beneficiaries of groundwater recharge structures.
2. Problems in devising accurate monitoring systems for measuring groundwater quality changes. This results in collection of unrepresentative samples for analysis and thereby the results obtained are often misinterpreted.
3. Technical feasibility of different recharge structures; ie what kind of recharge structures are feasible under different physical conditions and how much water could be captured by these recharge structures and recharged to groundwater.
4. Data are required for management of water resources in an area. Lack of sufficient data often makes it difficult to develop suitable water management practices to be adopted for an area.

Research Area:

1. Thorough understanding of physical issues concerning groundwater recharge. This will help to get idea about the feasibility of recharge structures in an area and how much they can contribute to increasing groundwater recharge in that area.
2. Accurate assessment of groundwater potential, status of groundwater development and surface water availability and correct determination of crop water requirements, infiltration rate for different types of soils etc. This will help in developing suitable water management practices for management of water resources in an area.
3. Collection of data on pumps ,well water levels (pre and post monsoon) water quality,type of crops,area cropped,water use etc. This can be used to determine actual increase in groundwater recharge due to the recharge structures and identification of beneficiaries of recharge structures. This will in turn make groundwater budgeting easy.

Economic Issues:

1. The economic viability of local water conservation projects is often not known.
2. The farmers are still not ready to invest in water conservation efforts in their fields as they are not sure about individual benefits.

Research Area:

1. The detailed economic evaluation of local water management efforts to know how much water conservation efforts will really cost in comparison to the actual benefits accrued from them.

Social and Institutional Issues:

1. On the supply side, often, there is difficulty in getting whole hearted support of people for water harvesting and uncertainty about the maintenance of structures constructed. On the demand side, farmers continue to apply excess irrigation to their crops.

2. Community water management solutions are difficult to apply in areas characterised by heterogeneity in social and resource conditions. Different communities have different water use priorities. People in the localities free from water problems never to contribute towards any management solution taken to solve the problems in another locality.

Action Research Area:

1. Create strong and effective village level institutions which can carry out water management activities in their localities and undertake the maintenance of structures constructed and also enable greater support of all communities in applying the water management solution for a given locality.
2. Assisting communities in developing suitable water management system in their localities.

Policy Issues:

1. NGOs are attempting community participation in developing water management strategies which are suitable for their localities and implementing them. But they are often not well documented thereby fail to make impact at policy level. This results in such approaches not being accepted by government agencies for large scale implementation.
2. The water use priorities of communities are often different from that conceived by development planners and policy makers. This leads to their schemes and programmes becoming ineffective in solving community water problems.

Documentation Needs and Policy Support:

1. Understanding and documenting people's perceptions on water and existing local management systems and communicating them to planners and policy makers.
2. Evolve an effective system for systematic monitoring,evaluation and documentation of the innovative water management programmes initiated by NGOs with community participation. This will help to make policy level influence to promote such programmes and bring them into standard water management policies.

Conclusions:

The proposed action-research network of NGOs, academicians and research institutions can deal with the issues identified above. This not only will lead to better implementation by NGOs but generate viable options for community based water management systems. This will also help the policy makers in the government to support similar efforts through government programmes.

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