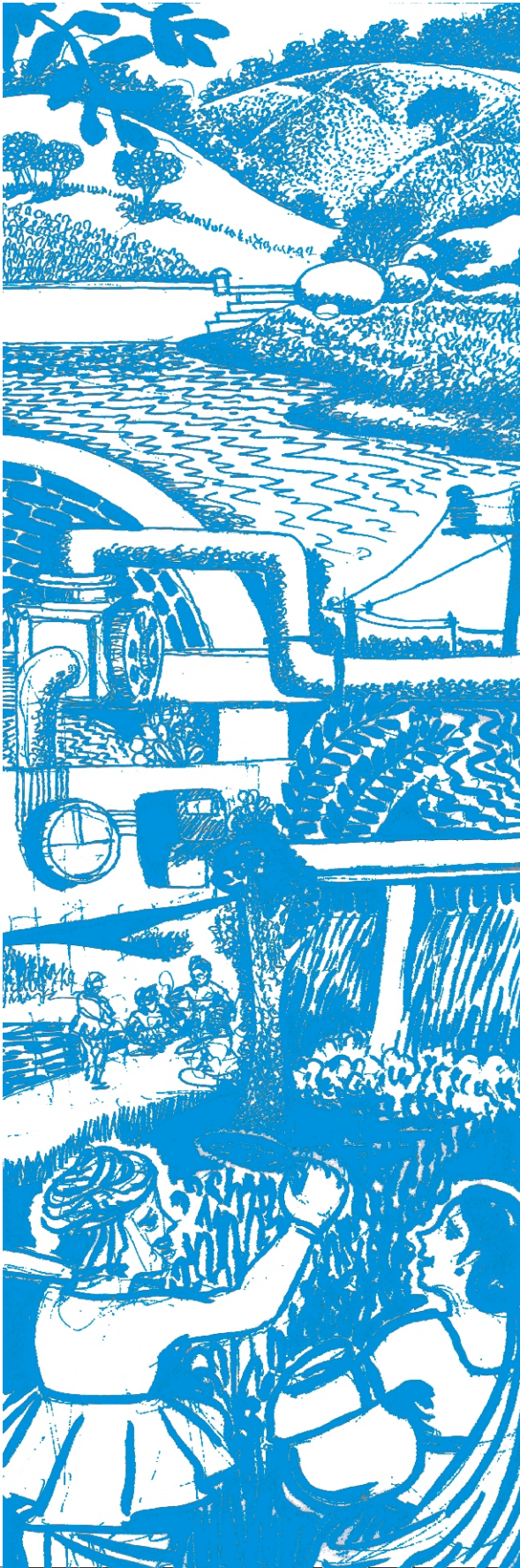


2nd IWMI-Tata Annual Partner's Meet Report

Putting research knowledge into action

IWMI-Tata Water Policy Program



Water, Livelihoods and Environment in India: Frontline Issues in Water and Land Management and Policy

IWMI-TATA RESEARCH TEAM, ANAND
2003


IWMI TATA
Water Policy Program

<http://www.iwmi.org/iwmi-tata>

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WATER, LIVELIHOODS AND ENVIRONMENT IN INDIA: FRONTLINE ISSUES IN WATER AND LAND MANAGEMENT AND POLICY

1. Background

The way we manage our water and land today will be an enduring gauge of our ability to foster sustainable and equitable growth in the future. This is all the more important in a developing country like India, where judicious management of water resources could be the crucial determinant of overall development in years to come. Thus, doing good research on frontline issues in water and land management is of supreme importance. Equally important is translating those research outputs into actionable policy recommendations so as to enlarge the basket of policy choices of key decision makers. But very often, there exists a gap between research recommendations and their actual implementation. The IWMI-Tata Water Policy Research Programme (ITP) aims to bridge this gap.

With a view to developing practical approaches to managing water for food, livelihoods, and nature, ITP was set up in 2001 with a generous grant from Sir Ratan Tata Trust (SRTT), Mumbai. Over the last two years, ITP has initiated several research activities in the field of water management in India as well as in other countries of South Asia, some through its own in house staff, but more through a number of research

IWMI-Tata Programme was set up in 2001 with a generous grant from Sir Ratan Tata Trust, Mumbai. The mandate of this programme is to develop practical approaches to manage water for food, livelihoods and nature in a way that can help India avoid her impending water crisis. Over the last two years, ITP has initiated several research activities in the field of water management in India.

partners, including universities, NGOs and other national and international research agencies.

The ITP organized the second annual partners meet from 27 to 29 January 2003, at the Institute of Rural Management, Anand (IRMA). Like last year, the partner's meet was designed for three purposes, to present result of research undertaken in 2002, obtain feedback from participants, and evolve future research agenda. Though the objective of the workshop was the same as last year, this year, there was a departure in the form of new design for the workshop, where every individual researcher was given an opportunity for presenting his/her own work. A total of eight themes emerged from ITP work in 2002 and accordingly, the first one and a half days were devoted to each theme and theme co-coordinators conducted theme specific sessions which ran parallel to one another. Within every theme session, each paper was presented by individual authors and, at the end, there was a panel discussion focusing on generation of new research ideas. The next one and half days were dedicated to plenary sessions, one plenary session for each theme. In the plenary session, the theme co-coordinators presented the synthesis of all papers and the main feedback and research issues that emerged in the session, thereby setting the research agenda for the year 2003-2004. The partner's meet started on the January 27 2003, but one of the theme sessions on groundwater governance in South Asia has held at the same venue on 26 January 2003. The workshop schedule and list of papers is given as Appendix 1, while the list of participants can be found in Appendix 2.

2. Introduction

Frank Rijsberman [1]¹, Tushaar Shah [2], Christopher Scott [3], Arun Pandhi [4], and K P

¹Designation and affiliation of each participant is given in Appendix 2. The names are numbered in the same sequence as they appear in the report.

Reddy [5] facilitated the opening session. Rijsberman said that IWMI as a research organization works at the interface between water research and water policy in order to make recommendations to policy makers, be it at the global, regional, or local level. Tushaar Shah gave a brief background to the ITP and the partner's meet by saying that originally ITP had envisaged an annual evaluation by an external panel of consultants. However, as the programme matured, it was felt that instead of evaluation by experts, perhaps a better way would be to hold partner's meet where, in addition to the partners, representatives of target audience such as policy makers could also be present. He said that ITP has been working in a problem solving mode for the past two years and its goal is to create a basket of options on various water management related issues and offer its findings in order to enrich the current policy discourse on such issues of great relevance. In doing so, a major emphasis has been on work done in collaboration with partners. In the last year, ITP has worked with 30 partners from not only India, but also from Nepal, Bangladesh and Thailand. Work done in the last year could be divided into 8 major themes, of which 3 themes were decided in the last years (2002) partner's meet. The 8 themes are:

ITP Research Themes in 2002

- **The Central India Initiative**
- **Energy Irrigation Nexus**
- **Tanks in India**
- **Groundwater governance in South Asia**
- **Promoting micro-irrigation**
- **Groundwater in Gujarat**
- **Irrigation and Poverty**
- **Managing India's public irrigation systems**

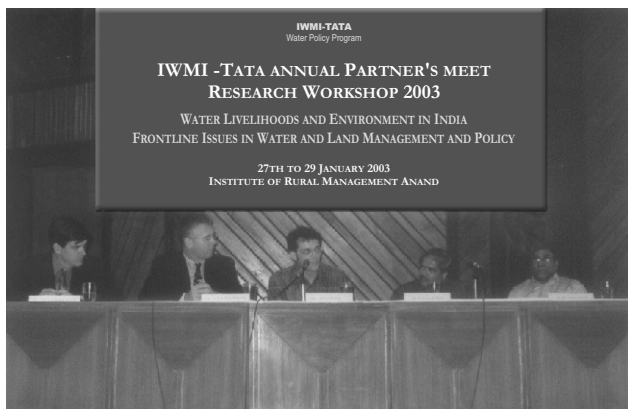
1. Central India Initiative: This was launched last year as a partnership between the NM Sadguru Research Foundation, PRADAN, and IWMI based on feedback obtained from the last year's partner's meet. Based on years of experience of working with the tribals,

Sadguru and PRADAN realized that irrigation can be a powerful trigger in tribal development. This initiative was set up last year to evolve a programmatic action plan for appropriate irrigation intervention in tribal areas.

2. Energy Irrigation Nexus was the second theme suggested last year. Most of South Asia is dependent on groundwater for irrigation and groundwater irrigation in turn has implications for the energy sector. However, the discussion in this theme has been rather uni-directional, most advocating metering of agricultural electricity use. But, the fact that this has not worked in the last 15 years or so shows that there is lack of understanding on the issue. Research done in this theme tries to generate new ideas on the theme.
3. Tanks were the third issue identified last year. India has thousands of tanks spread all over. However under the onslaught of development, tanks have been declining. Here again, the discourse has been dominated by technocratic rehabilitation, but now experience shows that such efforts are not sustainable. The central question in this context is: are there other alternative ways of improving gross tank productivity? Papers on this theme try to seek some of these alternatives.
4. Groundwater governance is an overarching theme of ITP as well as the global theme of IWMI. Last year, considerable amount of work has been done on this theme in the form of groundwater surveys in five Asian countries.
5. Promoting micro-irrigation was one of the important areas of last year's work. It is important to ITP because micro irrigation focuses on energy and water saving. However, so far micro irrigation kits of major companies have been far too sophisticated and expensive for most small farmers to adopt them. But in the last two to three years, there has been a virtual revolution in the micro irrigation sector though grassroot innovations such as *Pepsee* drip systems in the Maikaal region of Madhya Pradesh. These have become affordable to small and marginal farmers and ITP has been studying this phenomenon for the last one

year. In this, IDE as well as Bio-Re, a not for profit subsidiary of a Swiss organic cotton firm are ITP's research partners. In Gujarat, ITP has been collaborating with AKRSP (I) to popularize micro irrigation.

6. Groundwater in Gujarat was the sixth theme of this year's partner's meet and there were several papers related to groundwater use and recharge in North Gujarat and Saurashtra. Another focal point of this session was the update on the North Gujarat Initiative- an action based research programme running in 30 villages in North Gujarat. Through this Initiative, ITP is trying to implement water saving and yield enhancing micro irrigation in India's worst groundwater basket case of North Gujarat.
7. Irrigation and poverty was another overarching theme of ITP's research in last year. Irrigation and poverty linkages are very well researched. However, in recent past there has been resurgence in exploring poverty implications of irrigation projects and hence under this theme ITP has done some work.
8. Finally, managing India's vast public irrigation systems is another theme on which ITP has worked last year. Most public irrigation systems in India are in a state of disarray and the common refrain to salvage them has been through farmer's involvement. ITP tried to look at the issue critically and explore if there exists other alternatives to manage these huge systems.



Inaugural session of the ITP meet

Shah said that dissemination and communication of research results holds a high priority for ITP.

There are three ways in which ITP has been disseminating its results; these are through water policy briefings, IWMI-Tata research highlights and comments, and ITP website. He further solicited the need for feedback on the programme and the need to generate new research ideas. Some of the ideas that ITP had been toying around are interlinkage of rivers in India, the way the Narmada scheme is unfolding, virtual water, and interstate water dispute issues. He hoped that new research ideas will be generated at the end of this meet.

At this point, Rijsberman announced a six member evaluation group comprising of J S Samra [6], Nilima Khetan[7], Anil Shah[8], Lucy Maarse[9], David Molden[10] and himself. This evaluation group, as the name suggests, would provide formal feedback to ITP at the end of the three day long partner's meet.

Christopher Scott in his inaugural speech underscored the importance of a policy research based programme like ITP and added that other than the activities that ITP has been pursuing, the IWMI-India office has been working on some very pertinent issues, such as water management in a basin context, Challenge Programme on Water and Food, and use of wastewater for irrigation. Arun Pandhi said that the goal of ITP is to involve global scientific partners in formulating practical agenda in order to evolve ways to forestall the impending gloom in India's water resources sector. To this end, two more action oriented programmes have been instituted in the last year, viz. Central India Initiative and the North Gujarat Initiative. He hoped that, by next

Media Coverage

This years ITP meet got its fair share of media coverage. Several correspondents from local vernacular newspapers and national English dailies attended the press conference organized on the last day of the meeting. News on the ITP meet appeared in all leading newspapers such as Economic Times and Hindu and local newspapers such as Sardar Gurjari and Jai Hind. The meet proceedings were also telecasted on a Gujarati news channel.

year, ITP will have some more concrete policy findings in these two and other fields of water research. Reddy welcomed the participants of the meet and pointed out the dire need for research in the water sector.

One of the highlights of the partner's meet was the media attention it got. A pre-event press release was issued to press correspondents in Ahmedabad, Gandhinagar, Baroda, Nadiad, and Anand. The meet was covered by the *Economic Times* and *Indian Express* in English; *Madhyantar*, *Sardar Gurjari*, *Sandesh*, *Naya Padkar*, *Charotar Bhoomi* and *Jai Hind* in Gujarati and *Jan Hitaishi* in Hindi. A press conference was organized on the concluding day, January 29 2003, which was attended by over 40 press representatives and representatives from Doordarshan and All India Radio. A press note was issued on this occasion outlining the outcome of the different sessions. The media briefing was conducted by Tushaar Shah along with, Rijsberman, Scott and Pandhi. News items were carried by the *Economic Times*, *Indian Express*, *Hindu* and *The Times of India* and *Media Today* in English; *Naya Padkar* (two consecutive days), *Sandesh*, *Gujarat Samachar*, *Charotar Bandhu* and *Sardar Gurjari* in Gujarati. The event was covered by All India Radio and Doordarshan Gujarati and Alfa Gujarati channels two days later.



The press meet in progress

3. Organization of the report

This report will follow the same format as the partner's meet. The next section will record the proceedings of each theme session, held January 26 to 28, 2003, while the section after that will record the proceedings of the plenary sessions. The last but one section will be dedicated to evaluation received from the evaluation

committee, as well as from other participants and the final section will set out the research agenda for 2003-2004.

4. Theme Session Proceedings

There were eight theme sessions, one of which was conducted on the January 26. The rest ran concurrently on January 27 and 28. Following provide a summary of the papers presented and issues discussed in each of the theme sessions.

4.1 Groundwater Socio-Ecology of Asia: Governing a Colossal Anarchy

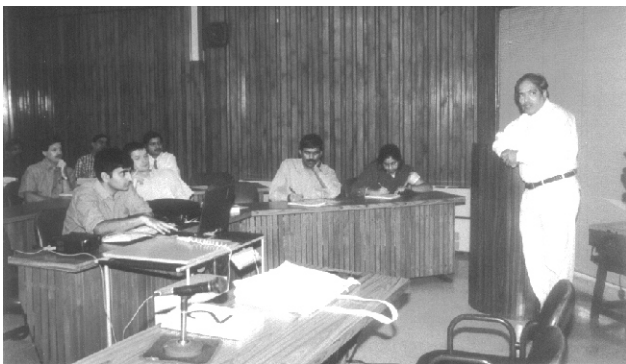
The session started with a short introductory presentation by Aditi Mukherji [11]. She let the audience know that, in the last year, IWMI had conducted primary groundwater surveys in five Asian countries, viz. India, Pakistan, Bangladesh, Nepal, and Thailand. The objective of this workshop was to present region specific analysis of data generated through the groundwater governance surveys. The collaborators in data collection from all countries were to present a refined and nuanced analysis of groundwater situation in their area of survey. Another objective of this session was also to identify researchable issues on groundwater for the year 2003-2004.

In recent years there is an increasing awareness about the important role of groundwater in fostering food sufficiency in much of India. At the same time, there is a realization that this precious resource stands the chance of rapid and irreversible exploitation. The issue is: how long can this good run continue without any mechanism for governing this colossus? What kind of governing structures and mechanisms might help? Refined understanding of the (non)existing governance structure in groundwater and further research into fine tuning this understanding in order to try and bring about a modicum of order in the functioning of this booming but anarchic economy is of great urgency- and this was the agenda of the groundwater governance session.

Tushaar Shah presented an overview of groundwater socio-ecology in South Asia. He said that, though there is enough technical expertise in the field, there are only a handful of social scientists working on groundwater in India. He emphasized that groundwater has immense social, economic, and institutional implications, and therefore stressed the need for better and refined understanding of this colossal economy in order to get a better handle on it, more so because the groundwater economy in India is largely informal and privately driven, with hardly any connection with public agencies. In this context, he emphasized the need for indirect regulation through managing the irrigation energy nexus in a proactive nature.

All the presentations in this session focused on the six issues that were identified as part of the groundwater governance survey. These six issues were: size, significance and growth pattern of groundwater economy, profile of well owners, technological configuration of the groundwater economy, groundwater supported irrigated agriculture, economics of groundwater irrigation including its financing, and groundwater markets.

K C Roy and others [12, 1.1]² presented their paper on socio-ecology of groundwater irrigation in Bangladesh. Groundwater is the most important source of irrigation in Bangladesh and its share in the total irrigated area has increased from a mere 3 per cent in 1977 to 64 per cent in 2000. Shallow tubewells is the most important means of irrigation. The cropping pattern in Bangladesh is rice dominated and boro or summer rice is the most important irrigated crop.



Groundwater session in progress

Most groundwater irrigation in Bangladesh is farmer financed. Diesel pumps constitute almost 80 per cent of total pumps in the sample. According to Roy, survey data shows that groundwater markets are quite active all throughout Bangladesh and various modes of payment for water prevail. There is no monopoly in groundwater markets, as the number of wells and tubewells is quite high.

Avinash Kishore [13, 1.2] presented the next country paper on Pakistan on behalf of Asad Qureshi [14] and Mujeeb Akhtar [15]. The main thrust of the presentation was that there has been a steady increase in the number of tubewells as well as area irrigated by them all across Pakistan, especially in Pakistan Punjab. Secondly, the operating factor of tubewells (i.e. number of hours operated in the year/total number of hours in a year*100) is determined among other things by type of motive power (electric or diesel), season, and type of crop grown. Here too, like India and Bangladesh, most groundwater irrigation is farmer financed. There is a well developed groundwater market, especially in Punjab province.

Madhav Belbase and others [16, 1.3] presented the next paper on the socio-economic implications of groundwater irrigation in Nepal terai. Compared to India, Bangladesh, and Pakistan, Nepal Terai has a modest number of groundwater structures, most of which came up in the late 1990s as a result of government subsidies. However, as soon as the subsidy was phased out, a decline in area irrigated by groundwater was seen. Besides, unlike the rest of South Asia where groundwater is used to grow one or two more additional crops, in Nepal, it is used mostly as supplemental irrigation. Thus, the groundwater economy of Nepal is different from the rest of South Asia in many respects, especially in respect of financing of irrigation and irrigation intensity.

The final presentation in the country paper section was made by Bancha Kwanyuen and others [17, 1.4]. This paper presented the first-cut analysis of groundwater survey data collected for Thailand. Thailand presents a contrast to the rest

²Designation and affiliation of the participant (see Appendix 2) and the paper presented (see Appendix 1). Papers are numbered from 1 onwards in each session. Thus, paper 1 of session is numbered as 1.1 and the first paper of session 2 as 2.1 and so on.

of South Asia, in the sense that here groundwater is a minor source of irrigation, and most of wells and tubewells in the countryside cater to drinking water purposes, rather than for irrigation. The main source of irrigation in much of Thailand is canal and canal water is delivered to farmers free of cost.

The next set of paper presentations concentrated on Indian state level findings of the groundwater governance survey. Sachin Madrikar [18, 1.5] presented the result of the survey in Maharashtra and Goa. He highlighted the fact that in the backward Vidharba region, groundwater development is only 12 per cent of its potential. Even then there are some 10 blocks which have been declared dark blocks and in all these orange cultivation prevails. According to him, the main problems faced by irrigators were lowering of the water table and high fuel costs. Ranjan Mohapatro [19, 1.6] presented the findings of his survey in Orissa. Orissa has very low pump densities, much lower than even Bihar and Bengal. Another contrast is that the share of electric pumps has been increasing steadily which is attributed to recent power sector reforms. However, more research is needed before we can come to that conclusion. Falling water table has been reported as the most critical problem faced by well irrigators. Well owners are mostly large farmers and so far groundwater development has increased inequities in the villages. Seetapathi Rao [20, 1.7] presented survey results for two states, Andhra Pradesh and Karnataka. He pointed out that source wise irrigated area has changed dramatically from the 1960s to the 1990s. While in the 1960s, canals and tanks were the main source of irrigation, in the 1990s; borewells have become more important than tanks. He said that, over the past 10 years, there has been a significant decline in the command area of a borewell and an increase in the number of borewells at the cost of dugwells. He also talked about some innovative projects that IRDAS has taken up, especially in connection with power supply to borewells. Karnataka [1.8] presents a similar picture. Here, the survey results show that almost 37 per cent of total irrigated area is under groundwater irrigation. Of all the wells included in the survey, some 18 per cent were reported to have dried up. After these two presentations, Abhishek Sharma

[21] asked Rao about the interlinkages between groundwater and tank irrigation and if growth in borewells was one of the reasons for decline in importance of tanks. Tushaar Shah asked why there is a steady decline in open dugwells in south and peninsular India, while tribal central India with the same kind of hardrock terrain is registering an increase in the number of dugwells. This was answered by Dinesh Kumar [22] and Niranjan Pant [23], who pointed out that most of tribal central India receives much higher rainfall than southern peninsular India and given the low levels of groundwater exploitation so far, dugwells do not go dry as frequently as they do in Andhra Pradesh and Karnataka. Rajen Rao [24, 1.9], an independent consultant presented his survey results for Gujarat.

In the final round of presentations, there were three papers. Using rigorous techniques, Shakeel Ahmed [25, 1.10] constructed a water balance model for a small watershed on the outskirts of Hyderabad. In the watershed studied, there has been a boom in the number of tubewells, from only two in 1975 to as many as 929 in 2002, of which 228 (mostly dugwells) have dried up. His model predicts that in the next 20 years, the water table will go down by 20 to 25 meters. Frank van Weert [26] raised the question as to how accurate these water balance exercises need to be, since it is an expensive proposition to make detailed water balance calculations for thousands of watersheds in India. David Molden said calculating such basic figures such as how much water is flowing in and out of the system does not need very high levels of sophistication and precision. The next presentation was by S J Phansalkar [27, 1.11]. He discussed some of the emerging issues in view of the new groundwater act in Maharashtra. However, this act is applicable only to drinking water wells and preliminary evidence shows that many of the penalty clauses mentioned in the act are not being implemented owing to social and political realities of village life. Frank van Weert asked if the act specified any quality issues, and Phansalkar replied that right now the act concentrates only on quantity depletion rather than quality problems. The final presentation was by M. Mainuddin [28, 1.12]. He talked about arsenic contamination of groundwater in Bangladesh and said that new evidence shows that

arsenic has been found in paddy and, if it is true, the consequences will be far more serious than arsenic contamination of drinking water. He also talked about the need for co-management of surface water and groundwater, saying that ever since the focus has shifted to groundwater irrigation, surface water bodies have been totally neglected. Dinesh Kumar asked if there has been any study on the impact of drawdown on groundwater recharge in Bangladesh. Roy said that in years of good rainfall, the aquifers are recharged completely and Bangladesh more or less gets good rainfall every year. However, way back in 1983, some excessive drawdown was seen in some pockets, but it was a temporary crisis.

Panel Discussion

At the end of paper presentations, panel discussions began under three panelists, viz. Shaktivadivel [29], Niranjana Pant, and M Mainuddin. Shaktivadivel set the agenda by saying that the purpose was to generate new researchable ideas for the next year and asked the participants to express their views.

Tushaar Shah said that there was still considerable scope for work on arsenic contamination of groundwater in Bangladesh, particularly from the point of view of its impact on agriculture. In addition, fluoride poses a serious health problem in much of hard rock India and therefore a similar investigation of the socio-economic impact of fluoride contamination is needed. To this, Abhishek Sharma added that there is a need to look at the socio-economic impact of groundwater overdraft in peninsular India. Aditi Mukherji highlighted the need to study poverty and groundwater interlinkage, both in the context of overdraft in western and peninsular India and underexploitation in eastern India, Nepal, and Bangladesh. Janwilhelm Liebrant [30] said that the transition from crop economy to cow economy on the face of groundwater depletion could be interesting to study. Niranjana Pant took grave exception to the research methodology followed, particularly in respect of the way the groundwater survey was conducted. Shah responded by saying that a proper balance needs to be maintained between time taken to collect reliable data and time taken to complete a research project, especially in view of the fact that IWMI-Tata

funding is for a limited period. K C Roy raised the issue of high energy price and low returns from groundwater irrigation and the need for a policy shift. Sachin Mardikar suggested that one should study the interlinkage between proximity to markets and level of groundwater use. In Maharashtra, he said there is quite a close interlinkage between the two. Aditi Mukherji pointed out the need to understand specifically the role of overall food policy on groundwater use. Sithapati Rao talked about the need for increasing efficient use of groundwater, especially in hard rock peninsular India. In this respect, Madhusudan Bhattarai [31] pointed out that irrigation energy nexus needs to be studied more carefully. Dhruba Pant [32] stressed the need for conjunctive use in the Nepal Terai and also the need to do more research on technological alternatives for groundwater irrigation in Nepal, because the deep tubewells promoted by the government seemed inappropriate. Finally, Shaktivadivel summed up by saying that three main research areas emerged. These were on study of socio-economic impact of arsenic and fluoride, groundwater-poverty interlinkage and study on institutional and public policy

4.2 *Garibi Hatao* : Does Investing in Irrigation Help?

The session started with a brief introduction on the impact of irrigation on rural communities and on how irrigation schemes-minor, medium, and major help reduce rural poverty in India. The overall objective of the workshop was to present irrigation and poverty related research papers from both micro and macro level studies done by various researchers and to understand how the present design and management of irrigation projects can help in reducing poverty.

Samad [33, 2.1] highlighted the impact of irrigation on poverty with a review of global evidence. He subsequently discussed irrigation intervention for poverty alleviation in six countries. He argued that irrigation can make a significant contribution to poverty alleviation but the past patterns of irrigation investments are no longer feasible. Moreover, he emphasized the recent trend of private investment in small scale irrigation development and on the need for more

investments on software such as capacity building of rural communities rather than hardware such as irrigation infrastructure creation.

There has been renewed interest in recent times in the impact of irrigation development on rural poverty. However, compared to the micro-level research methods based on surveys of command areas of irrigation projects, the focus of inquiry has now shifted to the macro-level. Recent IWMI-Tata research suggests that irrigation projects act as magnets that attract rural poverty from their surround. The central research issue to be addressed now is: does investing in irrigation help reduce rural poverty in a region? How can design and management of irrigation projects help do so?

Shah and Singh [34, 2.2] talked about impact of irrigation on rural poverty in the context of Gujarat. Using government of Gujarat's 1997 census of Below Poverty Line (BPL) households as well as the Village Amenity Survey, this paper brought out the interplay between irrigation development and rural poverty in 177 predominantly rural talukas of Gujarat. The study showed that irrigation impact on the BPL ratio in a taluka was relatively small in magnitude but statistically significant. Likewise talukas with highest rural BPL ratio had low irrigation density. Degree of urbanization and industrialization emerged as big rural poverty reducers.

The next presentation by Bhattarai and others [2.3] was on irrigation impact on agricultural growth and poverty alleviation. This study analyzed the relationship between irrigation and other factor inputs on interstate variation of agricultural productivity growth (total factor productivity) in India over last twenty-six years. They also analyzed the structures and relative importance of factors affecting variation in poverty and rural consumption across 14 major states. It found that improved access to rural education and irrigation were two of the most critical factors affecting interstate variation in agricultural productivity growth and rural

development in India over the past two and a half decades. Bhattarai pointed out that unlike the case of agricultural productivity growth, the effect of irrigation variables was more pronounced for poverty reduction and rural income.



Irrigation and poverty session in progress

Phansalkar [2.4] highlighted the factors that had an impact on differential levels of development. In particular, he looked into how access to and use of water was associated with differential regional development. Using secondary data from state and central government sources, the study suggested that there is a significant variation in per capita income across blocks in Vidarbha, Maharashtra. Moreover, this variation is associated with composition of communities in the blocks, crop mix, and most crucially with the extent of groundwater use.

Sakthivadivel's [2.5] study assessed the impact of Ooranis for promotion and dissemination of innovations in smallholder water management with a view to improving the livelihoods of poor people. The study suggested how the rehabilitation of this system helped improve the livelihood of poor who were vulnerable to scarcity of basic needs like water and food.

The last presentation in the session was made by Dinesh Kumar [2.6] who emphasized the need to manage water for agricultural production and to ensure food security. The study suggested that managing water resources requires a multi-level approach. Supply of and demand for irrigation water need to be balanced at aggregate level and efforts should be made to maximize production from available resources with least environmental consequences.

Panel Discussion

After the presentations and the question and answer session, four panelists, namely, R. Sakthivadivel, M. Samad, A. Narayanmoorthy [35], and S. Phansalkar, were invited to provide ideas on future research. The panel discussion was focused on two issues-exploring alternative propositions about irrigation and its impact on rural poverty and alternative interventions on design and management of irrigation projects to help reduce poverty.

Samad pointed out that the focus of investment in irrigation should change from public to private. Previously production was the main target and now focus should be on physical investment in the private sector like micro irrigation schemes. Furthermore, he wondered whether the current trend of private sector led investment would help reduce poverty. The second point was that the impact of irrigation in isolation is not good enough; other aspects of irrigation should not be missed out. An insightful remark was made by Shakhivadivel that there is a need to focus on the quality and reliability of water. Similarly, Molden raised inequity issues like the need to focus on who are the losers and why? Shakhivadivel emphasized the reliability of water in micro level, proposing the research question what will be the impact on productivity if we bring an additional district under irrigation?

Narayanmoorthy contended that there has been no study on irrigation impact on consumer prices and on how far improved access to irrigation help reduce rural migration. Another concern was water productivity raised by Phansalkar, who suggested exploring the determinants of water productivity. Other points on institutional and gender aspects were also raised. Chowdhary [36] and Vasavada [37] suggested exploring what kind of institutional or regulatory framework is necessary to ensure that marginalized farmers will have equal access to resources, and, how access to irrigation help improve the livelihood of *de facto* and *de jure* female headed households.

4.3 Energy-Irrigation Nexus in Asia: Catching the Bull by the Horn (rather than the tail)

The fortunes of groundwater and energy economies are closely tied in South Asia. Little can be done in the groundwater economy that will not affect the energy economy. However, the struggle to make the energy economy viable is frustrated by the often violent opposition from the farming community. As a result, the region's groundwater economy has boomed by bleeding the energy economy. Does it have to be so? Are there approaches to sustaining a prosperous groundwater economy with viable power sector? This was the central question in the session on energy-irrigation nexus.

In the populous South Asian region the fortunes of groundwater and energy economies are closely tied. Little can be done in the groundwater economy that will not affect the energy economy; and the struggle to make the energy economy viable is frustrated by often violent opposition from farming community to efforts to rationalize energy prices. As a result, the region's groundwater economy has boomed by bleeding the energy economy. Does it have to be so? Or are there approaches to sustaining a prosperous groundwater economy with viable power sector?

Abhishek Sharma presented a paper by Shah et al [3.1] which says that groundwater regulation though essential is difficult in South Asia as a large number of very small players are involved monitoring whom will be very costly. For comparable amounts of groundwater draft, India has 200 times more pumpers than the USA. Also in India, groundwater irrigation is a source of livelihood support for 55-60% of the population which makes the issue politically sensitive. Moreover, there are no direct linkages between the booming groundwater economy and the existing public systems to facilitate any kind of regulation. Scott et al [3.2] presented a paper based on Mexico's experience in groundwater regulation. In Mexico, regulatory efforts have failed to check overexploitation even when the

total number of tubewells is much smaller. Efforts to involve community in groundwater regulation by building aquifer councils have also been largely ineffective. The authors suggest that given the nature of the resource, it is unlikely that either direct regulatory or participatory approaches in isolation would succeed in checking groundwater exploitation. Power supply which is done by the state monopoly is the only available window of opportunity. However, this opportunity has not been used imaginatively. The current flat rate supply system is degenerate and dysfunctional. The study argues that a flat rate system can be functional only if it is accompanied by an astute supply schedule which enables the utility to cover its cost and still meet the needs of the consumer. This is possible if a proactive power supply system is developed which is more closely in tune with the seasonal nature of water requirement in agriculture. Sanjoli Batra [38] and Animisha Singh [39,3.3] presented a study based on a field survey in four districts of Haryana, Punjab, and Uttar Pradesh which showed that there is indeed a marked seasonality in irrigation demand with peaks in the paddy season and troughs in periods when fields are fallow. They also prepared a month-wise power supply schedule for their study area which would simultaneously ensure farmers' convenience and higher efficiencies.

Narayana [40, 3.4] contested the validity of data being used to calculate the power subsidy to agriculture. He said that energy audit in Andhra Pradesh has shown that actual power consumption in agriculture is much lower than what is claimed in the utility reports and the full allocated cost of power supply to agriculture is much lower than claimed in APERC's calculations. Therefore per unit subsidy to irrigators' overall subsidy that goes to irrigation is grossly overestimated. He argued that even in drought prone areas like Rangareddy district of Andhra Pradesh farmers grow two to three crops of paddy. This offers huge scope and opportunity to rationalize energy and water use in agriculture by effecting cropping pattern changes.

Avinash Kishore and Shilp Verma [41, 3.5] in their presentation argued that, in areas with vibrant water markets, returns from selling water to a

willing buyer is much higher than the electricity tariff. So, a pump-owner will go on pumping as long as power is available and there is demand for water. It is this opportunity cost of selling water which checks inefficient use by even the pump owners with flat rate connections.

Pradyumna Deshpande [42, 3.6] presented his ongoing study on farmers' pumping behaviour under flat rate tariff and water scarcity in the Vidarbha region of Maharashtra. His study suggests that small farmers with limited water in their well prefer unit rate system to flat rate while larger farmers prefer flat rate. There is high incidence of pump size under-reporting especially by larger farmers in Vidarbha and non-payment behaviour is increasing as penalties for non-payment are not strictly levied by the utility.



Energy irrigation nexus session

Panel Discussion

The discussion following the presentations covered several aspects of groundwater regulation including the role and likely impact of pricing mechanisms, legal and regulatory tools, and participatory approaches in ensuring efficiency, equity, and sustainability.

Limitations of price-led techno-centric approaches: Pricing of power and water has remained an issue of enquiry for decades without much success and there is little chance that pricing will work in future. There is also a need to examine the differential impact of power pricing and supply policies on different sections of society as the cost of groundwater often gets shifted to poor and women. Community control and not pricing is the better option for groundwater regulation. So, it is time now to work

with communities for groundwater regulation in an enabling legal environment. Experiments like COTAS (aquifer councils of Mexico) can succeed if they are vested with property rights and provided with requisite resource knowledge.

Basin approach to groundwater management:

There should be a river basin/watershed approach towards water management with clearly defined laws to support ownership and user rights on both surface and groundwater within the community. The idea of creating basin level forums of all stakeholders to provide an opportunity for interaction and dialogue should be given a chance. Only such organizations can ensure proper policy formulation and adherence to those policies. Researchers should carry out detailed studies of the nature and availability of resources like water balance accounting and share this knowledge to facilitate informed choices. There is a greater need for research effort in hard rock areas where heterogeneity of aquifers is much higher.

Some participants questioned the practicality of building basin level people's organizations as no state in India collects data at basin level. Only recently Uttar Pradesh and Rajasthan have undertaken huge World Bank funded projects to create basin level organizations. Moreover in hard rock areas of South India the geology and hence groundwater availability is highly localized and difficult to manage at basin level. Therefore, there is a little chance that basin level organizations will work in checking groundwater overexploitation.

Need for demand side management: Energy-water co-management can be possible only through demand management. Both pricing and rationing are politically sensitive issues and therefore difficult to implement. The only possible ways are to promote better cropping pattern and encourage efficiency measures in water application. Without demand side management even efficiency improvement measures will not work in a desired manner as they would provide more facility to the farmer to pump more thereby worsening the situation. Therefore the prevailing inefficiencies in irrigation practices in a way are helping in arresting groundwater depletion. But this is an inefficient solution from energy and productivity points of

view. Crop diversification should be encouraged by promoting cultivation of crops that yield higher returns for same water consumption. In longer-term even livelihood diversification should be encouraged in areas of extreme water scarcity.

Scope for supply improvement: Quality and reliability of power supply should be increased to reduce wastage of water and energy. Flat rate system should be replaced by unit price system to encourage efficiency. Groundwater augmentation through rainwater harvesting and recharge should be given a boost. Gramsabhas (village community) should be given the charge for both water and power management. SEBs should sell power to the gram sabha which should work out the power supply schedule within the village.

4.4 Making India's Public Irrigation Systems Viable: Abandoning, Salvaging, or Improvising upon?

This session was further divided into three sub-sessions, one on impact of irrigation and financing irrigation, the other two on irrigation management institutions in groundwater and surface water respectively. The purpose of this session was two fold: to take stock of current state of Indian public irrigation systems with special reference to huge canal systems and assess current management practices with special reference to Irrigation Management Transfer (IMT) and Participatory Irrigation Management (PIM). The other objective was to derive some discussions on alternative modes of institutional arrangements in the public irrigation sector.

The first paper in the session [4.1] was presented by Madhusudan Bhattarai and A Narayanamoorthi. The objective of this paper was to measure the impact of irrigation on agricultural productivity using panel regression analysis. The main conclusion of this presentation was that improvement in irrigation and rural literacy rate are two most important factors for growth in agricultural total factor productivity (TFP) and agricultural production. Prof. Ballabh [43] argued that a large numbers of studies are available which shows that rural literacy is not important for farm level productivity at micro level. Parthasarathy [44] raised the issue of specification problem in the

model used by the authors, which was successfully defended by Bhattarai. Comments were made by others including Anil Shah about the missing trend of TFP for India as a whole. Concerns were also raised about the negative (though non-significant) trend of the impact of irrigation on TFP. The authors explained this apparent anomaly in terms of pooled data that they have used for three decades and stressed that incremental benefits from irrigation were higher in the 1970s and 1980s than in the 1990s. The next paper on irrigation subsidies was presented by Sonal Pandya [45, 4.2]. She made the point that irrigation being a quasi-public non merit good, subsidy was justified to a

There is a lot that is wrong with the way government irrigation systems are run in India. Their commands fall far short of design commands; the quality of irrigation service on offer is often poor; the maintenance and repair of the head-works and canal systems are pathetic. Clearly, at this rate, India will soon face erosion of a huge irrigation capital it built at a massive investment. What might be the approaches to reversing this invidious trend? The dominant answer, it is widely claimed, is involving farmers in managing their irrigation systems either through Participatory Irrigation Management (PIM) or Irrigation Management Transfer (IMT). However, results of these reforms are still hazy. Will PIM or IMT salvage India's public irrigation systems? Or is there need to think of and experiment with alternative strategies of vitalizing this important sector?

certain extent if the benefits of this subsidy were distributed equally both spatially as well as among different groups of farmers. She then presented her estimates of total capital account and revenue account subsidies for five schemes in Gujarat. Commenting on the relevance of this study, Peter Mollinga [46] pointed out that total revenue collected does not say anything about the performance of the systems (such as efficiency and equity in water distribution); all that it does say is about the relative performance of the irrigation agency in collecting its dues. Manas Satpathy [47]

pointed out that calculating revenue account subsidy on the basis of government's spending on O&M does not reflect whether the systems were maintained properly or most of the O&M funds were actually allocated for paying staff salaries. Anil Shah pointed out that this paper missed out two most important issues. They were what is due to the government on account of water charges and how much of that due has been collected cumulatively over the years. Without these figures, he said, no realistic picture about total subsidy could be generated. The final presentation in this sub-session was on innovative means of financing irrigation projects by KV Raju [48, 4.3]. Krishna Bhagya Jal Nigam Limited (KBJNL) was constituted in order to raise capital for construction work in view of the Bachawat Committee award which gave deadline for claiming Krishna water by 2000. KBJNL was very successful in raising capital and in completing physical construction work on time. However, it never emerged as a financially autonomous irrigation agency as originally envisaged and ultimately had to depend upon the government of Karnataka for repayment of public bonds. Somnath Bandopadhyay [49] pointed out that KBJNL initiative after all was a failure. Rohit Desai [50] asked how SSNNL could derive lessons from the KBJNL initiative. Anil Shah asked if credit agencies such as CRISIL took into account the repayment capacity of KBJNL or if it gave accreditation to KBJNL based on government of Karnataka's backing? Apoorva Oza [51] pointed out that there was a need to examine critically various dimensions and implications of private financing of public irrigation projects. Parthasarathy pointed out that in the history of corporate India, there was a shift from bonds to equity and in view of that it seemed inexplicable why agencies such as KBJNL and SSNNL focused on bonds. KV Raju reiterated that the KBJNL case could not be dismissed as a complete failure given that it has been able to complete physical infrastructure on time. However, it can be indeed termed a failure if its objective was to achieve financial self-sustainability, which in case it did not attempt seriously at any point in time. In reply to other relevant questions, K V Raju concluded that improvement in delivery system and political will are necessary to make the public system viable.

Thus, at the end of discussion on this paper, two major concerns were raised; whether it is possible to insist on performance improvement of the agency (in terms of water delivery and water fees collection) and given the existing political compulsion, whether it is indeed possible for these so called financially autonomous irrigation agencies to fix their own water charges, over and above the state government specified rates.



Session on India's public irrigation systems

The second sub-session focused on institutions for management in surface flow schemes. Jayesh Talati [52] presented a paper by Neetha N [4.4], which discussed various alternative irrigation institutions that have come up on a canal command in Kerala in response to deficiencies in canal water supply in the region. Archana Londhe [53] and GV Sarat Kumar [54, 4.5] presented their findings from an MTS study on participatory irrigation management in Andhra Pradesh and Gujarat. They studied 15 water users associations (WUAs) in Gujarat and Andhra Pradesh. They emphasized that grass root initiated PIM in Gujarat at the behest of such renowned NGOs such as AKRSP (I) and DSC has been more successful than the government initiated and much acclaimed PIM in Andhra Pradesh. After this, Aditi Mukherji presented a synthesis of 19 case studies [4.6] on PIM and tentatively put forward the view that most of the successful cases of PIM were found under a wide range of conditions, such as small size of the command, small number of irrigators, no huge income disparity among the irrigators, and no perpetually disadvantaged sections such as pronounced head tail conflicts. These two presentations elicited a number of questions. Firstly, reacting to Archana and Sarat's contention that WUAs in Andhra Pradesh cannot fix their own water charges, Peter

Mollinga pointed out that there was nothing explicitly stated in the APFMIS that would stop WUAs from doing so. However, Anil Shah pointed out that WUAs in Andhra Pradesh cannot increase water charges, all that they can do is to add a service fee over and above water charges, while WUAs in Gujarat can and do fix their own water charges. Prof. Vishwa Ballabh and Peter Mollinga raised questions about the methodology used by Mukherji in her study and Parthasarathy pointed out that such kind of analysis does not really help in finding out the reasons for successful operation of any WUA. Satpathy commented that in addition to the factors that Mukherji mentioned, access of markets and type of crop grown also affect functioning of WUAs. Nafisa Barot [55] asked about participation of women in WUAs. Anil Shah pointed out that it was not advisable to reject PIM as an alternative, indeed we need to look not beyond PIM, but towards PIM plus. Capacity building of WUAs was a major focus of discussion and Ujjwal Ganguli [56] and Nafisa Barot emphasized the need for capacity building at all stages. Peter Mollinga commented that governments of most countries, including India, have very successfully transferred the onus of irrigation management to farmers, so much so that no one except in the academic circles talk about proper Irrigation Management Transfer (IMT), while most public policy debates focus on Participatory Irrigation Management (PIM). He further said that simple enactment of PIM law does not guarantee successful PIM. After this rather heated debate on PIM, Jayesh Talati and Janwilhelm Liebrand presented two papers on the Narmada Project, one written by Tushaar Shah [4.7] about the level of preparedness of SSNNL officials and villagers to receive Narmada water about a month and half before Narmada water was to be formally released for irrigation. The second paper co-authored by Talati and Liebrand [4.8] took stock of 12 WUAs in eastern and central Gujarat in the Sardar Sarovar Project Phase-I command area, with special focus on institutional issues. These two presentations possibly evoked maximum and heated debate on the fate of the Narmada Project. K V Raju seemed disconcerted at the fact that years of experience of managing public irrigation systems by farmers in Gujarat was not put to use

in case of the Narmada Project. Anil Shah pointed out that it was indeed an encouraging sign that SSNNL has been able to fix water charges in the Narmada command area over and above the existing state government irrigation charges. Ujjawal Ganguli and Peter Mollinga asked researchers to probe into other aspects of WUAs, such as equity issues and water rights issues. Then discussions ensued on de-facto reconfiguration of the Narmada system from a flow system to a lift system, given that sub-minors and field channels have not been constructed. Hammond Murray Rust [57] pointed out that management implication will be very different for a flow system and a lift system. Nafisa Barot asked about interlinkages between drinking water and irrigation water in the Narmada project. Rohit Desai expressed concern about non-representation of drinking water users in WUAs formed by SSNNL.

The last but one presentation in this session by Avinash Kishore talked about the success of GWRDC [4.9] in transferring almost 60 per cent of its tubewells to farmers. The model, he asserted was in essence that privatization rather than PIM and he contended the process of transfer has been more or less successful. Hammond Murray Rust took exception to this and said that through such transfers, the government was encouraging uncontrolled and unregulated exploitation of groundwater in the state. However Mukherji and Kishore pointed out that since public tubewells in Gujarat were a miniscule part of the total number of tubewells in the state, it was unlikely that they will have deleterious impact on groundwater extraction. K B Trivedi [58, 4.10] pointed out that transferred tubewells have worked more efficiently (i.e irrigated more area in less number of hours) than tubewells under government ownership and therefore in essence have performed much better than GWRDC owned tubewells. Rajnarayan Indu [59, 4.11] presented the last paper of the session on tubewell transfer programme of the government of West Bengal. Quite in contrast to the pragmatic approach of GWRDC, the tubewell transfer process mediated through panchayats in West Bengal seemed to be caught up in a quagmire of elaborate procedures and political

influences, right from the selection of tubewell site to final sanctioning of tubewells. Added to this was the quite inexplicable thrust of the government of West Bengal on financing deep tubewells to the exclusion to more suitable shallow tubewell. Owing to lack of time, further discussions could not take place.

Panel Discussion

At the end of paper presentations, panel discussion began. The panelists were Anil Shah, K V Raju, and Peter Mollinga. The focus was on institutional alternatives for managing India's public irrigation systems. All participants agreed that there was a need for institutional reforms in the irrigation sector. Peter Mollinga opined that irrigation agencies in India have successfully put the onus of management on irrigators, thus emphasizing more on PIM rather than IMT per se. He emphasized on the need for agency reform and pointed out that very few irrigation agencies have looked inward in order to reform themselves. Anil Shah, though agreeing in principle, differed by saying that given the political milieu, agency reform was not an easy task. He stressed on the need for researchers to influence policy makers. In any case, the irrigation agency is just another department of the government and, therefore, all the departments need to be reformed in conjunction. He pointed out that the basic issue was putting irrigation investments to proper use and WUAs through PIM was doing this to a large extent. Parthasarathy too urged on the need for agency reforms saying that isolated cases of success of PIM cannot be replicated everywhere. Ballabh added to this discussion by adding that local capacity building was equally important if PIM were to succeed in the long run. Nafisa Barot took exception to the idea of looking beyond PIM. She said if PIM has worked in some places and not in others, the focus should not be towards looking beyond PIM, but to look at ways in which it can be replicated elsewhere. B R Sharma [60] opined that similar models cannot work everywhere and therefore there was a need to look for alternatives in addition to PIM, though, in all the alternatives, people's participation should be the cornerstone. Bhaskar Rao [61] talked about private participation not

only in building canal infrastructure, but also in day to day management of the systems. Bancha cited the example of agency reforms done by the irrigation department in Thailand and how it has transformed itself from a department with engineering focus to one with service focus. Avinash Kishore talked about private-public participation in irrigation management. To this, Ujjwal Ganguli responded by saying that very often privatization leaves marginal people more marginalized and therefore equity issues have to be kept in mind before soliciting private participation. K C Roy cited the example from his country, Bangladesh, where gradual disengagement of the state from provision of irrigation (groundwater based) led to rapid increase in irrigated area. K V Raju summed up the discussion by saying that there have been lots of pilot projects aimed at finding the “right” institutions, but the lessons so derived have never been applied to other systems. Accountability at all levels is desired, but rarely met with. There was thus need for a regulatory authority in the irrigation sector, just as there is a regulatory authority in the power and electricity sector. At the end, all participants suggested that IWMI should do more research on Narmada in the coming year.

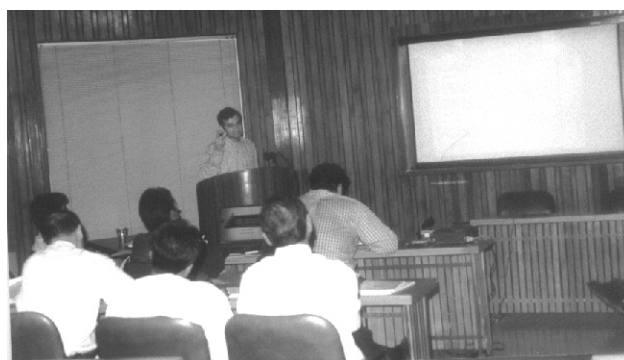
4.5 Central India Initiative: Improved Water Control as the Strategy for Vitalizing Tribal Agricultural Economy

The Central India Initiative (CInI) is a collaborative action-oriented research project of the NM Sadguru Water and Development Foundation (NMSWDF), Professional Assistance for Development Action (PRADAN) and the ITP.

Arpan Sharma (62, 5.1) in his review of literature found that whereas tribals have control over and ownership of land, the lack of inputs, both technological and material, inhibit their productivity, thus pushing the community into a downward spiral of increasingly falling yields and rising indebtedness and associated livelihood challenges. Yet, the reviewed literature points at higher total household income for irrigated households than for unirrigated households. Some of literature talks of land reforms but another set suggests that despite land reforms tribal economies would not go on an upward spiral until

Significant opportunities to develop small-scale irrigation from small perennial streams exist all over the hilly and undulating region of Central India, covering Jharkhand, non-coastal Orissa, eastern Madhya Pradesh and eastern Maharashtra. This region is also home to some 50 odd million tribal people-one of the poorest communities in India. In spite of the fact that most tribals them own land, agricultural practices are very primitive and production is low. Therefore, small irrigation projects would benefit households unable to produce enough food to last the year and gradually to transform their subsistence farming. Has India's irrigation development strategy exploited this opportunity to any significant extent? If not, what might be the appropriate design and strategy for a programmatic intervention to develop this opportunity?

other issues concerning productivity are taken care of. At present there are both supply side and demand side issues but the significant positive impact of irrigation cannot be denied. It can, however, be enhanced by certain other activities like watershed management. Prof. Ballabh indicated that the selection of literature in itself seemed to be guided very strongly by the CInI concept note and therefore could have lead to biases in the review. He suggested that the reviewer should go beyond the CInI concept and also review other literature to get a clearer picture of the work done by many scholars. Reacting to this, Niranjana Pant suggested that keeping in view the vast range and diversity of available literature, it might be a good idea to choose a few journals



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such as the Economic and Political Weekly and the Indian Journal of Agricultural Economics and then review all relevant literature available over the past 15-20 years.

Shah and Singh (5.2) found interesting evidences in their analysis of district level data of 282 districts arranged in ascending order of percentage of tribal population. The paper illustrates that the tribals have been restricted to higher altitudes and upper catchments areas where the land quality is less suitable for agriculture despite their average per capita land holding being higher than the national average. Also they showed how the subsidy to minor irrigation had bypassed the tribals leaving them bereft of the agrarian prosperity that has come to the nation with the development of groundwater utilisation. The major argument that emerged was that the tribals have a poor demand system and hence have not been able to gain from the numerous tribal development schemes of government and non-government institutions. There were suggestions that the data of the Shah and Singh study did not clearly present the true pictures of the tribal world as districts like Surat had distinct pockets that were tribal and very backward and other highly industrialised and affluent pockets that were non-tribal.

The study of Sadguru's intervention by Harmeet Saini (63) and Rakesh Pandey (64, 5.3) highlighted the importance of technological robustness to deliver water to the communities and therefore eradicate the failure on parts of most government schemes. It is a case where the community was able to take up management of the schemes in their own hands from the implementing agencies. Also it showed how other linkages of water availability like watershed management or catchment afforestation had helped the schemes to run better during drought years as well. The Jhabua study by Harnath Jagawat (65), Kanhaiya Chowdhury (66) and Hitesh Shah (67, 5.4) brought out the role played by the external variables like electricity supply as an important determinant in the extent of success. The highlight of the Jhabua schemes is that the smaller ones were designed as family level schemes and they achieved only 30-35% irrigation. This was attributed to unfulfilled need

for appropriate technology. It was also highlighted that a mismatch existed between the availability of water at sites and the size of schemes installed there. This left both untapped potential at some places and failed schemes at others. Sachin Mardikar (5.5) found that family level or individual or small group size ownership of the irrigation infrastructure was preferred by the tribals in the Wardha and Yavatmal regions. He dealt in detail on the management processes that were a critical component for the schemes being successful amidst other things like the crop restriction and proper allocation and distribution norms set up in consultation with the implementing agency, ASSEFA. It was noted that most ASSEFA schemes did not achieve original targets as not all tribal farmers could afford irrigated agriculture as they are very poor. The PRADAN study by Vaibhav Bhamoriya (68, 5.6) and Saroj Mahapatra highlighted different factors affecting success of an irrigation intervention at different places. It also raised the point that tribal communities are heterogeneous among themselves and there are some sections that are more vulnerable than others and it is probably these sections that do not take to irrigated agriculture as easily as others. It also found that role of PRADAN was critical. The GWRDC study by Shilp Verma and Manas Satpathy (5.7) presented the case where the sugar factories helped bring the market to the doorstep of the farmers thereby creating a pull for irrigated agriculture. The scale at which the intervention was pitched by the government also helped sustain the sugar cooperatives and thus there was a symbiotic relationship. Being a government financed canal lift structure the cost of irrigation very less compared to other schemes. The tribal farmers also learned from the non-tribal farmers in the vicinity and picked up skills of commercial agriculture. This set of enabling variables helped tribal agriculture into an upward economic spiral. The AKRSP study by Aditi Mukherji, Shilp Verma and Prabhat Rath (5.8) highlighted the role played by AKRSP (I) in promoting PIM in Surat and Bharuch districts of South Gujarat. The study highlighted that given the enabling conditions; tribals can be as good agriculturists as any other community. It also suggested that the well-off farmers in the villages can play a

significant and positive role in promoting pro-poor livelihood interventions by creating demonstrations of success for the poor.

The IRMA MTS study by Sunil Kumar Singh (69) and Praveen Kumar Singh (70, 5.9) highlighted the need for proper market mechanisms for the success of irrigation interventions in the tribal belt. The authors argued that irrigated agriculture as a livelihood option does not become lucrative for a tribal farmer unless appropriate market linkages are ensured. The authors also brought out the differences in issues and challenges in eastern and western parts of the tribal belt essentially hinting at location specific strategies to cover the diversity of the region.

The synthesis paper by Phansalkar, Verma and Bhamoriya (5.10) presented the learning's from the six case studies taken up in the first phase of the initiative. It stated how tribal people are similar to and dissimilar from other groups of people in the country. It presented critical factors for the success of the various interventions studied and what inferences may be drawn out of the exercise. It also suggested a categorisation to capture the heterogeneity amongst the tribal and their different responses to irrigated agriculture. The paper also suggested a hierarchy of success of an irrigation intervention amongst the tribals:

1. Whether the intervention in fact can deliver water on the farms is zeroeth order question. Any irrigation intervention that can not deliver water to all the people in the defined command, for whatever reasons has failed the most basic test.
2. Whether the tribal perceives and actually gets a viable livelihood option by using water from the scheme is the first order question. In other words, water may reach the tribals' farms but they may not use it. This is also indicative of a failure.
3. Whether tribals' use of water for growing a second crop can continue to happen in a medium term and largely with community based management is the second order question. This would subsume both the durability of the hardware, soundness of the local management system as well as social sustainability of the local governance system.

4. Whether the arrival of water sets the family or the village economy on an upward ratchet of "higher-production-savings-newer choices-investment-even higher income" is the third order question.

5. Whether the group becomes capable of managing all the forward and backward linkages and is also able to replace worn out assets is the final question.

The authors also presented a refined set of research hypothesis for the next phase of case studies in CInI and suggested a protocol for the case authors to capture all the relevant data for a meaningful synthesis.

Panel Discussions

The discussion revolved with how apt was irrigation as an alternative for tribal people for enhancing their livelihoods and what worked and what did not work for irrigation interventions amongst tribals. It was expressed that many options might be available to the tribals and irrigation might be just one of them. However some amongst the tribal might have other options more suitable for them. The critical question then is: What do tribal want for themselves? Lucy Maarse said that it is important for CInI to find out 'What do the tribals really want?' Sreenivasan (71) pointed out that the presentations brought out factors for success, which were equally true for irrigation interventions with non-tribal poor and that there was nothing specific about them to tribal agriculture. Jagawat pointed out that a natural resource approach was required as the tribal population had high poverty levels and the only thing that they had was natural resources. Water was a good entry-point activity but other things like forestry and watershed management and land use issues are also significant. He cited the example of horticulture being promoted in Sadguru areas. He therefore highlighted the need to expand the scope of the initiative to 'Water PLUS' aspects as well. Neelima Khetan, also a panelist, pointed out that CInI seemed to be in a dilemma on whether irrigation is a preferred option over other options. She said that there was need to study the impact of other variables that could be more critical than irrigation. She also questioned the suitability of LI schemes without

enhancing water availability in areas like Rajasthan where water availability in itself was a serious constraint for promoting irrigation. She suggested that CInI should broaden its scope by including water availability issues and not work on the underlying assumption of water availability in all tribal areas. At this Jagawat pointed out that even in Rajasthan with 30-35 inches of rainfall not all the potential had been tapped and opportunities still existed. Neelima also pointed that perhaps CInI was focussing too much on the technical and physical aspects of tribal irrigation and agriculture rather than the social aspects that required more focus. She said that there were very few studies available as to why the institutional base in tribal areas was so poor and how this could be rebuilt and that there was a need to articulate institutional building in the tribal context. Kamal Bhattacharya (72) said that the economics in the case studies needed reconsideration as the tribal farmers practised integrated agriculture and therefore crop based economics differed from their economic considerations. The session concluded with Apoorva Oza specifying that the tribals have a poor demand system and as such they were losing out on benefits and as such there was need to take many things to them even if they seemed not to voice for them. He also suggested that CInI should explore the possibilities of replicating the successful implementation of PIM in South Gujarat to other medium and minor canal irrigation projects throughout central India.

4.6 Groundwater Management in Gujarat: Elevating the Game

M Dinesh Kumar presented an overview of the groundwater management challenge in Gujarat. He said that three major frameworks are generally followed for groundwater resource management. They are resource management action framework; maintaining water supplies and sustaining socioeconomic activities in the short run; and sustaining long term socioeconomic growth without compromising on the hydrological and ecological integrity. The resource management framework needs maintenance of: sustainable yields of aquifers and water levels at desirable depths; groundwater quality and protection of the resource from pollution; protection of wetlands;

and, prevention of water logging and salinity. This overview was presented by M Dinesh Kumar [6.1]

Groundwater depletion has emerged as one of the most formidable consequences of agricultural development in the state of Gujarat over the last five decades. Gujarati farmers have proved highly inventive in creating robust economic institutions for wealth creation; for example, the state is widely regarded as the heart-land of India's co-operative movement; similarly, the first groundwater markets in South Asia probably emerged in Gujarat as far back as in 1920. However, a critical issue facing the state now is: will the Gujarati people be as inventive in dealing with the challenge of restoring the region's aquatic equilibrium as they have been in devising economic institutions for wealth creation?

The first framework includes several options. They are: 1] control and regulation of agricultural pumping with adequate compensation to the farmers in areas of mining and seawater intrusion; 2] ban on excessive use of fertilizers and pesticides with adequate compensation in areas with non-point pollution; 3] relocating industrial areas in areas with groundwater pollution; 4] reduction in surface water allocation in water logged canal commands; and 5] proper planning and enforcement of land use in the outcrop areas and major recharge areas.



Session on groundwater management in Gujarat

In the second framework, ecological sustainability and hydrological integrity are not important concerns. Here the options are: 1] continued mining with drilling of deeper wells and tube wells for agricultural purposes in inland areas; 2] providing water for high priority uses through alternative sources like desalination plants; 3] roof water harvesting and import of surface water from long distances in areas where groundwater contamination is a problem; 4] continuing with surface irrigation and salt-resistant crops in the command areas; and 5] diversification of livelihood options.

The third framework has much more wider options. They are: 1] local recharging of groundwater and conjunctive management; 2] harnessing of excess surface water that goes to the natural sink from the local areas for irrigation and other uses; 3] demand reductions through improving water productivity in agriculture, crop changes, promotion of water transfer from agriculture to economically more efficient uses; and 4] providing cheap surface water wherever possible, all in areas facing over-development and depletion.

These are, however, mainly for areas where groundwater demand exceeds supplies. In other areas, with diametrically opposite conditions, the options are: 1] reducing groundwater recharge in areas where recharge far exceeds abstraction through reduction in return flows; and 2] increasing socioeconomic demand for groundwater through proper incentive structures such as pump subsidy, electricity subsidy; manipulating the price of canal water in such areas.

Groundwater problems in Gujarat are many and can be categorized into two problems due to overdevelopment and problems due to underutilization. The problems which arise due to overdevelopment are many. They are: excessive withdrawal and mining of groundwater in deep alluvial; sharp seasonal drops in groundwater levels in hard rock areas and acute seasonal water shortages in inland Saurashtra; excessive withdrawal from coastal aquifers causing intrusion of seawater in to the coastal areas of Saurashtra and Kachchh; ingress of seawater the coastal aquifers through coastal creeks and depressions;

and groundwater contamination in alluvial areas of north Gujarat. The examples of contamination are high levels of salinity in groundwater making water non-potable; high concentration of fluorides in groundwater in alluvial areas of Mehsana, Patan and Banaskantha districts.

Problems due to underutilization are: rising groundwater levels and water logging and salinity in the canal command areas of South Gujarat; groundwater pollution owing to excessive leaching of fertilizer residues and biomass causing high levels of nitrates in groundwater.

To pursue the first set of management actions, there are many challenges. They are: groundwater ecology and livelihood trade offs owing to heavy dependence of rural communities on groundwater for survival; difficulty in enforcing land use plans; groundwater ecology and political economy trade off because of high dependence of rich and influential sugarcane growers on cheap canal water in south Gujarat; and differential and inequitable impacts of regulations.

For the second set of actions, the challenges are: trade-off between short term economic gains and long term sustainability; limited scope of decentralized water harvesting like roof water harvesting in low rainfall areas, especially in years of below normal rainfall when drinking water scarcity becomes acute; and limited coverage of drinking water markets.

For the third set of management actions, there are many constraints. They are: trade-off between hydrological opportunity and economic viability of local recharge options in alluvial areas of north Gujarat; trade off between hydrological opportunity and recharge potential in Saurashtra; trade-off between economic incentives and resource sustainability in the case of adoption of water saving technology. However, this seems to be the most preferred one by NGOs, community organizations and government agencies in Gujarat.

As regards water harvesting, VIKSAT's research study on local water harvesting using desilted pond with recharge tubewell in alluvial area of Gandhinagar showed significant micro-level impact of water harvesting in terms of groundwater mount and rise in water level. This

paper was presented by M. Mudrakartha [73, 6.2]. M. Chopde. G. Sastry's [74, 6.3] study on watershed based land treatment activities in Saurashtra showed positive correlation between surface water storage and groundwater recharge augmentation in terms of rise in groundwater levels in the area of influence. The study by Sakthivadivel on recharge movement in Saurashtra showed differential impact of different methods of recharge in hard rock areas of Saurashtra (6.4). Vilind Parikh's and others [75, 6.5] study on spreading channels showed high uncertainty in the pattern of impact of recharge structures in terms of change in groundwater availability and quality conditions in hard rock areas.

Kumar [6.6] highlighted the limited and iniquitous impact of roof water harvesting systems in the context of Gujarat. Rajnarayan Indu's [6.7] paper highlighted the newly emerged, fast growing drinking water markets in north Gujarat, which is facing drinking water crisis owing to excess fluorides in pumped water, and showed that they still covered only a small segment of the market.

As regards demand reduction in agriculture, the study by Vipul Patel [6.8] showed differential positive impact of micro and mini sprinklers on water productivity of alfalfa. The study by Ramkrishna [76] and Kumar [6.9] on the adoption of water saving technologies by farmers showed several misconceptions about the benefits and drawbacks of water saving irrigation devices and mainly economic considerations for adoption, rather than water saving considerations. Janwillem Liebrand [6.10] highlighted the role of women in producing irrigated fodder crops and milk production in groundwater scarce north Gujarat. He argued that women are more conservation oriented than men so far as water resource use is concerned; and emphasized on their role in scaling up adoption of water saving irrigation devices.

Future options for groundwater management are: conjunctive management of surface and groundwater involving large-scale import of water from water surplus south Gujarat for recharging the depleted deep alluvial aquifers of north Gujarat through decentralized water harvesting systems like pond; projects to rejuvenate rivers of north Gujarat using water from the Narmada

Main Canal; integrated management of surface and groundwater in Saurashtra owing to limited storage potential of aquifers; low cost, non-pressurized water saving technologies in agriculture to scale up use of efficient irrigation practices; promotion of community irrigation to bring down system overhead and management costs; and watershed based land treatment activities to improve soil moisture. Indirect management options are: introduction of unit consumption based pricing of electricity; introduce pricing of canal water based on crop water requirement and area; trading of green fodder from water rich south Gujarat to water scarce north Gujarat.

The session came out with the following major research questions for future viz. technical aspects of planning, building, and operating decentralized water harvesting systems that distribute hydrological benefits; institutional structures for decentralized water harvesting that also promote sound hydro science; role of social institutions in regulating groundwater use and preventing overdraft; institutional processes to build political consensus for price shifts; and ways to facilitate scaling up of water saving technology adoption in irrigated agriculture.

4.7 Tanks in Today's Context: Critical Issues in Raising 'Gross Tank Product'

Tanks have been a part of the irrigation infrastructure of India for hundreds of years. However, they have been on a spiral of decline—both in terms of absolute and relative area irrigated by them. Presentations in this session were focused on strategies and issues relating to rehabilitation of tanks in different regions of India.

The session began with the presentation of a 'position paper' [7.1] on tank by Abhishek Sharma. The paper started with the argument that since a lot of public money is being spent on rehabilitation of tanks, it is worth examining what is the best method of rehabilitation. The paper argued that the historical context within which tanks had existed has changed dramatically in the recent decades. Because of this traditional approach to tank rehabilitation, which aims at rehabilitating the physical structure before

Despite their dubious role in the agrarian history of feudal India, our Zamindaars and Raja's did to their subjects some small acts of kindness. One of these was building tanks, several hundred thousand of them that pepper the Indian landscape. Just three states--Andhra Pradesh, Karnataka and Tamilnadu-had apparently well over 100,000 on the eve of Independence. But today, India's tanks lie in a state of disrepair, partly due to the onslaught of modernization and urbanization, but partly also because their context has changed beyond recognition. Evolution of modern irrigation systems has certainly taken its toll; but above all, the rise of the pump irrigation technology has fundamentally altered the organic relationship between tanks and 'tank communities'. In this changed context, characterized by growing water scarcity, is there scope for reinventing this relationship?

handing them over to communities for their maintenance, might not work.

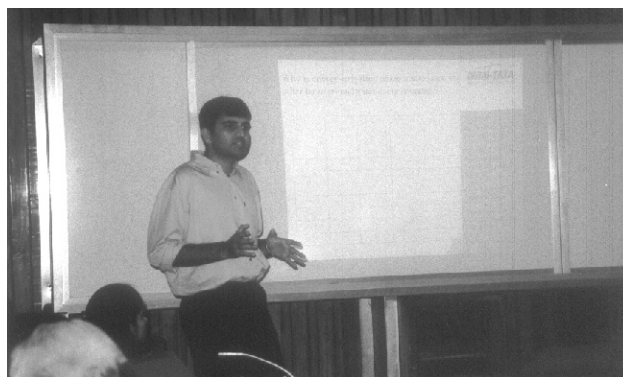
The next presentation was on Dhan foundation's pioneering work of rehabilitating as many as 600 tanks [7.2]. This was presented by R Seenivasan. Dhan does not use specific project money for rehabilitation. Instead they assess first how much money can be made available from sources like DRDA. Rehabilitation work is then decided on the basis of availability of funds. However there are many issues in securing government funds and Dhan has to face a lot of hassles. Dhan promotes the building of a microfinance group and development of usufructs. This ensures the availability of funds for future maintenance and for sustaining the tank farmers' association.

The next presentation by G Bhaskar Rao highlighted the role of SPWD in converting tanks into percolation ponds in Andhra Pradesh [7.3]. SPWD's experience has shown that tank rehabilitation is the most cost effective exercise that any agency can undertake in Andhra Pradesh with ROI of more than 100% in some cases. However the kind of rehabilitation that is happening today in most tanks across Andhra

Pradesh is a 'contractor led' money making enterprise.

The next presentation by Niranjan Pant focused on the Ahar- Pyne systems of South Bihar [7.4]. Pant brought out the differences between tanks of South India and those of South Bihar. However just like the south Indian tanks, the area irrigated by the Ahars and Pynes have declined significantly. But, according to the speaker, handing back the management of tanks to the people is not an option for their revival because in no situation has management by a heterogeneous community worked.

The next presentation by Sriramappa [77, 7.5] emphasized that increase in population pressure has resulted in the decline of tank irrigation. This raises the question whether ancient gravity schemes meant for surface water supply meet current need. The solution for current needs has to be found within the ambit of integrated water resource management. Also any programme of rehabilitation should address the needs of the landless and non-irrigation needs like drinking water as well. Ved Arya[78, 7.6] emphasized these points and built upon them by showing the poor linkages between watershed, tank rehabilitation, and water supply schemes in Karnataka.



Discussions on tanks in India

Panel Discussion

Much of the discussion was focused on community involvement in management of tanks. A number of speakers raised the point that community should be treated as the primary stakeholder in any tank rehabilitation project. They should be facilitated to find solutions themselves. The debate was broadened when the issue was raised that stakeholders were being

viewed too narrowly. Future generations are stakeholders in tank rehabilitation as well, considering the vast impact of tanks on the ecology and the environment. Some argued that community handover will never work because of inherent complexities in forging co-operative strategies.

On the institutional aspects several researchers raised the point that tank rehabilitation should be a demand driven programme instead of a donor driven programme. Donor driven programmes have only a short time frame. Thus even well intentioned NGOs, which would like community participation in donor programmes, end up doing nothing but physical rehabilitation. An innovative loan based approach helps to make rehabilitation a continuous programme instead of it being contingent on the availability of donor funds.

A lot of researchers emphasized the need for looking at tanks at the watershed level. A point was made that tanks are not sacrosanct just because they have been existing for hundreds of years. In the present context they might actually be a sub-optimal solution as far as harvesting of water is concerned. Looking at tanks at the watershed level would give a good idea about the extent of resource (water) availability.

A new dimension to the debate was added when it was emphasized that tanks are important not only as sources of irrigation but also in the urban context. In urban areas they help in recharge as well as drainage of rainfall water. But many of the tanks in urban areas have been filled up. The need to look at tanks in the urban context still holds because of the rapid urbanization.

Towards the end of the session possible research issues were raised. One of the most important was the definition of tanks themselves. Tanks are broadly defined to include all stagnant water bodies, big and small, whether equipped for surface irrigation or not. But such a diverse set of water bodies would make it complex to talk about their rehabilitation because the dynamics of different structures is different. Another problem is that there are no reliable estimates of their numbers and hence a status report on tanks is needed.

Another issue was raised on qualifying the multiple uses of tanks. For example it was felt that some numbers should be put on the environmental impact of tanks. Another important issue for study is usufructs and how their development can become an effective revenue source for tank management. Finally the house felt that it was very important to study as to how much to expect from different stakeholders in the process of rehabilitation. More specifically it is important to understand what makes communities effective and what makes them ineffective as they are the primary stakeholders in any rehabilitation exercise.

The following issues emerged from the discussion:

1. Information on the resource to be managed (using tools like water accounting) is the first step to tank rehabilitation and management.
2. Community has to be recognized as the primary stakeholder in tank rehabilitation.
3. Bridge the gap between research and action. Research should thus focus on best practices of implementation.
4. Areas outside south India are poorly researched as far as tanks are concerned and more work is needed.
5. There should be greater partnership between research institutions and implementers such that research better serves the interest on the ground and comes out of the boundaries of pure theoretical research. At the same time new and innovative ideas emerging from research should be implemented in actual field conditions.

4.8 Promoting Micro Irrigation: Saving Water and Building Livelihoods

Shah and Keller [8.1] in their study assessed the livelihood potential of low-cost drip irrigation technologies tried to understand the 'fit' between the technology and the needs of the poor and to explore issues involved in scaling up of technology. The study looked at two distinct potentials of micro-irrigation technology in five different locations in India and Nepal including Nepal Hills; Rangpur Ashram in Chhotaudepur region of Gujarat; Saurashtra region of Gujarat; Maikaal region on Madhya Pradesh; and Kolar

region in Karnataka. A Narayanamoorthy [8.2] presented an overview of drip-irrigation technology its impacts, spread and potential in India. He pointed out that the technology covered a very small area of the potential 40 million hectare, and that the spread was largely concentrated in high value commercial crops despite being tried and tested for success and high economic benefits for around 80 crops. He emphasized that subsidy was required for micro-irrigation technologies as the technology was in the take off phase and subsidies served as incentive for adoption. The author presented figures on the benefits of drip irrigation in terms of improved yields, cost reduction and labour saving for different crops other varying agricultural conditions.

Ever since they became popular in Israel and the US, drip and sprinkler irrigation technologies have appealed to large, commercial, technology-savvy farmers. In recent years, attempts have been made-by NGOs like International Development Enterprises (IDE) and corporate like Netafim and Chapin-to adapt these technologies and promote them as livelihood-creators for the poor of Asia and Africa. In South Asia, micro-irrigation has the potential to respond to two critical but distinct needs of the poor, one to create a new means of income and livelihood; and second to help farmers in water scarce areas cope with extremes of water scarcity. The question is: what might work best in promoting this technology on a mass-scale for the resource poor and women?

Sudarshan Suryavanshi [79] presented IDE's [8.3] experience in India across the mulberry growers in Kolar, cotton growers in Maikaal, lemon and chikoo growers in Saurashtra and with treadle pumps in the eastern parts of the nation. He argued that the issues in scaling up micro-irrigation technology to the masses were: affordability; supply chain; water availability; credit; power; awareness; and income levels. He said that about 90% of farmers were defaulters and as such they were out of reach of financial

help. It was more difficult for them to take the benefits of micro-irrigation. This was coupled with high initial investment despite IDE's attempts to reduce the cost of technology. Narayanamoorthy argued that poor market linkages were another barrier which prevented the farmers from reaping full benefits of micro-irrigation. Randhir Chauhan [80] presented Netafim's [8.4] experience and ideology in promoting water saving technologies. He emphasized that Netafim believed in promoting sophisticated high quality products which had the potential to cater to all segments of the market large commercial farmers as well as smallholders with little access to irrigation. He agreed that subsidies had skewed the market unfavourably as Netafim was still operating at 80000 acres of coverage because of the fact that it did not take any subsidy support from the government. He cited the example of Kuppam district in Andhra Pradesh where Netafim achieved great success without government subsidies. He said that Netafim's ideology is based on the pay back concept and that the payback period of any pressurized irrigation system is less than two years for any crop. Janwillem Liebrand [8.5] presented how agriculture was becoming more and more uneconomical for the farmers in North Gujarat and that there was a strategic shift to dairying as the major source of income for the households. This meant there was a lot of demand for fodder in the area and a lot of fodder was being brought in from the southern parts of Gujarat to fulfil the needs of the dairy industry. He pointed out that farmers in North Gujarat are fast turning into 'cow farmers' as against 'crop farmers'. It is usually the woman who manage dairying activities and therefore has greater role in the decision



Micro irrigation session in progress

making process. Thus there was a need to look at women as target audience for the promoting agencies. He said that north Gujarat farmers are getting into a new farming system and if micro-irrigation can be made inherent in this system at the adoption stage itself, it would take off very well. Dinesh Kumar [8.6] presented his views on the myths and realities regarding adoption of drip irrigation by farmers. He contended that farmers do not adopt micro irrigation technologies for water saving; rather they adopt them when irrigation becomes difficult owing to water or power scarcity. He said that better-off farmers are generally not concerned about water saving issues and technologies as they have the money to fulfill their needs through other supply side alternatives while the poor do not have enough investment ability to shift to other water sources. Low cost technologies are suited for those regions where the well yield is low and crops are under moisture stress. He concluded that economic incentive is the ultimate deciding factor and the degree of incentive depends on how the farmer is positioned with respect to water availability, power availability, and electricity pricing. What was required was region and target specificity. He suggested that IDE needs to target water buyers and members of tubewell partnerships in North Gujarat. Shilp Verma [8.7] presented a brief overview of the SDC supported IWMI-FiBL-bioRe collaborative research project in Maikaal, titled "Growing Organic Cotton under Groundwater Stress". This was followed by a presentation by the IRMA MTS students on a paper by Shilp Verma, Stanzin Tsephal [81] and Tony Jose [82, 8.8]. The presentation traced the origin of the innovation in the Maikaal region and the growth of the technology through its various stages of development. The study results were based on a survey of 180 farmers in West Nimar (MP) and Jalgaon (Maharashtra). The study also detailed the market channels and the comparative costs and benefits of Pepsee adopters, drip adopters and flood irrigators in the region. The results showed that while the benefits were higher for adopters of the IDE promoted micro-tubes and for conventional drip kit adopters, farmers continued to adopt Pepsee as the technology reduced the initial investment requirements to half. The study pointed that Pepsee systems were

looked as stepping stones for the adoption of more sophisticated but capital intensive technologies like micro-tubes and drip kits. The study also made some recommendations for IDE which has recently started promoting its own version of Pepsee aptly named 'Easy Drip'. They pointed out that low price was the biggest value which Pepsee or 'Easy Drip' offered to its potential buyers and IDE should not tamper with the price of the product. Secondly, biggest perceived disadvantage was the short life span and durability of the Pepsee systems. Therefore, they recommended that IDE should offer one-year warranty on the product for the first time users.

5. Plenary Session Proceedings

At the end of the theme sessions, plenary sessions for each theme was organized with two objectives: acquaint the full house of the papers that were presented in the individual session and sum up the discussions that ensued and highlight new research ideas that were generated. Each plenary session was of an hour's duration, with around 20 minutes dedicated to the theme managers' synthesis presentation and the rest 40 minutes in further discussions. The following are the main comments and feedback on each theme based plenary session in the order they were presented.

5.1 *Garibi Hatao* : Does Investing in Irrigation Help?

The plenary presentation was made by Bhawana Upadhyay [83]. She summed up the main conclusion of all the papers presented in the session and also drew up a list of new research ideas that emerged. After the presentation, Rijsberman pointed out that distinction between irrigated and non-irrigated agriculture has become rather less useful than it was in the past. Therefore, now it is more relevant to talk about water management for agriculture and investment on water management for agriculture in a continuum of approaches. Neelima Khetan said that the complexity of issues raised during the session has not been brought out fully in the synthesis. She also stressed the need to emphasize on the software or institutional side of irrigation. Madar Samad said that the first wave of irrigation has generally not been useful in decreasing

poverty in agriculturally backward areas. It was a donor-driven expansion of irrigation. The new wave of irrigation is market-driven. The question is “will poor people benefit this time? There is a need for regulatory mechanisms to safeguard the interest of disadvantaged groups because now only those who can invest will benefit from irrigation.



Plenary session on irrigation and poverty

Tushaar Shah said water sector reforms currently underway are not meant to alleviate poverty but to get more finance to keep the public institutions running. J S Samra said that there is a need to graduate from irrigation management to water management as the difference between irrigated and non-irrigated agriculture is becoming fudgy. He said that land fragmentation is also a problem that needs to be corrected. He said that the issue of poverty alleviation is closely related to water productivity. Encouraging multiple uses of water to increase farm productivity and farm income will contribute to poverty alleviation. Citing the example of the caste-stratified society in Bundelkhand, Ved Arya said that a bigger issue was equity in access to resources specially when a number of stakeholders use and derive their livelihoods from this water. He encouraged ITP to undertake concurrent research while attempting to solve the issue instead of doing a post-facto analysis. As of now irrigation investment was largely driven by a desire to get more donor funds than to improve the system and ensure equity in its use. He also suggested the idea of getting independent legal recognition for tank user groups instead of subsuming them under canal irrigation user groups as is the current practice. He invited ITP to collaborate with SRIJAN to design an intervention for a huge rehabilitation

project funded by the World Bank in Karnataka. Another participant said that ITP seems to be promoting privatization of water. In such case how do we plan to safeguard the community values? He suggested a need to do research on leadership issues that would help the community handle these issues better. Chris Scott informed the house about the primary findings of the ADB pro-poor study in India. He said that irrigation has helped to reduce poverty by direct as well as indirect ways through greater labour absorption and by attracting migrant labourers from unirrigated areas. In irrigation transfer, he said, at times vested interests can wrest control over the system as suggested by the study in Madhya Pradesh. There is also a need to work out the investment that has to be made in hardware and software of irrigation systems. In a study of the canal system in Vidisha, Madhya Pradesh, it was found that in head reaches land ownership had shifted to larger farmers and there was a greater incidence of bonded labour than in tail reaches. There was a higher incidence of farm mechanization in head reaches leading to job loss to the landless and marginal farmers. This shows a need to empower people to enable them to take over the institution of irrigation management. Capacity building is essential and we should invest in it before we transfer irrigation systems to WUAs. S. Janakrajan [84] said that it is crucial to take a position on this issue especially in the wake of WTO and GATT. Privatization is already taken place in the sector. Should we encourage it? Frank Risjberman said that this is not a place to take a position on privatization. We should rather set an agenda for the next year.

Lucy Maarse said that irrigation and poverty is a very important issue and we must address it very clearly because it has large policy implications. Therefore, ITP should invest more into it. Frank Risjberman informed the house that work on this issue will be finalized once other components of IWMI mature, and there is also a need to do some synthesis of work done elsewhere. B R Sharma suggested that ITP has its strength in groundwater and therefore it should focus more on it and specially to explore investing in groundwater irrigation helps in alleviating poverty. J S Samra suggested that in analysis of impact of

irrigation on poverty, we should take all three stakeholders landless, land owners and those who lease-in land and the interlinkages should be probed into.

5.2 Groundwater Socio-Ecology of Asia: Governing a Colossal Anarchy

Presentation in this session chaired by Aditi Mukherji, focused on three aspects: an overview of groundwater socio-ecology of South Asia based on work done in 2002; the complexity of evolving appropriate institutions for groundwater governance in South Asia; three key issues for further research. These key issues were: studying the health and environmental impact of groundwater irrigation, including the need to better understand the socio-economic dimensions of arsenic and fluoride contamination; understanding poverty and groundwater linkage in overexploited and underexploited areas and groundwater policy and food policy issues affecting groundwater use.

Sakthivadivel pointed out that arsenic contamination has emerged as a big problem in West Bengal and Bangladesh. The possibility of arsenic entering the food-chain through paddy is a much bigger threat than the problem of arsenic in drinking water. This is the issue ITP and IWMI should work on in the coming year. The efforts should be directed towards understanding and quantifying the socio-economic impact of arsenic contamination of groundwater in eastern India and Bangladesh. There was also a suggestion that South Asia is not homogenous and there should be greater research focus on scarcity hit areas than eastern India which is water rich. B R Sharma pointed that ITP research has focused mainly on good quality aquifers while 30-84% of aquifers are of poor quality. In such aquifers farmers do not have enough opportunities to use groundwater. ICAR has been doing technical research in such areas and ITP should complement it by studying farmers' coping mechanisms in the wake of marginal quality aquifers. Apoorva Oza said that groundwater is also the main source of drinking water in India meeting the need of almost 80% of its people. Therefore there is a need to explore the groundwater-drinking water linkages. He said that

self-regulation of groundwater by community is difficult but indirect regulation through energy supply policy will get a political constituency only when we work with communities. Otherwise there would be a political backlash to these indirect measures. He suggested finding cases where communities have come together to regulate groundwater draft. J S Samra said that rice-wheat production system leads to overexploitation of groundwater but is supported by the food policy. A shift in cropping pattern would take place only if the food policy changes. Secondly, he said that farmers go for groundwater structures even in canal command areas which show that something is wrong in canal supplies. Farmers want water to be available on demand to maximise productivity and this should be taken into consideration while attempting groundwater regulation.

R. N. Athavale [85] opined that a ray of hope can be seen from the work carried out by Tarun Bharatsangh and Anna Hazare in India. A systematic study should be done on why such initiatives work in some place while not elsewhere. K.B. Trivedi suggested that option for inter-basin water transfer should be explored. He said that out of 104 river basins in Gujarat, 4 are water surplus and their surplus should be used to make up for the deficit of other basins. He said that demand management of groundwater takes place only in areas where communities invest heavily into recharge structures. First generation demand management norms have already been formed in areas like Saurashtra where such investment has been made. Citing the example of the area he said that there is a norm there that nobody will lift water directly from the recharge structures. This offers a lesson that greater the degree of animation of local community in increasing the supply of water, greater the propensity of demand management. K V Raju said that there seems to be an interlinkage between groundwater regulation and drinking water crisis. Political consensus and willingness to legislate on groundwater comes forth only when drinking water is threatened. For example, the groundwater regulation bill was not touched in last 2-3 years due to fear of political backlash. Of late, when drinking water crisis has worsened, all parties have

agreed to act on groundwater pumping for irrigation in areas where it threatens drinking water sources. P. Narayana informed the house of the main provisions of the Andhra Pradesh Land, Water, and Trees Act which has recently come into force. The act provides to create an inventory of all existing groundwater extracting structures and sanctioning new wells and registering well drillers. It also has a provision to provide ready access to groundwater balance data to all villages and prevent drinking water sources from overexploitation.

5.3 Energy-Irrigation Nexus in Asia: Catching the Bull by the Horn (rather than the tail)

Avinash Kishore made the plenary presentation. His presentation concentrated on indirect ways of managing the energy irrigation nexus with a view to encouraging both sustainable groundwater use and viable energy sector. He put forward the thesis that proactive energy demand and supply management coupled with high reliability and convenience to farmers has the potential of creating positive implications on both sectors. P. Narayana presented an overview of work done at the IWMI-Hyderabad office in collaboration with IRDAS and NGRI.

Niranjan Pant pointed out that, though theoretically this idea seems fine, at the ground level there would be serious supply constraints. This is because peak period in agriculture coincides with peak period in domestic use and therefore there might be production problems. Reacting to the presentation of Narayana, he said that in Uttar Pradesh, one transformer caters to one pump connection only and therefore the type of model he suggests for Andhra Pradesh may not be feasible in Uttar Pradesh and other North Indian states. On the issue of subsidy to farmers, Pant pointed out that recently agricultural tariffs have been brought up by three times in Uttar Pradesh, from Rs 450/HP to Rs 1400/HP. Harnath Jagawat said that the same blanket policy of either flat rate or metering should not be imposed externally. For example, in their area of work, the tribals prefer metered electricity to flat rates ones because they use their pumps for very

less number of hours. Rijsberman summed up the discussion by saying that this work at IWMI is essentially giving an alternative perspective by highlighting the fact that metering, though desirable is almost impossible given the disposition of the farmers and therefore, the thrust on proactive energy management regime. However, special dispensation is needed for the energy deficit but water surplus eastern India. Swati Seshadri [86] talked about the stark contrast between northern India and eastern India in terms of access to power and pointed out that in eastern India, more than just power subsidies will be needed to reinvigorate the region. Similarly, she raised the concern about how to convince such donors as ADB to go ahead with subsidies when their conditions clearly state otherwise. She emphasized that managing only energy irrigation nexus will not suffice; one has to manage the food policy nexus as well. Samra asked whether given the political unwillingness, one could generate demand driven improvement in the power sector. Unless, demand and willingness to pay exist among farmers, it will be very difficult to impose even fair and high quality rationing. To this Avinash Kishore said that studies done by TERI shows that farmers are willing to pay more if and only if the number of hours of power supply is increased. Samra added to this by saying that there is a need to change the perception of farmers through training and exposure.

5.4 Groundwater Management in Gujarat: Elevating the Game

The plenary presentation was made by M Dinesh Kumar. The discussion on groundwater management in Gujarat started with Sakthivadivel citing a remarkable experimentation in Kachchh where groundwater recharge has been integrated with demand management with the ultimate goal to increase water productivity and farmer incomes. The intervention is self-sustaining and makes profit. He suggested doing a case study of the intervention to derive useful lessons from it. Athavale said that research has shown that smaller the catchment area, greater is the efficiency of runoff collection. Therefore, farm ponds are the most efficient way to groundwater recharge. He also said that not coefficient of variation but the

incidences of rainstorms decide the quantum of run off to be generated. Also lesser the rainfall, greater the rainstorm incidence and intensity and in fact one good rainstorm will be able to fill one farm pond which is enough for one supplemental irrigation.

Dinesh, however, pointed out that the impact of smaller vs. larger catchment on runoff collection efficiency depends on the climate and soils and is highly location specific. Further, in the case of Gujarat it was found that in years of poor rainfall number of good rainfall events that could possibly generate runoff were lesser as compared to high rainfall years.

Apoorva Oza said that the evaluation of the recharge programme should not be mixed up with the evaluation of recharge technique. A programme failure is not an indicator of the unsoundness of the technique of water harvesting per se. He quoted A S Patel's study which says that recharge is effective if planned properly.

Countering the presenter's stance he said that rooftop rainwater harvesting structures (RWHS) act as a decentralized water storage system as they are under community control. Nafisa Barot advocated RWHS as a crisis management strategy. The increasing demand from rural people for RWHS and their willingness to share part of the cost were indications of the effectiveness. Responding to these issues Dinesh made a point that what we call RWHS are not water harvesting but water storage systems. He added that in low rainfall regions, with high variability in rainfall and rainy days, the amount of water collected through RWHS would be too little as found in some cases in Saurashtra and north Gujarat.

Harnath Jagawat said that there is nothing like upstream-downstream inequity by building water harvesting structures in Sadguru's work as they are small and open-gated structures. He said that Sadguru has built 19 structures on the same river and all of them are overflowing. He stressed that in fact small structures at intervals are far more effective and equitable. Dinesh responded by saying that top-bottom inequity may not be there in Sadguru systems where regulation is there but in north Gujarat and Saurashtra where there is no regulation and structures are not gated there

certainly is a top-bottom inequity. R. Sakthivadivel said that building of water harvesting structures has indeed affected downstream flows in the case of the Aji basin. He said that water harvesting structures have definitely helped people to get a supplemental irrigation during kharif and in some cases also in rabi but the same thing could have been done far more cost effectively with proper planning.

Neelima Khetan said that IWMI's strength is in irrigation and water but ways to augment water availability does not come out as IWMI's strength even when it is the major groundwater challenge. It should be listed in the future research agenda. She stressed the need to research on the important issue of why watershed management approach has failed in India. Samra countered her contention by saying that there are several independent evaluation studies which show that the watershed approach has not failed. He also said that in any watershed there are large non-arable areas and a large number of poor people who depend on livestock. Benefits to livestock are seldom evaluated in watershed evaluation. In situ moisture conservation and its quantification is another missing link in research that gap should be filled. Shah pointed out that watershed management as a concept is still good and its potential needs to be fully explored.

Swati Shesadri argued that decentralized water harvesting and inter-basin transfer were spoken in the same breath when they are contradictory. Dinesh responded by saying that the extent to which local water harvesting could help augment groundwater resources and mitigate depletion problems and water scarcity is limited in north Gujarat, given the magnitude of the problem and lack of sufficient surplus runoff within the basins there. Therefore, exogenous water would be needed, after ensuring optimal use of water within the basins there. Therefore, local water harvesting and inter basin transfer are not mutually contradicting and can go hand in hand. So long as Madhya Pradesh does not build its dams planned under SSP, Narmada would have surplus water in the rainy season which can be used to recharge the aquifers of north Gujarat. No new structures are required for that as dry riverbeds will be used for recharging. The session concluded with a

decision to explore opportunities to find alternative solutions to drinking water problem in rural Gujarat in the year to come with IWMI, AKRSP (I), and UTTHAN working together as partners.

5.5 Central India Initiative: Improved Water Control as the Strategy for Vitalizing Tribal Agricultural Economy

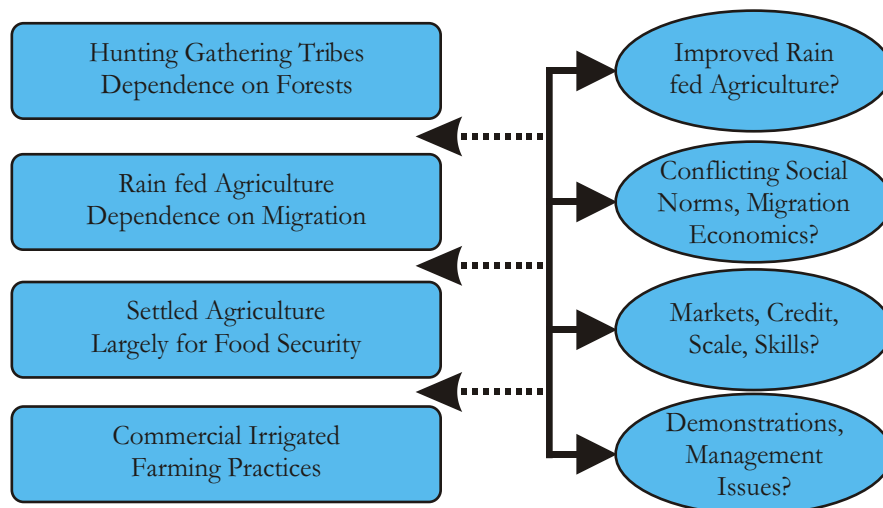
The plenary session presentation was made by Shilp Verma. The plenary presentation provided the context in which the Central India Initiative (CInI) was started. It laid out how despite a positive bias in public policy the returns on investments made by the state and its agencies have fallen far below expectations. Data on self financing of irrigation infrastructure indicates that only in the case of shallow tubewells does the self-financing fall with increasing tribal population thereby indicating that it has taken the lion's share of institutional credit and government subsidies. Green revolution which brought prosperity to other parts of India have more or less bypassed the tribal belt. The first phase of activities in CInI was briefly elaborated and important lessons from the first phase were presented. The objective of taking up six case studies in Phase I was to develop and understand of the context and to refine the research hypotheses. A categorization of the continuum of tribal agriculture attempting

to capture the diversity was proposed to the house as shown below:

The criteria for success were also laid out and the questions and points raised during the workshop were presented followed by the roadmap for success that emerged from the discussions. The plan for the second phase was discussed in brief and the specific hypotheses for each of the proposed development categories were presented.

Sakthivadivel raised the issue about how would promotion of irrigated agriculture in the upland catchment areas effect water availability downstream? He suggested that CInI should look into these aspects as well while drawing out a blueprint for an intensive irrigation development programme. Samad pointed out that the property rights regime in tribal areas was important. Continuing with this point Neelima Khetan pointed out that most of the land in tribal Rajasthan was public land. She said that CInI needed to change its objectives as it presupposed the existence of large scale unharvested surplus water. This was not true for the western part of the country though it was true for the east. She stressed the need for concurrent emphasis on recharge or else the sustainability of interventions would be threatened. Niranjan Pant stressed on the need for NGOs in such a task as he opined that tribal people held belief systems and culture as most important and this required a major

Figure 1: Continuum of Tribal Agriculture



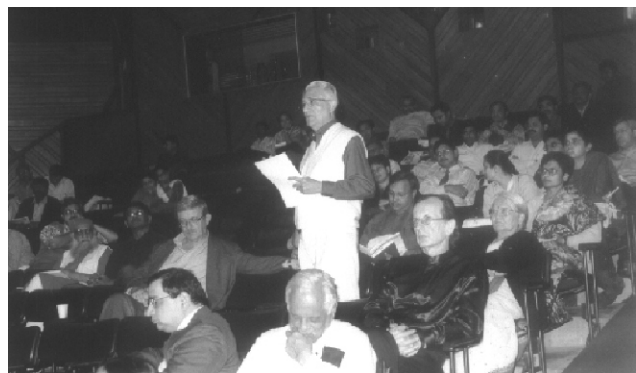
resource investment that the NGOs made but was not possible for the bureaucracy to put in. Samra brought the issue of land tenure stating that without settled land tenure and ownership the tribal people won't be interested in irrigated agriculture. There was need to understand their needs as tribal people were open to new inputs as exemplified by the Koraput experience. In high rainfall areas local water harvesting structures were required due to undulating and hilly topography. Kamal Bhattacharya said that the categorization was not meaningful as there were no clear groups but only mixtures and same farmer behaved differently in different situations. Also land and water conservation made little sense to tribals as they did not own land. He added that without market linkages the demand for irrigation would be absent. He suggested linking of the four categories to the case studies in phase II. Similarly, Neelima expressed her reservation in accepting the cosmetically perfect scheme of tribal categorization. Arun Pandhi asked the presenter to clarify how the case studies in the two phases of CInI would be linked and integrated into the overall design. K V Raju suggested that an interesting thing could be to look at the new role of panchayati raj institutions in these tribal areas. Neelima added that even with irrigation based livelihoods natural resources was inevitably linked and therefore such linkages had to be looked at. Phansalkar clarified that CInI was already looking at water management aspects. Kamal Bhattacharya added that part of tribal land is under forests and hence joint forest management (JFM) was researchable issue linked to water availability. Dinesh Marothia [87] pointed out in most tribal areas local water harvesting traditions were in place and its dynamics had to be understood before making any intervention. They practice integrated agriculture and consume more of tubers and traditional cereals and as such food security and irrigated agriculture might not always make sense to them. While responding to the questions raised in the house, Shilp Verma clarified that while issues other than irrigation definitely had their impact on tribal livelihoods, CInI primarily looks at irrigation as a livelihood option for the tribals and the impact which a concerted irrigation development programme can have in the central Indian tribal belt. In the next

phase, CInI would like to draw inputs from anthropological and sociological studies for a better understanding of tribal livelihoods.

5.6 Making India's Public Irrigation Systems Viable: Abandoning, Salvaging, or Improvising upon?

The plenary synthesis was presented by Ms Aditi Mukherji. Her presentation talked about three issues, viz.: revitalizing the irrigation sector, drawing up lessons from international experiences, and key issues that emerged from the session discussions the day before.

The discussion started with a comment from Hammond Murray Rust that the assumption that the Indian irrigation sector was not working well itself was not correct. He said that pricing reforms won't be effective in bringing a change or improvement in canal systems. Also it is not fair to expect the irrigation systems to perform according to design specifications as they are dynamic systems. He contended that in fact true value of irrigation is about twice that of the value of agricultural production. The multiplier effects are much larger and therefore subsidy is in fact justified. Anil Shah contested Hammond's statement and said that canal systems are definitely sick as they deliver much below the expectations and are slowly going out of use.



Plenary session on India's public irrigation systems

Unreliable canal supplies are compelling farmers to invest in tubewells. This is a sign of their poor performance. About the session output presentation he said that it has quickly jumped to 'beyond PIM'. Therefore, it would be better to look into the problems and check if they are beyond remedy. PIM is not a total failure. It works

at least much better than the current system of government management. Therefore 'PIM plus' and not 'beyond PIM' is a better approach worth following. On irrigation financing he said that issuing public bonds is not going to work and economists should find better ways to do so which would ensure that investors put pressure on department to perform better and ensure better returns as it happens in the corporate world. He also said that it is impractical to expect capital cost financing of canal projects by the private sector. The government should keep subsidizing capital investment but water prices should be raised to a level where it can cover O&M costs. J. S. Samra suggested the idea that Gujarat State Fertilizer Corporation should take up the responsibility to sell water in the Narmada command. It should also sell other inputs like fertilizers and pesticides apart from water to farmers and provide forward and backward marketing linkages. This will make the whole system highly productive. GSFC should exploit its existing retail network to implement the scheme and reduce transaction costs involved. G. Parthasarthy said that irrigation reform has not worked because it is highly sectoral and is not linked to the performance of the agricultural sector. For improving performance of the irrigation sector we need to work on improving the overall agricultural productivity. He said that PIM rhetoric has failed and it might fail in Narmada as well. So what could be those pluses that would make PIM successful should be the research agenda. On the issue of the structure of irrigation department, a representative from SWAJAL said that what is needed is rightsizing and not downsizing. He also said that getting rid of additional staff in government organizations is almost impossible. Vested interests have to be managed while restructuring government departments. One participant stressed the need to do a micro-level exploration of engineer's roles and responsibilities. They are under a very heavy burden of litigation and meetings which make it impossible for them to attend to their duties. Seenivasan said that before debating on success or failure of participation we need to first define participation. He said that researchers should also examine the delivery process to develop a better understanding of why things work not and how

to replicate success. Narayanmoorthy said that expenditure reforms make more sense than price reforms in irrigation. Norms are in place to limit expenditure per hectare of command area served while actual expenditures are much higher. He also made a point that India has a huge irrigated area which makes it different and difficult challenge for PIM. Even after 15 years of its launch less than 1% of the irrigated area is under PIM. That itself explains the performance of these reforms. Swati Shesadri said that before suggesting the lease-own-operate model for irrigation systems more thought needs to be given as to how to operationalize it. Nafisa Barot stressed on the need to do research on what NGOs can do to scale up PIM and make it more successful. About Narmada, she raised the concern that providing drinking water was also an important goal. In fact the idea was that income from irrigation will be used to subsidize drinking water supply. If irrigation income from irrigation itself is not sure, what will happen to drinking water duties? Rijsberman summed up the discussion by saying that IWMI has done some considerable work on this issue and it will be worthwhile to look for answers to many of the questions raised in the session.

5.7 Promoting Micro Irrigation: Saving Water and Building Livelihoods

The plenary synthesis was presented by Shilp Verma. He said that ever since micro irrigation become popular in Israel and the US, drip and sprinkler irrigation technologies have appealed to large, commercial, technology-savvy farmers. In recent years, attempts have been made by NGOs like International Development Enterprises (IDE) and corporates like Netafim and Chapin - to promote them as livelihood-creators for the poor of Asia and Africa. IDE, which has simplified and demystified the technology, has focused on cutting its cost to the minimum and on promoting the technology massively amongst the poor. In South Asia, micro-irrigation has the potential to respond to two critical but distinct needs: of the poor, especially women, to create a new means of income and livelihood; and of farmers in water scarce areas to cope with extremes of water scarcity. Thus, strategic issues in marketing micro-irrigation to the poor are different from

promoting it to farmers coping with extreme water scarcity. The question is: what might work best in promoting this technology on a mass scale? This presentation concentrated on this central question.

After the presentation, Narayanamoorthy reiterated his point made in the session discussion that since micro irrigation technology was in the take-off phase it needed subsidy support. The potential in terms of crops and areas was not yet recognized and known at the state level. To understand the potential there was need to do studies with all types of crops as there were no empirical studies at present. Hammond Murray Rust added that micro irrigation reduces per ha application of water but does not result in water saving. So the focus should be on more “crop per drop” and not on water saving. Dinesh Kumar opined that micro irrigation leads to water productivity increase up to 80% in north Gujarat and that it would lead to water saving if the total area under irrigation does not increase on a corresponding scale. Apoorva Oza pointed out that so far drip was amenable to horticulture crops which had a very low share in total water use at the system level. The challenge lay in popularizing it with major crops like wheat, groundnut etc. and only then would it make sense to talk of water saving at system level. He said that there is a need to enhance the potential of micro-irrigation technologies through innovations that would allow their use in more crops. Shilp Verma pointed out that the best innovations would come from farmers and that if the technology is transferred successfully to farmers, newer avenues of its application would come up from the grassroots. Examples of this are available in Maikaal where the Pepsee system became popular in cotton cultivation and today is being used in many other crops as well. Phansalkar added the need to couple micro irrigation technology with on-farm water harvesting schemes as many farmers do not have access to irrigation.

5.8 Tanks in Today's Context: Critical Issues in Raising 'Gross Tank Product'

The plenary presentation by Abhishek Sharma summarized the discussion in the session and emphasized the point that water should be treated

as the resource to be managed and not tanks. On this G. Sriramappa said that taking such a view would be too simplistic. Everything is a resource land, silt and everything associated with tanks can be used for productive purposes. Bhaskara Rao emphasized that tanks are crucial to the district of Ananthpur. In the district there are no alternative for irrigation except tanks so conservation of tanks is crucial. However a point was raised that in Ananthpur as much as 70% of the irrigated area is under tubewell irrigation and so it is not correct to call tanks as the only source of irrigation. Madhusudan Bhattarai raised the point that a cost-benefit analysis needs to be done for tank irrigation. It is important to find out how tank irrigation compares with alternative sources of irrigation. John Grisjen [88] said that tanks should be looked at basin level to understand their utility. He also talked of interlinkages across themes. For example the theme on micro irrigation is linked with tank irrigation. He spoke of a watershed project that he had visited where the use of drips was mandatory of the farming community. He felt that appropriate use of micro irrigation technology could enhance the utility of tanks. Anil Shah recommended that innovative solutions like leasing tanks to fishing contractors might be practical. However selling such solutions to policymakers might be a difficult. He said that one should look at case studies of successful rehabilitation schemes instead of attempting to do new ones. Athahvale raised the point that tanks are a very intelligent system for water holding but they were not built with groundwater abstraction in mind. So another innovative solution which calls for their conversion into percolation ponds needs to be done after careful study. Otherwise, their benefits will not be realized. Ved Arya said that the World Bank project in Karnataka offers the opportunity to test many of the ideas on tank rehabilitation. The project is trying rehabilitation of only those tanks which fill up regularly and is backed up by sound studies. Project management is also ready to incorporate inputs from researchers if they help improve the working of the project. The watershed approach is a crucial one that needs to be understood by engineers. They are only concerned with rehabilitating one tank system and are not looking at interlinkages between tanks. He also stated that the focus is too

narrow, as the discussion on tank is concentrated on South Indian tanks alone. There is a need to do more work on tanks of Rajasthan, Madhya Pradesh and Chhattisgarh. On this Nafisa Barot talked about a tank which people have rehabilitated for supplying drinking water. She said that it would be interesting to see how people regulate water distribution from this tank. Shaktivadivel of IWMI brought a new dimension to the debate by emphasizing that tanks have not come up according to hydrological opportunity but according to need for water. By selecting a few tanks which are filling up the Karnataka project is not following the right approach to rehabilitation. For rehabilitation one has to first find where the water is and who gets how much of this water. This has a poverty implication as well. Normally in such exercises most of the rich people's tanks are taken up for rehabilitation. Tanks that don't get water are not taken up for rehabilitation. However a livelihood approach requires that desiccated tanks are taken up for rehabilitation. Seenivasan raised the point that there seems to be no need to take up any new studies on tanks. Studies should instead focus on implementation aspects of rehabilitation. The work of Anna University in suggesting strategies for rehabilitation has been pioneering and complete. Madar Samad said that Sri Lanka has had tank rehabilitation of various types for over 20 years. Thus it might be a good idea to incorporate the experiences of Sri Lanka in tank rehabilitation.

6. Evaluation and Feedback

A formal evaluation team consisting six members was constituted to observe the proceedings and evaluate the programme's performance till date. Another mandate of the evaluation team was to give its suggestions on how to make the programme achieve its goal better in the years to come. The evaluation team consisted Frank Rijsberman, David Molden, J S Samra, B R Sharma, Lucy Maarse, Anil C Shah and Neelima Khetan. David Molden said that the team relied on its observations during the meeting and therefore the evaluation was based on this narrow exposure. Feedback was received at two levels, first on the design of the workshop and second on the process and content of the workshop.

Outlining the strengths of the programme he pointed out that ITP's work on groundwater and the way it has involved a diverse group of collaborators is its strength. However, there are ups and downs in research quality and there is a need for greater consistency in the quality of output within and across various themes. He recommended that apart from collaborating with NGOs who are stakeholders, ITP should also collaborate with hardcore research organizations which will help it in bringing more rigour to the work. He pointed out that there was lack of holistic approach to water and related issues. It did not come out in the presentations even if it was there. Poor understanding and integration of community issues and lack of a sound gender perspective in research are other weaknesses of ITP. Lucy Maarse opined that technology was not gender neutral and this should be borne in mind as the basic principle in all the work we do. At present lack of gender perspective is a major weakness of ITP's research work. She said that community dimension did not come out pronounced enough in ITP's work. Institutional issues and conflicts should come out in a more structured fashion in each of the themes. She pointed out that the number of activities conducted are loosely structured and are even contradictory. So, there is a need for more connection between researches done under several themes. She suggested that a common framework for the whole programme is either missing or did not come across in the presentations. Anil Shah said that a lot of brainstorming has been done during the workshop and now it is time to select and focus on some of the issues that can have greater impact. The programme needs to keep identifying frontier issues of relevance. He suggested forming a small advisory group that could meet more often and interact with the core research group to give direction to the research agenda. He drew attention to almost total absence of policy makers in the meeting. He said that there are several government schemes like the Andhra Pradesh government's PIM programme which would of great interest to the ITP, but the central issue is to attract policy makers in such discussions. J S Samra said IWMI, NGOs and NARS have a different set of core competency and each should collaborate in order produce

research of high quality. On the whole, the evaluation committee opined that there is a need for greater rigour in research and secondly, there is a need to proactively seek and involve policy makers in such initiatives. Attention was also drawn to lack of focus on institutional and gender issues.

Besides the evaluation committee, comments were invited from all other participants. Ved Arya said that he found the workshop very informative. He stressed on the need to go deeper into the research on institutional issues. He also emphasized the need to invite policy makers in such meets. Stressing the need to work with the political constituency, he suggested that ITP should try to find ways to influence the manifestos of different political parties in the wake of elections next year in Madhya Pradesh and Rajasthan to be able to create real policy impact. Prof. Sanjiv Phansalkar said that the workshop seemed to suggest a tendency towards “quick fix” research in ITP. He suggested a need for more rigorous research of higher quality and better theoretical grounding.



Discussions during a tea break

Apoorva Oza said that it took a great courage to open one self to peer review and that is what ITP has done. He said that top government officials cannot find time to attend a two day workshop which addresses a wide array of issues many of which do not concern them directly. He suggested that ITP can contemplate holding a Gujarat focused workshop in Gandhinagar. He pointed out the lack of gender perspective in ITP research. He said that gender is a cross-cutting issue and therefore gender analysis and gender disaggregated data need to be built in every work

even if it means structural change in the research approach. He entreated researchers to deal with process issues that can help in scaling up community organizations. Swati Seshadri praised the professionalism with which the workshop was carried out but made a point that the power point presentations did not reflect research heterogeneity and the complexities involved in social science research. And said that this was perhaps why the sessions looked disconnected from each other. Kamal Bhattacharya appreciated the research team for its openness. However, he cautioned against the tendency to generalize from small case studies. He stressed the need to strike a balance between context specificity and generalization. K C Roy of Bangladesh said that water sector discussions in Bangladesh were totally engineering focused even when social science people had a lot to contribute in this kind of workshops and said the experience of this workshop would help him in doing better research. Dinesh Marothia informed the house that Chattisgarh has rich tradition of tanks called *debris*. Studies had shown that if they could be shared by four to five farmers they could be of great value. Encouraged by this, the state government has given 100% incentives to farmers to come together and the scheme is working well. This showed that we would sensitize policy makers and if we provided quality information, they would act upon it. He thus stressed the need for more community focused research.

Tushaar Shah, the ITP programme leader, said that the programme had benefited immensely from the feedback and ideas and it would be reflected in the proceedings. He said that the points raised by participants resonated and reflected his own conversations with himself and therefore did not come as a surprise. He said that, ITP was ready to accept the criticisms and intended to act on some of them. This would be reflected in future communications from ITP.

7. Appendices

7.1 List of papers and workshop schedule

Session 1: Groundwater Socio-Ecology of Asia: Governing a Colossal Anarchy

Paper/presentation Code ³	Papers Presented at The Groundwater Governance Workshop on 26 th January 2003	
1.1	K.C. Roy/M. Mainuddin	Groundwater Socio-ecology in Bangladesh
1.2	Asad S Qureshi and Mujeeb Akhtar	The Groundwater Economy of Pakistan
1.3	Dhruba Pant and Madhav Belbase	Socio-ecological Implication of Groundwater In Nepal
1.4	Bancha K Wanyuen	Groundwater Irrigation in Thailand
1.5	Sachin Madrikar	Socio-ecology of Groundwater Irrigation in Maharashtra and Goa
1.6	Ranjan Mohapatra	Socio-ecology of Groundwater Irrigation in Orissa
1.7	Sithapati Rao	Socio-ecology of Groundwater Irrigation in Andhra Pradesh
1.8	Sithapati Rao	Socio-ecology of Groundwater Irrigation in Karnataka
1.9	Rajen P Rao	Socio-ecology of Groundwater Irrigation in Gujarat
1.10	Shakeel Ahmed	Recent Research in Weathered-fractured Aquifers in Hard Rock Regions
1.11	S J Phansalkar	Ongoing Work on Maharashtra Groundwater Act
1.12	M. Mainuddin	Groundwater Irrigation in Bangladesh: Tool for Poverty Alleviation' or 'cause of Mass Poisoning'.

Session 2: 'Garibi Hatao': Does Investing in Irrigation Help?

Paper/presentation Code	Papers Presented at the Irrigation Poverty Workshop on 27 th January 2003	
2.1	M Samad	Water and Poverty: IWMI's Position Paper
2.2	T Shah and O P Singh	Irrigation Development and Rural Poverty in Gujarat, India: A Disaggregated Analysis
2.3	M Bhattarai and A Narayanamoorthy	Irrogation Impact On Agricultural Growth and Poverty Alleviation: Macro Level Impact Analyses in India
2.4	Sanjiv Phansalkar and Sachin Madrikar	Understanding Underdevelopment Water and Poverty in Vidarbha
2.5	R Sakthivadivel	Mainstreaming Ooranis A Way Forward: Issues and Options
2.6	M Dinesh Kumar	Food Security and Sustainable Agriculture in India: The Water Management Challenge

³See the report

Session 3: Energy Irrigation Nexus in South Asia: Catching the Bull by the Horn (Rather Than the Tail)

Paper/presentation Code	Papers Presented at the Irrigation Poverty Workshop on 27 th January 2003	
3.1	Tushaar Shah, Christopher Scott, Avinash Kishore and A Sharma	Energy-irrigation Nexus in South Asia: Approaches to Agrarian Prosperity with Viable Power Industry
3.2	C Scott, Tushaar Shah and Stephanie J. Buechlerand	Energy Pricing and Supply for GW Demand Management: Lessons from Mexican Agriculture
3.3	Animisha Singh and Sanjolie Batra	Evolving a Proactive Supply Management Regime for Agricultural Power Supply
3.4	P. Narayana	Economics of Supply Oof Power to Agriculture Sector to Establish Linkages for Energy-water Co Management
3.5	Avinash Kishore and Shilp Verma	Pumping Behaviour Under Different Tariff Regimes: The Anand Survey
3.6	Pradyumna Deshpande	Farmers Response in Groundwater Scarcity and Flat, (on Going Work)

Session 4: Making India's Public Irrigation Systems Viable

Paper/presentation Code	Papers Presented at the Public Irrigation System Workshop on 27 th January 2003	
4.1	Madhusudan Bhattarai and A Narayanmoorthi	Irrigation Impacts and Factors Contribution to the Agricultural Productivity Growth in India: A Cross-state Panel Analysis for 1970 to 94
4.2	Sonal Pandya	Extent of Subsidy in Major and Medium Irrigation Projects of Gujarat
4.3	K V Raju	Innovations in Irrigation Financing: Tapping Domestic Financial Markets in India
4.4	Neetha N	Irrigation Institutions in Canal Command: The Case of Chalakkudy River Diversion Scheme in Kerala
4.5	Sarat Kumar and Archana Londhe	PIM in Canal Irrigation Systems in Gujarat and Andhra Pradesh
4.6	Aditi Mukherji	Irrigation Management Transfer and Role of Self Governing Institutions: Synthesis of 19 Case Studies (on Going Work)
4.7	Iwmi-tata Research Group	Framing the Rules of the Game: Preparing For The First Irrigation Season in Sardar Sarovar Project Command
4.8	Jayesh Talati and Jan Willem Liebrand	Evolving Institutions for Irrigation Management in Sardar Sarovar Project
4.9	Aditi Mukherji and Avinash Kishore	Irrigation Management Transfer: The Case of GWRDC's Tubewell Transfer Programme in Gujarat

4.10	K B Trivedi and V M Yagnik	PIM in Groundwater: Success Story of GWRDC
4.11	R. Indu	Transfer of Government Tubewells and River Lift Irrigation Systems to Panchayats in West Bengal

Session 5: Central India Initiative

Paper/presentation Code	Papers Presented at the Central India Initiative Workshop on 27 th January 2003	
5.1	Arpan Sharma	Irrigation Interventions in Tribal Communities: A Review of Literature
5.2	Tushaar Shah and O P Singh	Improved Water Control as a Strategy for Agricultural Intensification in India's Tribal Heartland
5.3	Rakesh Pandey and Harmeet Saini	A Study of Land and Water Resources Development Programme Promoted By N M Sadguru Water and Development Foundation in the Tribal Regions of Gujarat and Rajasthan
5.4	Harnath Jagawat and K Choudhary	A Study of Government Installed Lift Irrigation Schemes in Jhabua, MP
5.5	Sachin Mardikar	Community Lift Irrigation Schemes in Wardha and Yavatmal Districts of Maharashtra
5.6	V Bhamoriya and Saroj Mahapatra	Where is the Demand? PRADAN's Irrigated Agriculture Programme
5.7	Shilp Verma and Manas Satpathy	Irrigation Development for Tribal Farmers in Surat
5.8	Aditi Mukherji, Shilp Verma and Prabhat Rath	Demonstrating Success: Participatory Irrigation Management With Tribals in AKRSP(I) Supported Canal Irrigation Systems in South Gujarat
5.9	Sunil Kr. Singh and Pravin Kr. Singh	Issues in Developing Irrigated Agriculture Based Livelihoods Among the Tribal Poor in Central India
5.10	S Phansalkar, Shilp Verma and Vaibhav Bhamoriya	What Works and What does not in Irrigation Based Livelihood Intervention in Tribal Regions: A Synthesis of Six Case Studies

Session 6: Groundwater Management in Gujarat: Issues in 'Elevating the Game'

Paper/presentation Code	Papers Presented at the Groundwater in Gujarat Workshop on 27 th January 2003	
6.1	M. Dinesh Kumar	Overview of ITPs Work in Groundwater In Gujarat
6.2	Mudrakarta Srinivas	Closing the Demand-supply Gap Through Rainwater Harvesting
6.3	G. S. Sastri, Y. V. R. Reddy and H. P. Singh	Watershed Based Land Management Treatments for Augmenting and Sustaining Water Resources in Different Semi-arid Regions of India.
6.4	R. Sakthivadivel	Efficacy of Well Recharging in Hard Rock Areas: Case of Kadvanthali Village in Saurashtra
6.5	Vilind R. Parikh and A S Patel	Development of Parameters for Determining Efficacy of Seawater Intrusion Preventive Structures in Coastal Saurashtra
6.6	M. Dinesh Kumar	Roof-water Harvesting in India - Who is the Gainer and Who is the Looser
6.7	Rajnarayan Indu	Groundwater Degradation and Human Health: The Rise of Reverse Osmosis Plants in North Gujarat's Cottage Sector
6.8	Vipul Patel	Yield and Water Productivity Impacts of Pressurized Irrigation Systems in Banaskantha, North Gujarat
6.9	Ramakrishna and Kumar	When Farmers Adopt Water Saving Technologies? Findings of a Market Research Study in North Gujarat, India
6.10	Janwilhelm Liebrant	Drips for Crops or Cows?

Session 7: Tanks in Today's Context: Critical Issues in Raising 'Gross Tank Product'

Paper/presentation Code	Papers Presented at the Tank in Today's Context Workshop on 28 th January 2003	
7.1	Abhishek Sharma	Cock-eyed View of Tank Management-Results from a Study of 5 Tanks in Andhra Pradesh
7.2	R. Seenivasan	Review of DHAN's Work on Tank Rehabilitation
7.3	G. Bhaskara Rao	Review of SPWD's Work on Tank Rehabilitation
7.4	Niranjan Pant	Tanks in India: A Study of the Ahar-pyne System in Bihar (jharkhand)
7.5	Ved Arya	Concept note on Community Driven Integrated water Management and Sustainable Livelihoods in a Micro river Basin in Karnataka
7.6	G. Shriramappa	Oxfam India's Strategy for Tank Revival in Southern India

Session 8: Promoting Micro-Irrigation- Saving Water and Building Livelihoods

Paper/presentation Code	Papers Presented at the Micro Irrigation Workshop on 28 th January 2003	
8.1	Tushaar Shah and Jack Keller	Global Overview on Micro-irrigation and the Poor
8.2	A Narayanamoorthy	Overview of Micro Irrigation in India
8.3	Sudarshan Suryavanshi	Promotion of Micro-irrigation Among the Poor: IDE's Experience and Strategies
8.4	Randhir Chauhan	Promoting Micro-irrigation: Netafim's Experience and Strategies
8.5	Janwillem Liebrand	Drips for Cows or Crops: Practical Recommendations for Involvement of Women and Men in the NGI-pilot Project.
8.6	M Dinesh Kumar	Micro Irrigation in North Gujarat - Issues, Prospects and Future Directions
8.7	Shilp Verma	Overview of “Growing Organic Cotton Under Groundwater Stress”: IWMI-FiBL-Biore Collaborative Research Project in Maikaal
8.8	Shilp Verma, Stanzin Tsephal and Tony Jose	Pepsee Systems: Grassroots Innovation Under Groundwater Stress

26th January 2003: Theme Workshop

09:30 16:30

Theme Workshop on “Groundwater Socio - Ecology of Asia: Governing a Colossal Anarchy”

Water, Livelihoods and Environment in India: Frontline Issues in Water and Land Management and Policy

Day I: 27th January 2003

9:30	10:30	Welcome and Introduction to the Workshop Frank Rijsberman, Arun Pandhi, Christopher Scott and Tushaar Shah		
10:30	13:30	<i>Garibi Hatao</i> : Does Investing in Irrigation Help?	Making India's Irrigation Systems Viable	Energy-Irrigation Nexus in South Asia
13:30	14:30	Lunch Break		
14:30	18:00	Central India Initiative	Making India's Irrigation Systems Viable	Groundwater Management in Gujarat

Day II: 28th January 2003

9:00	13:00	Promoting Micro Irrigation	Tanks in Today's Context
13:00	14:00	Lunch Break	
		Presentation of Session Outputs	
14:00	15:00	Policy Synthesis: Pro-poor Strategies of Irrigation Investment and Management	
15:00	16:00	Policy Synthesis: Instruments of Groundwater Governance	
16:30	17:30	Operational Plan for Sustainable Groundwater Irrigation with Viable Power Industry	
17:30	18:30	Outline of a Strategy for Sustainable Groundwater Management in Gujarat	

Day III: 29th January 2003

		Presentation of Session Outputs	
8:30	9:00	Lessons for India from International Experience	
9:00	10:00	Outline of an up-by-the-bootstraps Strategy for Development of Irrigated Agriculture for Tribal India	
10:30	11:30	Assessment of Alternative Institutional Approaches to Improved Management of Public Irrigation Systems	
11:30	12:30	Mass Promotion of Micro-irrigation Technology: Outline of a Social Marketing Strategy	
12:30	13:30	Policy Synthesis: Alternative Approaches to Improving Gross Tank Product	
13:30	14:30	Lunch Break	
14:30	15:15	Dialogue on Water, Food and Environment	
15:30	17:00	Feedback, Ways Ahead for the IWMI-Tata Program and Conclusion	

7.2 List of participants

Sl. No	Name, designation and contact details of participants
1.	Dr. Frank Rijsberman Director General, International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080 (f) +94-1-786854 (e) f.rijsberman@cgiar.org
2.	Dr. Tushaar Shah Theme Leader and Principal Scientist Leader of IWMI-Tata Water Policy Research Programme IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (f) +91-2692-229310 (e) t.shah@cgiar.org
3.	Dr. Christopher Scott, Director, IWMI-India International Water Management Institute, C/o ICRISAT, Pattancheru, Andhra Pradesh- 502 324 (o) 040-3296161-71 (f) 040-3296182 (e) c.scott@cgiar.org
4.	Mr. Arun Pandhi Sir Ratan Tata Trust, Bombay House, Homi Mody Street, Mumbai- 400 001. (o)022-5665 8282 (f) 022- 5665 8013 (e) apandhi@tata.com
5.	Dr. Prathap Reddy Institute of Rural Management, P O. Box 60, Anand 388 001 (o) 02692-260181, 260186, (f) 02692-260188, (e) kpr@fac.irm.ernet.in
6.	Dr. J S Samra Dy. Director General, Indian Council of Agricultural Research, Krishi Bhawan, New Delhi- 110 001 (o)011-23382306, 23388992-5, (f) 23382306, 23387293 (e) jssamra@icar.delhi.nic.in
7.	Ms. Nilima Khetan, Chief Executive, Seva Mandir, Old Fatehpura Udaipur-313004 (o) 0294-450960, 451041, (f) 450947, (e) smandir@vsnl.com
8.	Mr. Anil Shah, Chairman, Development Support Centre, 2, Prakruti Apartments, Opp. Red Rose Restaurant, HL Commerce College Road, Navrangpura, Ahmedabad 380 009. (o) 079-6305285, 6306144 (f) 079-6303296 (e) dsc@satyam.net.in
9.	Dr. Lucy Maarse, Head NRM Sphere and IC-Delegate, Swiss Agency for Development and Cooperation, Embassy of Switzerland, Chandragupta Marg, Chanakyapuri, New Delhi 110021. (o) 011-6877819 / 20 (f) 011-6873631, (e) delhi@sdn.net

Sl. No	Name, designation and contact details of participants
10.	Dr. David Molden International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080, (f) +94-1-786854, (e) m.david@cgiar.org
11.	Ms. Aditi Mukherji, Jr. Consultant, IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-3229311/12/13 (f) +91-2692-229310 (e) a.mukherjee@cgiar.org
12.	Dr. K C Roy Head Irrigation and Water Management Division, Bangladesh Agricultural Research Institute, Joydebpur, Gazipur 1701 Bangladesh (o) 880-2-925 2715 (e) baridss@bttb.net
13.	Mr. Avinash Kishore, Jr. Consultant, IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) a.kishore@cgiar.org
14.	Dr. Asad S Qureshi, IWMI-Pakistan office (could not attend)
15.	Mr. Mujeeb Akhtar, IWMI-Pakistan office (could not attend)
16.	Mr. Madhav Belbase Technical Development Associates, GPO Box 978, Kathmandu, Nepal (e) techda@infoclub.com.np
17.	Dr. Bancha Kwanyen, Assistant Professor, Dept. of Irrigation Engineering, Faculty of Engineering, Kasetsart University, Kamphaeng Saen Campus, Nakhon Pathom 73140, Thailand (e) fenbak@ku.ac.th
18.	Mr. S Mardikar, Consult-India, B-7 Vrindavan, Bharat Nagar, Amravati Road, Nagpur 440 001, (o) 0712 528289, (m) 098230 56718 (e) cigroup@nagpur.dot.net.in
19.	Mr. Ranjan Mahapatra, Executive Director, SHRISTI, B 205, Krishna Towers, Nayapalli, Bhubaneswar, Orissa (e) shristi4@rediffmail.com
20.	Dr. Seethapati Rao Institute of Resource Development and Social management, 10-1-123/A/3/1, Saifabad Hyderabad 500 004 (o) 040-330 7008, 3325 135, (e) irdas@rediffmail.com
21.	Mr. Abhishek Sharma, Jr. Consultant, IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) a.sharma@cgiar.org
22.	Mr. M Dinesh Kumar, Consultant, IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) d.kumar@cgiar.org

Sl. No	Name, designation and contact details of participants
23.	Dr. Niranjana Pant Director, Centre for Development Studies, B-2/68, Sector 'F' Jankipuram, Lucknow 226021. (o) 0522-361339 / 363880 (e) pantn@sify.com
24.	Mr. Rajen Rao 6, Sraddhadeep Society, Opp: Panvati, Gorwa-Refinery Road, Vadodara 390 016
25.	Dr. Shakeel Ahmed Team Co-Leader (India), Indo-French Centre for Groundwater Research National Geophysical Research Institute Hyderabad, Andhra Pradesh 500 007 (o) +91 40 27158090 / 27174433, (f) +91 40 27170491 (e) shakeel_25@yahoo.co.uk / shakeelahmed@satyam.net.in
26.	Frank van Weert, Aracadis Consultants, The Netherlands Visiting researcher at IWMI-Anand office
27.	Dr. Sanjiv Phansalkar AMOL Management Consultants, 4, East High Court Road, Ramdas Peth, Nagpur 440 010 (o) 0712-532649 (f) 0712-543048, (e) sanjv@nagpur.dot.net.in
28.	Dr. M Mainuddin International Water Management Institute, P.O.Box 1025, Kasetsart University Jatujak, Bangkok 10903, Thailand. (o) +66-2-5614433 (f) +66-2-561123 (e) m.mainuddin@cgiar.org
29.	Dr. R Sakthivadivel IWMI Fellow, 33, First East Street, Kamrajanagar, Thruvanmiyur, Chennai 600 041. (o) 00-91-44-4414170 (e) sakthivadivelr@yahoo.com
30.	Janwilhelm Liebrandt MS Student and Visiting Researcher to IWMI-Anand Wageningen University, The Netherlands
31.	Dr. Madhusudan Bhattarai International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080 (f) +94-1-786854 (e) m.bhattarai@cgiar.org
32.	Dr. Dhruba Pant International Water Management Institute, GPO 8975 EPC 416 Kathmandu, Nepal, (e) d.pant@cgiar.org
33.	Dr. M. Samad International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080, (f) +94-1-786854, (e) m.samad@cgiar.org

Sl. No	Name, designation and contact details of participants
34.	Dr. O. P. Singh, Consultant, IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat, (o) +91-2692-229311/12/13 (e) o.singh@cgiar.org
35.	Dr. A Narayanamoorthy Gokhale Institute of Politics and Economics, BMCC Road, Pune 411 004 Maharashtra. (o) 020-5650287 (f) 020-5652579 (e) na_narayana@hotmail.com
36.	Prof. Kameshwar Choudhary Institute of Rural Management, P O. Box 60, Anand 388 001 (o) 02692-260181, 260186, (f) 02692-260188(e) kc@fac.irm.ernet.in
37.	Ms. Shilpa Vasavada AKRSP (I), Swastik Cross Road, Choice premises Navrangpura, Ahmedabad 380 009. (o) 079-6427029, 6427205, 6427729 (e) akrsp@icenet.net
38.	Ms. Sanjoli Batra Block A, Institute of Rural Management, P O. Box 60, Anand 388 001. (o) 02692-260181, 260186 (f) 02692-260188
39.	Ms. Animisha Singh Block A, Institute of Rural Management, P O. Box 60, Anand 388 001. (o) 02692-260181, 260186 (f) 02692-260188
40.	Mr. P Narayana International Water Management Institute, C/o ICRISAT, Pattancheru, Andhra Pradesh, PIN- 502 324 (o) 040-3296161-71, (f) 040-3296182, (e) p.narayana@cgiar.org
41.	Mr. Shilp Verma, Jr. Consultant, IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) s.verma@cgiar.org
42.	Mr. Pradyumna Deshpande C/O Dr Sanjiv Phansalkar Flat number G-2,T-7, Laxminagar Nagpur-440022
43.	Dr. Vishwa Ballabh Institute of Rural Management, P O. Box 60, Anand 388 001 (o) 02692-260181, 260186, (f) 02692-260188, (e) vb@fac.irm.ernet.in
44.	Dr. R Parthasarathy Associate Professor, Gujarat Institute of Development Research, GOTA, Ahmedabad 380 060 (o) 079-7454192-93 (f) 7454191 (e) rpsarthy@hotmail.com
45.	Ms. Sonal Pandya PhD student at SPISER, Ahmedabad #2 Kedar, Professor's Society, Mota Bazaar Vallabh Vidya nagar-388120 (o). 02692 230741 (e) sonalvashist@rediffmail.com

Sl. No	Name, designation and contact details of participants
46.	Dr. Peter Mollinga SaciWaters/Wageningen University 18, Rukmini Devi Colony,Phase 2, West Marred pally, Secunderabad 500 026 (o) + 91 40 7806711 (e) pmollinga@asci.org.in , pmollinga@rediffmail.com
47.	Mr. Manas Satapathy PRADAN,60 Circular Road,K. P. Dutta Compound, Ranchi -834 001. Jharkhand (o) 06528-20164 (e) pradan_khunti@yahoo.co.uk
48.	Dr. K V Raju Professor and Head, Ecological Economics Unit Insitute for Social and Economic Change, Nagarabhavi Bangalore-560072, India (o) 0091-80-3215468, (f) 0091-80-3217008 (r) 0091-80-3214998 (e) kvraju@isec.ac.in , kvr88@hotmail.com
49.	Dr. Somnath Bandyopadhyay Gujarat Ecology Commission,GERI Campus, Race Course Road, Vadodara 390 001 (o) 0265-2336713, 2339115 (f) 0265-2340036 (e) somnathb@satyam.net.in
50.	Dr. Rohit Desai Professor of Economics, Sardar Patel Institute of Economic and Social Research,Thaltej Road, Ahmedabad 380 054 (o) 079- 6581428, 6850598 (f) 079-6851714
51.	Mr. Apoorva Oza Aga Khan Rural Support Programme (I), Swastik Cross Road, Choice premises Navrangpura, Ahmedabad 380 009. (o) 079-6427029, 6427205, 6427729 (f) 079-6870319 (r) 079-6870319 (e) akrspi@icenet.net
52.	Mr. Jayesh Talati, Consultant, IWMI, Elecon, Anand-Sojitra Road,Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) j.talati@cgiar.org
53.	Ms. Archana Londhe Block A, Institute of Rural Management, P O. Box 60,Anand 388 001. (o) 02692-260181, 260186 (f) 02692-260188
54.	Mr. G V Sarat Kumar Block F, Institute of Rural Management, P O. Box 60,Anand 388 001. (o) 02692-260181, 260186
55.	Mrs. Nafisa Barot Executive Trustee, UTTHAN, Development Action Planning Team, 36, Chitrakut Twins, Nehru Park, Vastrapur, Ahmedabad 380 015. (o) 079-6751023, 6732926 (f) 079-6763624 (e) utthan@icenet.bet
56.	Mr. Ujjal Ganguly SRIJAN,4, Community Shopping Ctr., Anupam Apartments, 1 st Floor, Saidullajag,New Delhi 110 068 (o) 011-6566947(f) 011-6868411(e) srijannd@nda.vsnl.net.in

Sl. No	Name, designation and contact details of participants
57.	Dr. Hammond Murray-Rust International Water Management Institute, C/o ICRISAT, Pattancheru, Andhra Pradesh - 502 324 (o) 040-3296161-71 (f) 040-3296182 (e) h.murray-rust@cgiar.org
58.	Mr. K B Trivedi Superintendent Engineer Gujarat Water Resources Dev. Corp. Ltd., Gujarat Water Mgmt. Circle 2,3 rd Floor, Shalimar Chambers, Opp. Sardar Bhavan, Jubilee Baug, Baroda-390 001 (o) 0265-2410570 (f) 0265-2431436
59.	Dr. R Indu Agro-Ecological Research Centre, Vallabh Vidyanagar, T-51, University Staff Colony, 3 rd floor Behind central school,VV Nagar 388120 (r) 02692-248419 (e) r_indu@hotmail.com
60.	Dr. B R Sharma Asst. Director Gen. (IWM),Indian Council of Agriculture Research, Krishi Bhawan, Dr. Rajendra Prasad Rd., New Delhi 110 001, (o) 011-23384537 (f) 011-23387293 (e) brsharma@icar.delhi.nic.in
61.	Dr. G. Bhaskara Rao, In-charge & Senior Programme Officer, SPWD, 303, Leeladhar Enclave, 43, Kalyan Nagar - III Hyderabad - 500018, India, (o) +91-040-3834935 (e) spwd_hyd@satyam.net.in
62.	Mr. Arpan Sharma SAMRAKSHAN, E-314, Anand Lok Housing Society, Mayur Vihar Phase-I, New Delhi-110 091 (o) 011-22796 088 /22751 907 (e) arpan@samrakshan.org
63.	Ms. Harmeet Saini Sadguru Water & Development Foundation, P.B. 71, Dahod-389 151 (o) 02673-238601, 238602 (f) 02673-246749 (e) nmsadguru@yahoo.com
64.	Mr. Rakesh Pandey Sadguru Water & Development Foundation, P.B. 71, Dahod-389 151 (o) 02673-238601, 238602 (f) 02673-246749 (e) nmsadguru@yahoo.com
65.	Mr. Harnath Jagawath Sadguru Water & Development Foundation, P.B. 71, Dahod-389 151 (o) 02673-238601, 238602 (f) 02673-246749 (e) nmsadguru@yahoo.com
66.	Mr. Kanhaiya Choudhary Sadguru Water & Development Foundation, P.B. 71, Dahod-389 151 (o) 02673-238601, 238602 (f) 02673-246749 (e) nmsadguru@yahoo.com
67.	Mr. Hitesh Shah Sadguru Water & Development Foundation, P.B. 71, Dahod-389 151 (o) 02673-238601, 238602 (f) 02673-246749 (e) nmsadguru@yahoo.com

Sl. No	Name, designation and contact details of participants
68.	Mr. Vaibhav Bhamoriya, Jr. Consultant, IWMI, Elecon, Anand-Sojitra Road,Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) v.bhamoriya@cgiar.org
69.	Mr. Sunil Kumar Singh Students Hostel, Institute of Rural Management, P O. Box 60, Anand 388 001. (o) 02692-260181, 260186 (f) 02692-260188
70.	Mr. Praveen Singh Students Hostel, Institute of Rural Management, P O. Box 60, Anand 388 001 (o) 02692-260181, 260186 (f) 02692-260188
71.	Mr. R Seenivasan Program Leader, Dhan Foundation, 18, Pillayarkovil Street, S. S. Colony, Madurai Tamil Nadu 625 010. (o) (0452) 610794/ 805 (f) (0452) 602247 (e) ghan@md3.vsnl.net.in
72.	Dr. Kamal Bhattacharya Technical Advisor-Agriculture & Environment Catholic Relief Services (CRS) 5, Community Centre, Zamrudpur, Kailash Colony Extn., New Delhi-110048 (o) 0091-11-648 7256 - 58 ,(e) kamal@crsindia.org
73.	Mr. Srinivas Mudrakarta Director, VIKSAT, Nehru Foundation for Development, Thaltej Tekra, Ahmedabad. (o) 079-6856220/88007-9 (f) 079-6856220 (e) mail@viksat.org
74.	Dr. G Sastry Principal Scientist and Head, CRIDA, Hyderabad 500 001
75.	Mr. Vilind Parikh Civil Engineering Department, Faculty of Technology & Eng., Kala Bhuvan, MS University, Vadodara (o) 02662-22653, 22089
76.	Mr. Umesh R Chinematapur International Water Management Institute Palanpur. Gujarat (o) 2742-55609
77.	Dr. Sriramappa Oxfam India, Vijaya Shree, 4 th A Main, Near Baptist Hospital (Off. Bellary Road), Hebbal Bangalore 560 024, Karnataka (o) 080-3633274, 3632964, (e) oxfamindia@vsnl.com
78.	Mr. Ved Arya SRIJAN,4, Community Shopping Ctr., Anupam Apartments, 1 st Floor, Saidullajag, New Delhi 110 068 (o) 011-6566947,(f) 011-6868411 (e) srijannd@nda.vsnl.net.in

Sl. No	Name, designation and contact details of participants
79.	Mr. Sudarshan Suryawanshi Consultant, International Development Enterprises, C-5/43, SDA, New Delhi 110 016 (o) 011-6969812/813/6899449 (f) 011-6965313 (e) ide@ideindia.org
80.	Mr. Randhir Chauhan General Manager, Netafim Irrigation India Pvt. Ltd. 1 st Floor, 297, C.S.T Road, Vidyanagari, Kalina, Mumbai 400 098. (o) 022-695 2761 (e) randhir_chauhan@netafim-india.com
81.	Mr. Stanzin Tsephal Students Hostel, Institute of Rural Management, P O. Box 60, Anand 388 001. (o) 02692-260181, 260186 (f) 02692-260188
82.	Mr. Tony Jose Students Hostel, Institute of Rural Management P O. Box 60, Anand 388 001 (o) 02692-260181, 260186 (f) 02692-260188
83.	Ms. Bhawana Upadhyay Associate Expert (Gender) IWMI, Elecon, Anand-Sojitra Road, Vallabh Vidyanagar-388120, Gujarat (o) +91-2692-229311/12/13 (e) b.upadhyay@cgiar.org
84.	Dr. S. Janakrajan, Director, Madras Institute of Development Studies, 79, II Main Road, Gandhinagar, Adyar, Chennai 600 020
85.	Dr. R N Athavale Emeritus Scientist (CSIR) National Geophysical Research Institute, Hyderabad 500007, India., (o). 7170293, 7174433 ext. 2321. (r) 7205008, (e) athavale_rn@satyam.net.in
86.	Ms. Swati Seshadri Manthan Adhyayan Kendra Badwani (Madhya Pradesh) PIN 451 551 (o) 07290-224867
87.	Dr. Dinesh Marothia Prof & Head, Dept of Agricultural and Natural Resource Economics, Indira Gandhi Agricultural University, Krishak Nagar, Raipur 492 012, (e) dkmarothia@yahoo.com
88.	Mr. Johann Grijssen, Team Leader Hydrology Project CSMRS Building, 4th Floor Olof Palme Marg, House Khas New Delhi 110 016
89.	Mr. Ajay Pandey Director, PROGRESS A-71, Mahi Sarowar Nagar, B/h. Ayurvedic Hospital, Housing Board Colony, Banswara, Rajasthan 327 001. (o) 02962-250821 (e) progressbsw@rediffmail.com

Sl. No	Name, designation and contact details of participants
90.	Dr. A S Patel Civil Engineering Department, Faculty of Technology & Eng., Kala Bhuvan, MS University, Vadodara (o) 02662-222653
91.	Mr. N J Shrimali Civil Engineering Department, Faculty of Technology & Eng., Kala Bhuvan, MS University, Vadodara (o) 02662-22653, 22089
92.	Mr. Pradeep Mahapatra CARE India, 27, Hauz Khas Village, New Delhi 110 016.
93.	Ms. Rekha Shenoy CARE India, 27, Hauz Khas Village, New Delhi 110 016.
94.	Dr. Jean-Christophe Marechal Team Co-Leader (France) Indo-French Centre for Groundwater Research, NGRI Uppal, Hyderabad -500007 Andhra Pradesh, India (o) +91 40 27158090 (f) 27171564 (e) marechal@ngri.res.in
95.	Dr. K D Bhatt GSFC Foundation, Vigyan Bhawan PO Fertiliser Nagar, Vadodara 391 750 (o) 2274472, 2274474 (f) 2274685 (e) kdbhatt@siffy.com
96.	Dr. Mats Lannerstad International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080
97.	Dr. Mark Giordano International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080
98.	Mr. Yogesh Bhatt Local Action Coordinator Secretariat of the Dialogue on Water, Food and Environment International Water Management Institute, 127 Sunil Mawatha, Pelawatta, Battaramulla, Sri Lanka, (o)+94-1-787 404, (f) +94-1-786 854, Website: www.iwmi.org/dialogue
99.	Mrs. Dawn Rodriguez International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080 (f) +94-1-786854 (e) d.rodriquez@cgiar.org

Sl. No	Name, designation and contact details of participants
100.	Mr. Regassa Namara International Water Management Institute,127, Sunil Mawatha, Pelawatta, Battaramulla,Colombo, Sri Lanka (o) +94-1-787404, 784080 (f) +94-1-786854 (e) r.namara@cgiar.org
101.	Dr. B N Hiremath Institute of Rural Management, P O. Box 60, Anand 388 001 (o) 02692-260181, 260186 (f) 02692-260188 (e) bnh@fac.irm.ernet.in
102.	Dr. Debiprasad Mishra Institute of Rural Management, P O. Box 60, Anand 388 001 (o) 02692-260181, 260186 (f) 02692-260188
103.	Prof. Prabal Sen Gupta Institute of Rural Management, P O. Box 60,Anand 388 001 (o) 02692-260181, 260186 (f) 02692-260188
104.	Dr. Ganesh Pangare, CEO Indian Network on PIM Central Soil and Material Research Station, Room No. 318 (old building), O/of, Palme Marg, Houz Khas, New Delhi 110 016. (o/f) 011-6569442 (e) gpangare@hotmail.com
105.	Dr. Katar Singh C-3 Shri Krishna Park, Near IRMA gate, Anand 388001 Phone (o) 262074 (r) 261341 (e) katarsingh@indiatimes.com
106.	Ms. Preeta Lal ProgramOfficer Swiss Agency for Development and Cooperation,Embassy of Switzerland, Chandragupta Marg, Chanakyapuri, New Delhi 110021. (o) 011-6877819 / 20 (f) 011-6873631 (e) delhi@sdn.net
107.	Dr. M S Rathore Institute of Developmental studies 8B, Jhalana Institutional Area Jaipur 302 004 (e) idsj@sancharnet.in
108.	Dr. Ravi Chopra Director, Peoples' Science Institute, 252, Vasant Vihar, Phase 1 Dehradun 248006, Uttaranchal. (o) (0135) 763649/773849, (f) (0135) 762140,(e) psiddoon@sancharnet.in
109.	Ms. Nivedita Narain Programme Director, PRADAN 3 Community Shopping Centre, P.O. Box 3827, Niti Bagh,, New Delhi 110 049., (o) 011-6514682, 6518619, (f) 011-6518619 (e) pradhanho@del2.vsnl.net.in
110.	Mr. Shamjibhai Antala Ram Krupa, Nr. Bus Stand, Dhoraji, Dist. Rajkot 360 001 (o) 02824-23150

Sl. No	Name, designation and contact details of participants
111.	Mr. Michael Devlin International Water Management Institute, 127, Sunil Mawatha, Pelawatta, Battaramulla, Colombo, Sri Lanka (o) +94-1-787404, 784080 (f) +94-1-786854 (e) m.devlin@cgiar.org
112.	Dr Sourindra Bhattacharya Indian Grameen services, 403, Nirmal Towers Dwarkapuri Colony, Panjagutta, , Hyderabad 500 082 (o) 040 335 0170 (f) 040 335 8846 (e) basix@hdl.vsnl.net.in , sourindra@basixindia.com
113.	Mr. N Venkatesan Dhan Foundation, 18, Pillayarkovil Street, S. S. Colony, Madurai Tamil Nadu 625 010. (o) (0452) 610794/ 805 (f) (0452) 602247 (e) ghan@md3.vsnl.net.in
114.	Mr. Pradyot Mukherji Sir Ratan Tata Trust, Bombay House, Homi Modi Street, Mumbai 400 001 (o) 022-5665 8282 (f) 022 5665 8013 (e) srtt@tata.com
115.	Mr. Sachin Oza Development Support Centre, 2, Prakruti Apartments, Opp. Red Rose Restaurant, HL Commerce College Road, Navrangpura, Ahmedabad (o) 079-6305285, 6306144, (f) 079-6303296 (r) 079-6469618, (e) dsc@satyam.net.in
116.	Mr. D Ramachandra SRIJAN, 4, Community Shopping Ctr, Anupam Apartments, 1 st Floor, Saidullajag, New Delhi 110 068, (o) 011-6566947, (f) 011-6868411, (e) srijannd@nda.vsnl.net.in
117.	Mr. M S Vahora Aga Khan Rural Support Programme (I), Swastik Cross Road, Choice premises Navrangpura, Ahmedabad 380 009. (o) 079-6427029, 6427205, 6427729 (f) 079-6870319 (r) 079-6870319 (e) akrspi@icenet.net
118.	Ms. Alka Rawal Aga Khan Rural Support Programme (I), Swastik Cross Road, Choice premises Navrangpura, Ahmedabad 380 009. (o) 079-6427029, 6427205, 6427729 (f) 079-6870319 (r) 079-6870319 (e) akrspi@icenet.net
119.	Mr. Srinivas Chokkakula Environmental Planning Collaborative, Paritosh, Usmanpura, Ahmedabad 380 013 (o) 7550102 (e) epcamd@wilnetonline.net
120.	Mr. Digant Oza Jalseva Satyaheet Trust B-1, Neeldeep Appt. Opp. Sandesh Press Laad Society Road, Vastrapur, Ahmedabad 380 015 (o) 6851230 (e) satyajeet1@icenet.net

Sl. No	Name, designation and contact details of participants
121.	Mr. Kulranjan Kujur Chief Executive, Seva Mandir, Old Fatehpura Udaipur-313004 (o) 0294-450960, 451041 (f) 450947 (e) smandir@vsnl.com
122.	Shri L M Tiwari Indian Grameen services 403, Nirmal Towers Dwarkapuri Colony, Panjagutta, Hyderabad 500 082 (o) 040 335 0170 (f) 040 335 8846 (e) basix@hd1.vsnl.net.in
123.	Dr. M K Khandelwal Joint Director, Central Soil Salinity Research Institute, Regional Research Station, Post Box-87, Faculty Block, Walmi Campus, Anand 388 001. (o)61603, 61644 (f) 61603 (e) M_K_Khandelwal@indiatimes.com
124.	Mr. Anjal Prakash H-65, Sachin Towers, Near Shyamal Row House III, Satellite, Ahmedabad - 380 015 Gujarat, India, (r) +91 79 6733 129 (m), 98254 30485, (e) anjal@egujarat.net
125.	Mr. Mansoor Khorasi C/O Dr Sanjiv Phansalkar Flat number G-2,T-7, Laxminagar Nagpur-440022
126.	Mr. Vivek Kher C/O Dr Sanjiv Phansalkar Flat number G-2,T-7, Laxminagar Nagpur-440022
127.	Mr. Manoj T Thomas FPRM Student Institute of Rural Management, Anand
128.	Mr. R K Sahu SHRISTI, B 205, Krishna Towers, Nayapalli, Bhubaneswar, Orissa (e) shristi4@rediffmail.com
129.	Mr. J K Natu, SWAJAL, Uttaranchal
130.	Mr. M M Kapadia, North Gujarat Initiative, Field staff, IWMI Palanpur, Gujarat (o) 2742-55609
131.	Mr. Viren Lobo SPWD, 7, Shiv Complex Badgaon, Udaipur 313 011
132.	Mr. Premjibhai Vriksha Prem, Upleta
133.	Mr. Sudhakar Mishra Institute of Rural Mangement, Anand (o) 260181, 260186(f) 260188
134.	Mr. Mukesh Desai Netafim Irrigation India Pvt. Ltd. 1 st Floor, 297, C.S.T Road, Vidyanagari, Kalina, Mumbai 400 098. (o) 022-695 2761, (e) randhir_chauhan@netafim-india.com

IWMI-Tata Water Policy Program

The IWMI-Tata Water Policy Program was launched in 2000 with the support of Sir Ratan Tata Trust, Mumbai. The program presents new perspectives and practical solutions derived from the wealth of research done in India on water resource management. Its objective is to help policy makers at the central, state and local levels address their water challenges – in areas such as sustainable groundwater management, water scarcity, and rural poverty – by translating research findings into practical policy recommendations.

Through this program, IWMI collaborates with a range of partners across India to identify, analyse and document relevant water-management approaches and current practices. These practices are assessed and synthesised for maximum policy impact in various IWMI-Tata Research Outputs.

The policy program's website promotes the exchange of knowledge on water-resources management, within the research community and between researchers and policy makers in India.

IWMI-Tata WATER POLICY PROGRAM

Elecon, Anand-Sojitra Road
Vallabh Vidyanagar, 388120, Gujarat, India
Telephone: 91-2692-229311-12-13
Fax : 91-2692-229310
E-mail: iwmi-tata@cgiar.org
Website: <http://www.iwmi.org/iwmi-tata>



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HARVEST
IWMI is a Futures Harvest Center
Supported by the CGIAR

HEADQUARTERS

127 Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka
Mailing Address : P. O. Box 2075, Colombo, Sri Lanka
Telephone : +94 1 787404, 784080 ; Fax : +94 1 786854
E mail : iwmi@cgiar.org

REGIONAL OFFICE FOR ASIA

(Bangladesh, China, Nepal and Sri Lanka)
127 Sunil Mawatha, Pelawatte, Battaramulla, Sri Lanka
Mailing Address : P. O. Box 2075, Colombo, Sri Lanka
Telephone : +94 1 787404, 784080, 1 ; Fax : +94 1 786854
E mail : iwmi-asia@cgiar.org

CHINA

Center for Chinese Agricultural Policy,
Chinese Academy of Sciences
Building 917, Datun Road, Anwai, Beijing, 100 101, China
Telephone : +86 -10 64889440, 64856535, 64856837
Fax : +86 -10 64856533
E mail : j.wang@cgiar.org

NEPAL

GPO 8975 EPC 416, Kathmandu, Nepal
Telephone : +977-1 535382 (Ext. 486)
Mobile Tel : 9810 - 22573 ; Fax : +977-1 523996
E Mail : d.pant@cgiar.org

REGIONAL OFFICE FOR AFRICA

141, Cresswell Street, 0184 Silverton, Pretoria, South Africa
Mailing Address: Private Bag X813, Silverton 0127, South Africa
Telephone : +27-12 - 845 9100 ; Fax : +27-12 - 845 -9110
E Mail : iwmi-africa@cgiar.org

KENYA

C/o. ICRAF, United Nations Avenue, P. O. Box 30677, Nairobi, Kenya
Telephone : +254 - 2 - 524751, 524000 ; Fax : + 254 -2 - 524001
E Mail : f.gichuki@cgiar.org

GHANA

IWMI Ghana, CSIR campus, Odeh Block,
Airport Res. Area, Accra
IWMI Ghana, PMB CT 112, Cantoments, Accra, Ghana
Telephone : +233-(0) 21-784752/53/54 ; Fax : +233-(0) 21-784752
E mail : iwmi-ghana@cgiar.org

REGIONAL OFFICE FOR INDIA

C/o. ICRISAT, Patancheru, AP 502 324, India
Telephone : +91-40 -329-6161 ; Fax : +91-40 - 324-1239
E mail : iwmi-india@cgiar.org

REGIONAL OFFICE FOR PAKISTAN, CENTRAL ASIA AND MIDDLE EAST

12KM Multan Road, Chowk Thokar Niaz Baig,
Lahore 53700, Pakistan
Telephone : +92 - 42 - 5410050-53(4 lines) ; Fax : +92-42-5410054
E mail : iwmi-pak@cgiar.org

UZBEKISTAN

Apartment NO.103, Home No.6, Murtazaeva Street,
Tashkent 700000, Uzbekistan
Telephone : +998 - 71-1370445 ; Fax : +998 -71-1370317
E mail : v.hornikova@cgiar.org

REGIONAL OFFICE FOR SOUTHEAST ASIA

(Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Thailand, Vietnam)
P. O. Box 1025, Kasetsart University Jatujak,
Bangkok 10903, Thailand
Telephone : +66 2 561- 4433 ; Fax : +66 2 561-1230
E mail : iwmi-sea@cgiar.org