PROCEEDING OF THE NATIONAL CONFERENCE

ON

MANAGING IRRIGATION FOR ENVIRONMENTALLY SUSTAINABLE AGRICULTURE IN PAKISTAN

Islamabad, November 5-7, 1996

VOLUME I

INAUGURATION AND DELIBERATIONS

Edited by

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Organized by
IIMI-Pakistan in collaboration with its National Partners

TABLE OF CONTENTS

ACRONYMS

CEWRE	Center of Excellence in Water Resources Engineering
CRBIP	Chashma Right Bank Irrigation Project
CIMMYT	Centro Internaciorrai De Majoramiento De Maiz Y Trigo
CGIAR	Consultative Group on International Agricultural Research
FGW	Fresh Ground Water
FO	Farmers Organization
FESS	Fordwah Eastern Sadiqia South (Project)
GOP	Government of Pakistan
IIMI	International Irrigation Management Institute
IRRC	International Agricultural Research Center
IRRI	International Rice Research Institute
ISNAR	International Service for National Agricultural Research
IFPRI	International Food Policy Research Institute
IWASRI	International Waterlogging and Salinity Research Institute
ISRIP	International Sedimentation Research Institute, Pakistan
LBOD	Left Bank Outfall Drain
LIM	Lower Indus Water Management.and Reclamation Experimental Project
Maf	Million Acre Feet
MREP	Mona Reclamation Experimental Project
NGO	Non-Governmental Organization
NRAP	Netherlands Research Assistance Project
O&M	Operation and Mainatenance
OFWM	On-Farm Water Management
PID	Provincial Irrigation Department
PIDA	Provincial Irrigation and Drainage Authority
PIPD	Provincial Irrigation and Power Department
PARC	Pakistan Agricultural Research Council
ROBD	Right Bank Outfall Drain
SCARP	Salinity Control and Reclamation Project
SGW	Saline Ground Water
SSOP	Soil Survey of Pakistan
TAC	Technical Advisory Committee (of the CGIAR)
USAID	United States Agency for International Development
WAPDA	Water and Power Development Authority
WUA	Water Users Association
WUO	Water Users Organization
WRRI	Water Resources Research Institute

FOREWORD

With the limited prospects for further expanding the irrigated lands, which are the mainstay of the agricultural economy, Pakistan is faced with the crucial problem of increasing and sustaining the agricultural productivity of the available land and water resources,

There is ample evidence to indicate that there is considerable scope to increase the agricultural productivity from the water resources that have been developed and of the lands on which they are applied. The means that can be employed to capture this potential, from an economic, social and technological standpoint within an overall policy framework have, however, to be clearly established.

At a time when the country has embarked on the formulation of its Ninth Five Year Plan (1998-2003), it was most opportune that IIMI Pakistan decided to hold this National Conference on Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan. The Federal Ministry of Food, Agriculture and Livestock welcomed this initiative and actively collaborated with IIMI Pakistan to make the Conference a success.

Based on IIMI-Pakistan past research work, in collaboration with its national partners, valuable papers were presented at the Conference which highlighted the issues confronting irrigated agriculture in Pakistan and pointed to the options that could be adopted. I was greatly heartened by the active participation of knowledgeable persons from the concerned quarters and by their contributions for achieving the Conference objectives. I am sure that the outcome of the Conference will be a great help to the policy makers in the country for introducing the most feasible options for increasing agricultural productivity.

The knowledge generated will be carefully utilized if and only if perceptive leadership is able to understand the implications of its application. Between ideas and their applications there is a considerable amount of thoughtful insights to be consistently developed Sometimes chance information triggers new ideas and ways to implement. Each conduit for a thought process is different. The conscience of leadership thereby comes into effect. This conscience has nothing to do with censorship and constraints, but is of a positive nature and propels leaders into action. The routine and the ordinary fall by the way. The danger, alas, is that this untraversed route is full of difficulties. The removal of obstacles is yet another art which will have to be understood and applied.

I would particularly like to express my gratitude to the Government of the Netherlands for its continuing generous support to IIMI-Pakistan for its research activities and for the supporting role of the Government of France with the international collaboration through CEMAGREF, which greatly contributed to the success of the National Conference.

In the end, I would like to congratulate IIMI and IIMI Pakistan for the most effective conduct of this Conference.

November 1996
Islamabad

Zafar Altaf, Secretary Incharge
Ministry of Food, Agriculture and Livestock

PREFACE

INTRODUCTION

IIMI-Pakistan, the largest Branch Unit of the International Irrigation Management Institute (IIMI), has been carrying out, in collaboration with its national partners, a major program of research on issues related to irrigation management in Pakistan from 1986 when it was created under a Memorandum of Agreement between IIMI and the Government of Pakistan.

This research program has been carried out largely under research projects sponsored by the Aid-giving agencies active in Pakistan and has been supported by the IIMI Headquarters for the components which contribute *to* generic research in the Themes selected by IIMI for its world-wide research activities in developing countries.

The thrust of IIMI's research and the mode of its conduct has been dictated by its Mission which in the earlier years was taken to be: "to strengthen national efforts to improve and sustain the performance of irrigation systems in developing countries through the development and dissemination of management innovations".

IIMI-Pakistan's research program started out with research activities in selected irrigation systems of Pakistan by investigating the management of the irrigation waters both surface and sub-surface, to identify the effect of physical and social factors on the efficiency of water use. In this work, consideration was also given to the impact of irrigation on the environment. These activities highlighted the need for action research on Decision Support Systems which could bring about a greater reliability and equity in the distribution of the canal water supplies. For the newly constructed or modernized irrigation systems, IIMI Pakistan also took up applied research to identify and apply management approaches that respond to crop water requirements and to improving the understanding of crop-based irrigation operations by agency personnel and farmers.

From 1988, IIMI-Pakistan, started work on a major 5-year research project, funded by The Netherlands Government under its bilateral Assistance to Pakistan entitled "Managing Irrigation Systems to Minimize Waterlogging and Salinity Problems". Recognizing that waterlogging and salinity were critical problems in the irrigated agriculture of Pakistan, the project aimed to develop and implement, through action research, a set of improved management strategies which could reduce the aggravating effects of these problems.

In recent years, the IIMI-Pakistan research program, has been greatly strengthened by Phase II of the Netherlands-funded Project entitled "Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan (1994-98) and by the research

activities that are related to IIMI's primary themes of research. The focus of these research activities now derives from IIMI's Mission which has been recently re-stated as:

> "to create sustainable increases in the productivity of irrigated agriculture within the overall context of water basins and an analysis of the water systems as a whole".

So far, the IIMI-Pakistan research program has covered many areas: management of canal systems including water allocation and distribution; water use below the 'mogha' (including conjunctive use); irrigation practices and their impact on agricultural production; groundwater quality and its effect on soils and crops; aquifer management as related to groundwater quality; and institutional aspects related to participatory irrigation management.

Through its collaborative research program with its national partners, IIMI-Pakistan has acquired considerable insights into some of the important issues in irrigated agriculture which impact on agricultural productivity and its sustainability in Pakistan. IIMI-Pakistan, therefore, felt that the knowledge it had acquired and that had been gained by its national collaborators, should be put to practical use by first convening a National Conference to evolve the most appropriate strategies.

CONFERENCE BACKGROUND

As stated in the introduction, IIMI-Pakistan has been working on Phase II of the Netherlands-funded research project since 1994. This project with three components (Operational Management, Institutional Development and Salinity Management) aims to further the originally stated objectives of developing and implementing a set of improved management strategies and techniques which can reduce the aggravating effects of irrigation on waterlogging and salinity. In addition, it emphasizes the objectives of expanding the institutional capacity to effectively manage the solutions, and maximizing the role of farmers and rural communities in irrigation management for increasing agricultural production.

Under this project, it was proposed to hold a National Conference in 1996 on Sustainable Irrigated Agriculture in Pakistan to present tentative results of project activities and to discuss future activities required to achieve sustainability.

Also, it was decided to use this occasion to serve wider national interests by organizing a National Conference on Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan, at which the important issues affecting the irrigated agriculture of Pakistan could be considered. Then, after due deliberation, feasible options and recommendations could be developed for adoption to improve the performance of this vital sector.

CONFERENCE OBJECTIVES

For organizing the National Conference, a note was taken regarding the existing status of irrigation development in Pakistan and its environmental impacts, as well as the prospects for future development, and it was realized that with limited water resources to expand the irrigated areas, and in a situation characterized with low crop yields, the sustained productivity of water for agriculture had assumed a critical importance. This view had also been reiterated by the National Commission on Agriculture several years back when it highlighted the need for realizing future increases in agricultural productivity "mainly from vertical expansion, effectively overriding the limitations on area expansion imposed by limited irrigation supplies" (1988).

Accordingly, for the National Conference, the objective was set as:

> *To* create a national awareness about the issues constraining the realization of the agriculture potential in the irrigated areas and *to* identify the ways and means for developing an environmentally sustainable agriculture.

CONFERENCE ORGANIZATION

Considering the overriding need to give attention to the institutional aspects impacting on the management on the vast irrigation systems in Pakistan, it was decided to focus attention at the National Conference on four themes:

Theme 1. Managing Canal Operations;

Theme 2. Water Management Below the Mogha;

Theme 3. Environmental Management of Irrigated Lands; and

Theme 4. Institutional Development

The subject matter coverage under each of these Themes is detailed below:

Theme 1. Managing Canal Operations: This was to cover the main system operation and its impact at the lower levels (secondary and tertiary) including water allocation and distribution.

Theme 2. Water Management Below the Mogha: This topic was intended to cover "the business end" of the irrigation systems because it is at this level that the management of the canal supplies (in conjunction with ground water supplies) impacts on agricultural production.

Theme 3. Environmental Management of Irrigated Lands: This is focused on the soil salinity problems in the irrigated areas brought about due to high water tables or induced by the use of hazardous ground water (secondary salinization).

Theme 4. Institutional Development: This Theme was included in view of the serious consideration which is being given by the Government to restructure the management of the irrigation systems and to the introduction of participatory irrigation management involving the water users (farmers) and irrigation agencies.

To give a direction to the deliberations of the National Conference, it was decided that the consideration of each theme should be preceded by an overview of the issues in the form of a paper produced by IIMI Researchers with its National Partners where appropriate. This was to be followed by papers, by IIMI-Pakistan and National Partners, to bring out the research findings and suggesting likely measures that could be taken to deal with specific issues.

Following the discussions on the Themes, by knowledgeable participants, it was expected that the options to deal with the issues would be synthesized and a set of recommendations developed which could be presented in a subsequent Policy Deliberation, to a small group of decision makers for adoption and implementation.

With this in view, a draft Information Bulletin on the National Conference was developed, which was sent to all members of the Consultative Committee of IIMI-Pakistan and to close collaborators, to elicit their views for making the Conference as effective as possible. Taking into consideration the various suggestions, the format of the National Conference was finalized and a Bulletin giving its particulars was sent to all the Federal and Provincial Agencies, Research Organizations and other Institutes and Bodies connected with irrigated agriculture in Pakistan to nominate their representatives to participate. Resource persons were also identified for participation.

While IIMI-Pakistan took the lead in preparing the papers based on its research, consideration was also given to the association of resource persons from amongst its national partners to develop papers independently, or jointly, with IIMI-Pak research staff.

CONDUCT OF THE CONFERENCE

The National Conference was held over three days at the Holiday Inn, Islamabad, November 5-7, 1996. The Conference was due for inauguration by the Federal Minister of Food, Agriculture and Livestock, Nawab Muhammad Yousaf Talpur, but due to some exigencies, he could not make it. In his place, Dr. Amir Muhammad, former Secretary, Ministry of Food and Agriculture, and Chairman, Pakistan Agricultural Research Council,

who had been closely associated with the CGIAR and IIMI during its formative years, was the chief guest and delivered the inaugural address. The address of the Minister was also read.

The Program of the National Conference, as it was followed, is given in Annex-I

The Conference was very widely attended. From the Federal Government the Ministries of Food, Agriculture & Livestock and Water and Power were represented along with the Planning Division, and the Federal agencies of Water and Power Development Authority (WAPDA) and Soil Survey **of** Pakistan. The Irrigation and Agriculture Departments of all the four Provinces participated. A large contingent of researchers, from the national research councils and institutes joined the Conference, as also the representatives from the Universities and Consultants. IIMI Pakistan's research staff took an active role. The list of the participants is given in Annexure 2.

CONFERENCE PROCEEDINGS

The National Conference Proceedings have been produced in five volumes. Volume 1 covers the Inauguration and Deliberations, whereas Volumes II to V bring together, in each volume, the papers on the four themes covered at the Conference.

The Inauguration and Deliberations has been presented in three sections. Section I covers the Inauguration, while Section II deals with Issues and Deliberations for each of the four themes, and Section III presents a synthesis of the conference outcome (recommendations).

In Section II, each of the four themes is preceded with an 'Issues Papers' followed a Summary of Panel Deliberations for each theme. In presenting these deliberations, an effort has been made to highlight the issues relating to the different themes as they were perceived and to bring out the salient points that were made for dealing with them, along with the recommendations which were considered most appropriate. It is hoped that this form of presentation, in place of the reporting of the diverse viewpoints, would help to focus attention on the salient points.

November 1996
Lahore

Muhammad Badruddin, Senior Executive
Pakistan National Program
International Irrigation Management Institute

ACKNOWLEDGEMENTS

There is no way that everyone involved with this National Conference can be acknowledged. However, those individuals who played a major role need to be recognized.

Mr. Muhammad Badruddin, Senior Executive and Mr. Muhammad Akram Khan, Executive Secretary were responsible for all logistical arrangements. They were assisted by the Administrative Management Committee and other support staff.

The technical program resulted from a series of meetings from April to June of 1996 involving both national and international research staff. During this period, a number of our National Partners were consulted. Then, Mr. Badruddin and Dr. M.S. Shafique took the responsibility for ensuring that all of the papers would be ready for presentation on time.

Throughout this time period, Dr. Zafar Altaf, who is also a member of the IIMI Board of Governors and will be the Board Chairman during 1997, was periodically consulted. He was always supportive and assited in many ways.

Finally, the most important role was played by our National Partners. They advised, actively participated, and contributed much to the issues, options and recommendations.

The financial support for this conference was provided by the Government of The Netherlands and IIMI Headquarters, for which we are very grateful.

Gaylord V. Skogerboe, Director
Pakistan National Program
International Irrigation Management Institute

NATIONAL CONFERENCE ON MANAGING IRRIGATION FOR ENVIRONMENTALLY SUSTAINABLE AGRICULTURE IN PAKISTAN NOVEMBER 5-7, 1996

SECTION I

INAUGURATION

WELCOME ADDRESS

by

Gaylord V. Skogerboe'

On behalf 'of the Pakistan National Program of the International Irrigation Management Institute (IIMI), I welcome all *of* you to this Conference organized by IIMI with its National Partners. We had hoped that the Honorable Minister of Food, Agriculture and Livestock, Mr. Nawab Muhammad Yousuf Talpur, would grace this occasion but events have prevented his presence here. Instead, I am happy to welcome Dr. Amir Muhammad a former member of the IIMI Board of Governors as a special guest for this inauguration.

Also, I would like to express my deepest gratitude to the Federal Secretary in-charge of Agriculture, Dr. Zafar Altaf, for his continued guidance to our efforts. Not only is he the Chairman of the Consultative Committee for IIMI-Pakistan, but he is the Chairman-elect of the IIMI Board of Governors.

On 28 September 1996, IIMI-Pakistan celebrated its Tenth Anniversary. Dr. Amir Muhammad will always be a special person to us because of his crucial role in bringing this organization into existence, and assisting with the development of our program.

Our program is a tripartite set of relationships with National Partners and International Collaborators. IIMI-Pakistan does only a modest amount of research by itself. Instead, we focus on working with National Partners and design our research activities to work together. To all of you who are present today I give my heartfelt thanks for your presence.

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[1] Director, Pakistan National Program, International Irrigation Management Institute

Our greatest supporter are the Dutch. In so may ways, they have contributed much in our efforts to develop as a research organization. To the representative of the Royal Netherlands Embassy, Mr. Wim van der Kevie, I would like to say that both the national staff and international staff of IIMI-Pakistan are extremely grateful for what your country has done for us.

In the overall global program of IIMI, I consider the collaboration with CEMAGREF, the French National Research Organization for Agriculture, Water and Forests, as the role model for international collaboration. This has become a highly productive relationship. I would like the French Ambassador to Pakistan His, excellency Mr. Lafrance, to know how much we appreciate the French Embassy for their support in this collaboration.

This Conference has been organized around four themes:

1. Managing Canal Operations;

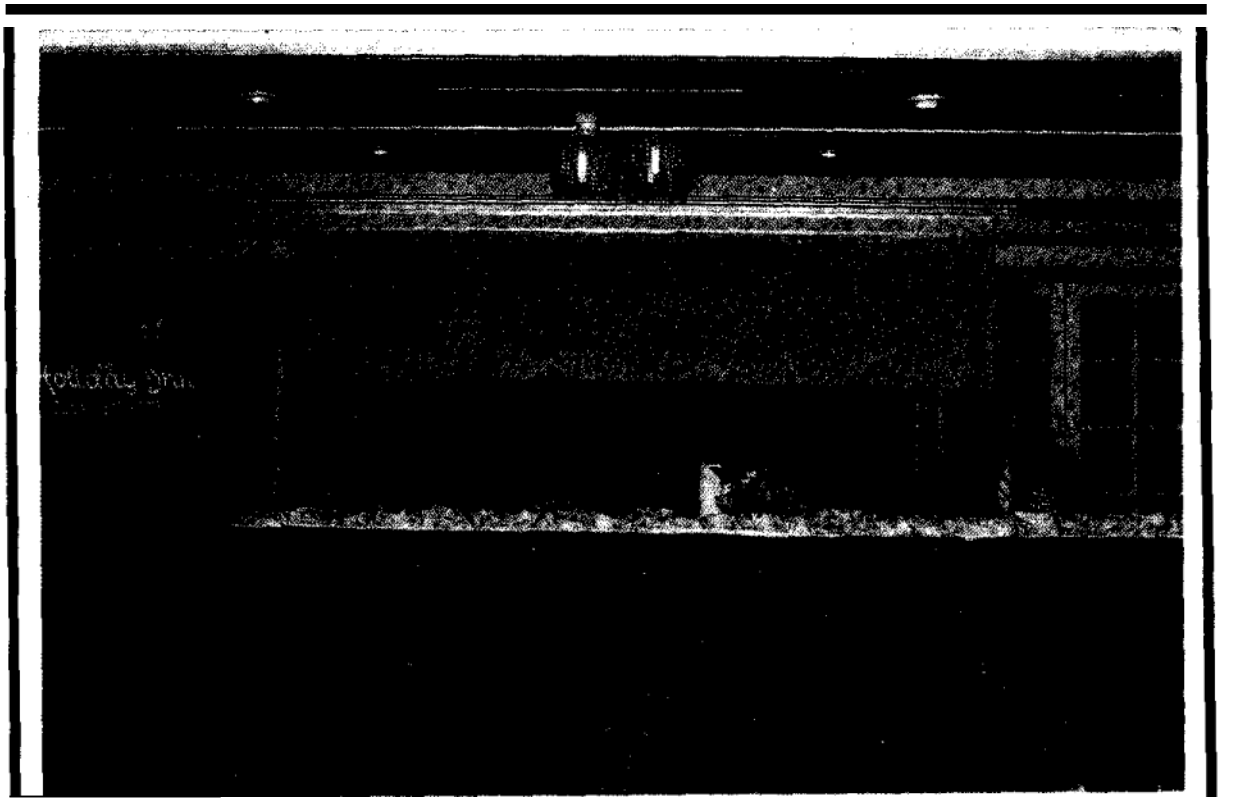
2. Water Management Below the Mogha;

3. Environmental Management of Irrigated Lands; and

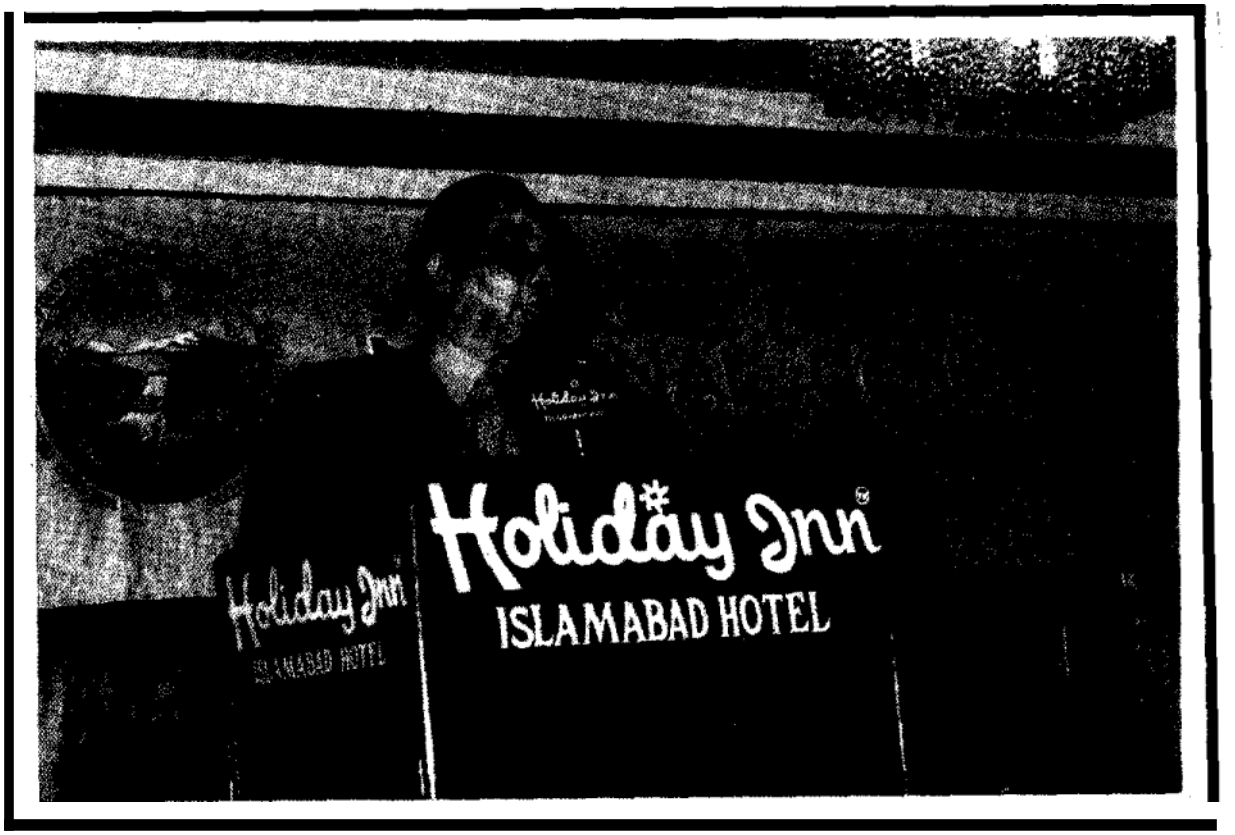
4. Institutional Development.

For each theme, an Issues Paper has been prepared and distributed. There is a Panel Discussion that concludes the session for each theme, which will emphasize options and recommendations. The Rapporteur for each theme will be assisted by others in preparing a report for the Panel Discussion.

On the third day, beginning at noon, each Rapporteur will present a 15-minute summary of their report. After lunch, we will began an open-floor session on Synthesis of Options and Recommendations in which we will look across all of the themes in order to develop broader approaches towards Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan.



OPENING OF THE CONFERENCE
(L to R: Mr. M. Badruddin, Dr. Zafar Altaf, Dr. Amir Muhammad (Chief Guest) and Prof. Gaylord V. Skogerboe)



INTRODUCTORY ADDRESS
(Dr. Zafar Altaf, Additional Secretary Incharge, Ministry of Food, Agriculture and Livestock)

INTRODUCTORY ADDRESS

by

Dr. Zafar Altaf [2]

Bismillah-hir-Rahman Nirrahim,

Dr. Amir Muhammad, Prof. Skog, gentlemen, ladies and friends. Words about IIMI. IIMI has come a long way since it was founded and since it was initiated by Dr. Amir Muhammad. But, it is those first few steps which are important. It may not have been that IIMI may never have come to pass, if Dr. Amir Muhammad had not been elected by the Asia Pacific Group. But he did play a crucial role.

As it happened, I revitalized my links with the CGIAR last week. Since they do not have a tie network, I call it the old boys network. I still found people there who had been going there for 30 years, 20 years and 25 years. I was the youngest of all those who were present there.

I am looking at my crib chart and wonder whether it is a sheer coincidence or not, but the headline on the crib chart says, "status of camel production in research in Pakistan". I am just wondering, whether Pakistan's irrigation system has one hump or two humps like the camel has. I say this because I have been worried a lot about the irrigation system in Pakistan.

I would like to start from a quote by Einstein that is relevant to the present times, it is relevant to the political economy, and it is relevant Io the irrigation departments. "A great spirit" he says, "has always encountered violent opposition from mediocre minds".

I would like to put it to you today that we have been involved in the irrigation system on the concept of rock logic, rather than **of** the concept of the logic of water. It is this logic of water, which is flexible. It is hard rock logic which is never flexible, which breaks in the end, encouraging events that have proven harmful to the system and proven the need for a different logic. Because the compulsion of water logic is really the compulsion of interaction, the compulsion of moving in directions which are smooth, finding a way of its own, without any violent interactions.

The Indus Basin Irrigation System has been messed up from being a water surplus source to ever increasing deficiencies. The Indus Food Machine is creeking, because of its inefficient use, because of the inequalities that are there. What have we done to this critically important resource ? Yet, if you look at the past, the past was

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[2] **Additional Secretary Incharge. Ministry** of **Food, Agriculture and Livestock**

more equitable. So, does the future lie in the past ? If the future lies in the past, docs it lie in the same institutional framework ? Or ladies and gentlemen, should there be a tremendous change in the system -- in the institutional system that is there ?

We looked at science, we looked a technology. We know that the scientists are loyal and have a strong allegiance to their science. But pure allegiance to science is not going to help us. It is not going to help us because this nation demands a higher level of responsibility from its scientists, from its agencies that are working here, so that allegiance and the work that has been done on the institutional framework can be taken to the people for their benefit.

I am talking like this with certain hard facts at my disposal. I am going to say to you that because of the inequitable distribution of water, IIMI has already documented secondary salinization in Sheikhupura District. IIMI has also shown waterlogging and salinity in other areas because of misuse of water and its inequitable distribution. What IIMI has also shown is beyond the use of water. IIMI has also shown that the tail farmer in wheat productivity takes 0.8 tons per hectare as against 5 tons per hectare that the head farmer takes. Now this is a difference of over six times. You have done us much wrong. You have pained us much as irrigation engineers and irrigation managers. Because one has to look at the practical outcomes of life. The losses that have been perpetuated, eventually led to income destruction for the farmers and in a food security debacle for the Country.

Not only the micro, but also the macro, economic framework suffers in the process. Yet, these contradictions and perceptions have to be removed. How do you remove these perceptions and contradictions. Let me tell you that it is not necessary to hold an opposing view. Being in conflict with another individual, you can hold an alternate view and yet be parallel with the views of other people. You may never win in your views; others may not accept it, but there is a change in their perception. You can be moved away from controversies, from contradictions, from posing fights to moving parallel in the same direction, maybe like the river at the delta, you might meet at some point in time.

I have been talking to irrigation people in WAPDA and I did give a keynote address at one occasion and the heading I gave, was "Drawing Water from a Dry Well". Specializations are the outcomes of the industrial revolution in which professionalism was linked with the industrial revolution, the individuals were linked to the values of specialization and I repeat "values of specialization". They were responsible to the degree that they were competent, that the individual was competent. It was not to maintain an ego trip. A specialization was not an ego trip. It was not three symbols next to his work, next to his name. It meant that each individual had to respond to his own effort, his own ability and he was responsible for that ability; in short, he built an empire of responsibility. Others would then join in this empire of meritocracy and responsibility by being equally merit oriented and responsible oriented.

I think It was one of Tito's compatriots who said something very worthwhile in my opinion. I would like to share this with you. The name of the author is too difficult for me to pronounce, but he said " there are three kinds of individuals in a nation". "You have a rare leader and in that you can put Tito". "Then", he said, "you have obviously failed ideologists and there were some people in that category". Then, "the third category", he said, "would be opportunistic or narrowly motivated men who like to dominate and they are in the majority". It is a worldwide phenomena. It is a phenomena which has developed over many years that you have these opportunistic or narrowly motivated men who dominate and who use the system to their own ends.

In Pakistan, in the irrigation system, you are looking at the agrarian systems of Pakistan. There, seven percent of the farmers are using and dominating the irrigation system to their own benefits. Equity and justice, ladies and gentlemen, is a substance having a lot of forms. These figures are hidden, the equity figures are hidden. There are, and Prof. Skog knows that !here are, minors and distributaries in which neither is there adequate water nor is there timeliness of water. I can tell you from a monitoring and evaluation system that the Japanese have developed and started at Faisalabad, that the shortage of water in five distributaries varied from 60 to 90%, whereas in one favoured distributary it was receiving 108% of the crop water requirements.

You then make your own assessment of what we are guilty of. We are not guilty of not having this water. We are guilty of not being able to distribute judicially and equitably what we have in our country. Because that could only occur in a society based on trust, and this trust has a complex moral code. It is not in your irrigation manual. It is not anything that IIMI will give you. These moral codes come to you from inside yourself. Nobody can teach you. The teaching starts from the psyche, from the very early substance of ones life.

Then, you can look at equally split outcomes. For instance, you could say that the tail would be given water before the head farmers will be given water. Also, you can equally split the water. You can have an equality of pain and gain. Human demands this from each one of us. To determine that each ones pain and each ones gain is based on equity and justice. We have tremendous evidence on these stories, where we have created a much larger amount of pain and a much lesser amount of gain.

We have looked after special interests. We have looked after interests that can connect themselves with me, with Skog, with Dr. Amir Muhammad, with everyone of us. We are unaware of ever having in our offices a person who is poorly dressed, who has done poorly in life. So, I put to you the legitimacy of equity and justice and it means that this legitimacy can only be developed if you have level playing fields. What is the basis for the level playing. Ladies and gentlemen, if a decision can be taken at the lowest level, why take it at the highest level? I was once incharge in the Ministry for trying to determine where two million acre-feet of water had vanished in the system. This water vanished in the system because powerful groups had taken over that water. I can only

hypothesize where it had gone. I could not locate it because water under the bridge, and water down the canal, cannot be recovered.

The inequitable stories are there to justly portray what has happened in this country. So, then in order to give a just solution, do you suggest that we fight inequality with inequality ? Do you think that those who were gainers in the past should be losers in the future ? What is righteousness of a position. What is the righteousness of depriving some people of 80 percent of their yields, which could have been their due, but which was not their due because some people thought it wiser and better to help themselves to my water.

Skog has talked about institutional changes. Would you like institutional changes which are cosmetic. Would you like the Irrigation Departments to go to PIDAs, the Provincial Irrigation and Drainage Authorities, with the same individuals going there, with the same culture going there, and what change would that bring about. Even this was something which happened in the past because of a gentleman called Dr. Kijne, who managed to get all of the Chief Engineers to agree that they wanted to change and improve the irrigation facilities. We had to go to a higher position in life and we went to the Murree hills. We were nearer to God, I suppose, so that the Chief Engineers would agree with us.

But today, as I stand before you, I talk of the vulnerability of power. Power is a very vulnerable thing. Power without reason is even more ridiculous. If you have reasonable powers, then your vulnerability is less. Ladies and gentlemen, society is based on unveiled self-interest, they create their own menaces, their own malice, and they die in their own bed. Because the strong must tumble down and in the dust we are made equal. We will be made equal in the dust.

We do not look out. But I also warn you, and I very rarely warn people, that equality is eternal. This eternal equality has its own nature and it is indestructible and it is like the second law of thermodynamics where energy can neither be created nor destroyed. It will march into the future just as those people who looked at Tarbela Dam and tried to control hydraulic power. They found that if they control one side of it, they lost something on the other side, till some wise person told them that a paradoxical situation of this kind needed to be balanced. Both sides have to be equally strong, with both sides having to equally bear the burden of this special situation. Otherwise, if you make one side strong, the other side will break down.

So, my involvement as minute taker of those Tarbela Dam days bring me back to the concept of the logic of water. It is very difficult to contain water once it becomes furious. Do not let it get furious. We have already had five floods in six years. Do not let us have seven floods in six years. That will happen if we do not look after what is the logic of water.

I must repeat that specialist people, with their minds in a box, have caused us much pain. The compulsions of this nation are now upon us. The slide of the macro-economic level has to be halted. It will not take an upturn by itself, much as you and I might wish it. Much as you and I might want to do it, you have to put some notches in the slide to stop it. To stop the speed, the acceleration by which we are going down, and then resurface by our own will, by our own efforts, and that will only be possible if we are able *to* harness this Indus Machine in a just and equitable manner.

Ladies and gentlemen, modernization and an ancient mind do not go together. If you have to modernize, you have to change your attitude and your values. Otherwise, you will be on a village trail. This is up to you. Whether you want to join the super highway or whether you want to go on a village trail. If you do so, if you choose the village trail, and I am not so afraid others will pull away, because others are already on the super highway. We need not have pedestrians in our midst. We need people who can walk faster than they are walking at the present. We need not be in the Anarkali Bazaar or whatever.

Prof. Skog, it has been a great pleasure to be here with you. You have heard that I have not talked about water at all. I have talked about the things that water can do. I have talked about things that water can manage. Ladies and gentlemen, I thank you very much.

INAUGURAL ADDRESS

by

Dr. Amir Muhammad

Dr. Zafar Altaf, Prof. Skogerboe, Excellencies, Ladies and Gentlemen,

I am very grateful to Prof. Skogerboe and the organizers for inviting me to inaugurate this important Conference. I have had a long association with IIMI, not only since it was established as a center of excellence with headquarters initially in Digana, Sri Lanka, but even from the time that the concept of water managetnent research was being discussed in the various forum of the Consultative Group of International Agriculture Research (CGIAR). I was elected to represent the Asia-Pacific Region on the CGIAR in 1980 and in that capacity participated in the CG policy making forums during the next 6 years. I recall the discussion on the TAC Chairman's report in the CG Mid-year meeting in Paris where irrigation was mentioned as a possible subject for future research activities of the CGIAR which until then had primarily emphasized breeding and agronornical research on major cereal crops. In the initial discussions, various speakers opposed the inclusion of irrigation as a subject for intensive research in CGIAR, mainly because irrigation involved major capital intensive projects and irrigation management was too location and environment specific to lend itself to an international research effort which could be of value to the food-deficient developing countries. I, along with several other CG members, strongly opposed this view maintaining that the developing world may still face famine and widespread starvation inspite of the "miracle" varieties and improved production technology developed by CGIAR research, if the limited water resources available for agriculture were not utilized judiciously. We maintained that research in improving water use efficiency to optimize sustainable crop production from limited water resources in the arid and semi-arid countries would hold the key to averting major disasters due to recurrent food shortages.

Although the arguments for the importance of irrigation research in pursuance of the CGIAR mission to produce more food in the developing countries to avert famines was accepted, the Group felt it did not have the necessary financial resources to create a new institution dealing with irrigation research. As an interim measure, all of the CG centers working on field crops were asked to include research to improve irrigation efficiency in their research agenda. However, several CG donors felt concerned enough about the irrigation issues that a small committee was established under the chairmanship of then TAC Chairman Dr. Ralph Cummings to explore possibilities for creating an international institute outside the CGIAR dealing with irrigation aspects, to be supported by some of the donors who were also regular donors to CGIAR.

I will not attempt to recount the whole process of the creation of IIMI-Pakistan, but will only mention that an important step in the establishment *of* IIMI-Pakistan was the contribution by GOP to pay for cost of constructing the headquarters building in Lahore

out of the World Bank loan to GOP for irrigation development. We were able to convince the policy makers in Pakistan that this investment would benefit Pakistan enormously, not only through improved technologies, which tlie institute would generate to improve irrigation management, hut also by providing a model for institutional management of the national research system which would significantly improve the productive efficiency of all the agricultural and irrigation research in Pakistan. Not only did Pakistan provide the building and equipment for the headquarters of IIMI-Pakistan, GOP also impressed upon other donors lo Pakistan lo support IIMI-Pakistan in its efforts to organize a viable research program aimed at itnproving the organization of the irrigation systerri in Pakistan and its management in order to eventually improve the productivity of the limited water resources of the country in terms of sustainable crop production and net income for the farmers. IIMI's research during the short period of its existence has amply justified the rationale for creation of this Institute and I have full confidence that the future research of IIMI will be instrumental in transforming irrigation management in the developing world so as to bring about sustainable improvement in irrigated agriculture. especially for the small larniers.

I was elected a member arid Vice-chairirian of the first Board of Governors of IIMI and we worked hard to establish the main institute in a temporary building in Digana near Kandy in Sri Lanka, and a branch in Lahore. The research program of the Institute evolved over the years and it earned the respect and attention of policy makers and researchers in the developing countries and the donor community. The next landmark in the short history *of* IIMI was its induction into the CGIAR farnily in 1989 when the scope of CG activities was enlarged by including forestry and irrigation research into the system.

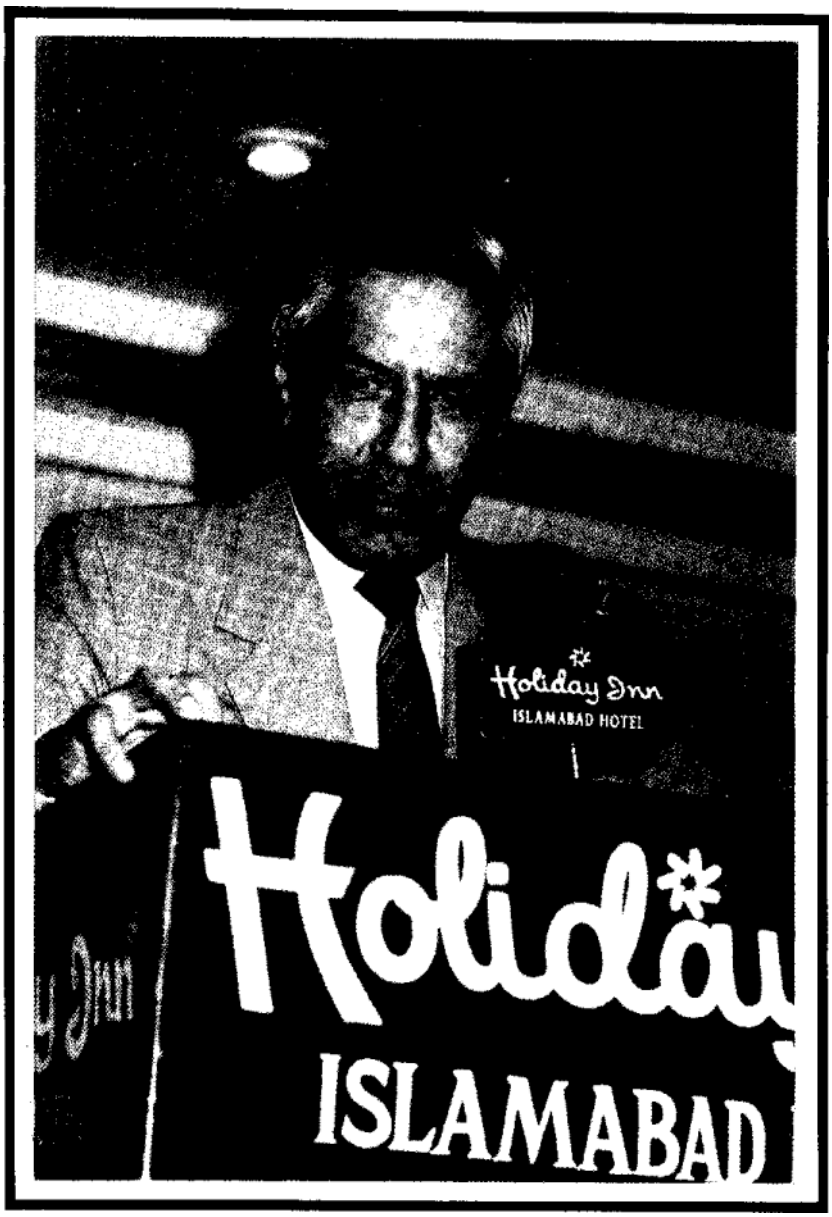
IIMI has a difficult mandate concerning diagnosis and improvement of the management of irrigation in developing countries. Management in general is the major problem of the developing countries, be it political, economic or administrative. Most of the developing countries, including Pakistan, are in a mess because of serious failures of governance and related management of various aspects of the public sector. The dissolution of the National Assembly last night, and the sacking of the Government by the President. are the result of a serious management failure in Pakistan. Irrigation management cannot remain isolated from the management culture in the rest of the country. Therefore, IIMI has to view serious lapses in management of the irrigation system in the board context of the prevailing governance culture in the country and not recommend measures in isolation for improvement of irrigation organization and management

The IARCs are constantly under pressure to produce results that have an impact in the developing countries in terms of the CGIAR mandate. While improved varieties and agronomic practices **make** a tangible, often dramatic, impact on crop yields within the very first year, the same is not the case for management research. Discovery of dwarf wheat and rice varieties produced the "Green Revolution", which gave a

tremendous boost to the prestige and program of CIMMYT and IRRI and *to* the CGIAR system as a whole. However, management research does not produce such innovations which can have such a dramatic impact. This research is considerably more difficult and inter-disciplinary, especially involving social sciences. Besides, the broad findings of such research have to be modified in order to adapt to different socio-cultural and governance situations, besides the agro-ecological circumstances and cropping patterns, etc. Therefore, IIMI alongwith some other management type institutes in the CGIAR system vis. ISNAR and IFPRI, has a very difficult and challenging task to demonstrate impact of their research efforts on tangible improvements in the target countries.

Ladies and Gentlemen, the present conference is indeed very timely. Pakistan is in the process of making a major institutional reform in its irrigation set-up. Provincial irrigation departments (PIDs) which historically played a pivotal role in bringing irrigation into the hot deserts of Pakistan to transform them into highly productive areas, are in the process of being converted into semi-autonomous Provincial Irrigation and Drainage Authorities (PIDAS). There is hope that this would bring in a new institutional cultural and attitude into the now highly corrupted and inefficient PIDs. There is really no reason to believe that merely converting the PIDs into autonomous organizations with essentially the same staff will necessarily bring about any change in institutional culture. Unless the rampant corruption, unhealthy influence of the politically powerful landlords in collusion with the irrigation bureaucracy, who usurp the water rights of the poor tail-end peasants resulting in low yields and rapidly increasing secondary salinity in the tail-end regions, and the prevalent inefficiency in operation and maintenance of the irrigation system are eliminated, the PIDAs may bring in more problems than solving the already well identified ills of PIDs, which have resulted in rapid deterioration of the system. IIMI, being the global center of excellence in the field of water management should assist Pakistan at this critical juncture by providing the experience of other countries from the Asia region which have faced similar problems and have brought about institutional changes in their irrigation management. There is a real danger that unless the real problems of corruption, usurpation of water rights and inefficiency in O&M are tackled, the change in institutional pattern may indeed destroy whatever healthy traditions survived in the PIDs and may irretrievably damage the whole irrigation set up in the country. If the identified ills of the system can be rectified through the envisaged institutional changes, then it will undoubtedly usher in an era of prosperity in Pakistan by bringing about radical improvement in the production efficiency of irrigated agriculture. IIMI has an opportunity to play a historical role in ensuring that this major institutional change brings about the desired results in Pakistan.

The Conference has planned a very stimulating program of lectures and discussions and I do not want to delay the start of the technical sessions. I apologize for the somewhat lengthy remarks, but I did want to emphasize on you the need for your contribution in the process of bringing about institutional reform in Pakistan's sick irrigation set-up. Once again, I have great pleasure in joining you this morning and have great pleasure in inaugurating the National Conference on Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan.



INAUGURAL ADDRESS

(Dr. Amir Muhammad, Chief Guest)

Message from Nawab Muhammad **Yousuf Talpur**
Former Minister **of Food,** Agriculture and Livestock[3]

In the name of Allah, the Beneficent, the Merciful, Dr. Zafar Altaf, Secretary, Food, Agriculture and Livestock, Prof. Gaylord V. Skogerboe, Director, IIMI-Pakistan, Lahore, Distinguished Delegates and Guests, Organizers of the Conference, Ladies and Gentlemen.

It is indeed a matter of immense pleasure for me to inaugurate the National Conference on "Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan". The Conference is of great significance to us in view of the importance of irrigation in the agricultural economy of Pakistan. On behalf of the Government of Pakistan, Ministry of Food, Agriculture and Livestock may I extend to you our sincere and good wishes on the occasion *of* this conference. I am pleased to welcome the distinguished speakers, who are presenting valuable papers in this Conference,

I will not dilate on the irrigation data, the water available. That is given, as much of quantitative factors are.

However, over the past decade, there has been increasing evidence of problems in canal performance in the Indus Basin, and it is now acknowledged that water delivery targets in most secondary or distributory canals cannot be met during much of the cropping seasons, especially during the period of peak water demand. Consequently, growing numbers of farmers in these canal commands, particularly those located in the tail reaches, must turn to marginal or poor quality groundwater to save their crops, reduce their crop area, or temporarily abandon their farms entirely.

Seemingly, agricultural productivity has leveled off as well, with yield per unit area of all major food and fibre crops continuing to be well below potentials. However, there are some reasons to believe that agricultural productivity per unit of water for many crops remains reasonably high as farmers stretch their irrigation water over a maximum area. The trade-off, however, is increased salinity risk. Because salinity remains a continuing threat to agricultural productivity and is a condition typically aggravated by low irrigation efficiencies, arresting the decline in canal system performance is an irrigation sector priority. Undoubtedly, some of the present problems of canal system performance are a consequence of deteriorating physical facilities; those conditions, however, are aggravated by inadequate system operation and management.

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[3] Message read by Dr. Rana Zakir Hussain, Cotton Commissioner, Ministry of Food, Agriculture and Livestock, Islamabad.

The major binding limitation in adding to the area of land is the scarcity of good quality water. The existing agricultural land is confronted with many problems too, including waterlogging, salinity, sea water intrusion. and lax management both at the canal and farm level. Other causes frequently cited are an institutional setting where the pressure and interference of influentials must be accommodated, as well as increasing water theft by farmers. Solid wastes and non-saline pollutants in the Indus Basin water are a cause for concern. Sea water intrusion affects substantial portions of the coastal lands.

There is a worldwide concern on decentralizing water delivery by involving water users associations in the management of irrigation systems. The underlying principle is that nothing should be done at a higher level which can be done satisfactory at the lowest level. Participation empowers the users to influence policy, the choice of design and investment, and management of the physical system. The international experience in this direction is encouraging.

In Pakistan the system management "blows up" in the distributories. Three social parameters interact: I) political interference; ii) rent-seeking, which is payment by the beneficiaries for unauthorized services; and **iii)** farmer anarchy. These social problems distort the water distribution between distributories and among watercourses along each distributory. For instance, wheat yield is 50 percent higher on head reaches as compared to tail enders. The value added per cubic meter of irrigation water is 2-3 times more at the head farms as opposed to tail farms. The only plausible mechanism to overcome inequity is to empower the irrigators so that they can play an effective role in managing the water supplies in their distributories, minors and watercourses.

Poor drainage has been identified as a serious impediment to increased agricultural productivity. Pakistan has been confronted with the menace of waterlogging and salinity since independence. With the construction of each canal, the groundwater recharge in its command due *to* infiltration from various sources caused a rise of water table. Many of the waterlogging and salinity conditions are created or aggravated by the excessive use of water in irrigation. Poor drainage has also resulted in gradual soil deterioration and subsequent reduction in productivity. If perennial irrigation had been accompanied by a more effective drainage system, agricultural productivity would have been higher.

The need to conserve water and reduce wastage has been put off for so many years that a crisis in water supply will be here before the long process of improvement can be fully implemented. In Pakistan, Indus water is supplied at negligible cost to irrigators. This makes it difficult to adopt irrigation practices that treat water as a precious resource. Water will become increasingly scarce in the future and the Indus riparian provinces will soon face critical water shortages. Conservation of water will be a critical element in the water management strategies of the country. Unfortunately, the nature of

water shortages is that they often 'are not felt until the crisis is severe, making conservation strategies difficult to implement.

The policy makers in the provincial irrigation departments and the Ministry of Water and Power are aware of the issues that need to be addressed. However, to refresh your memory, it may be said that:

* Charges for water should reflect crop water demands;

* Make the irrigation system self-financing and self-sustaining;

* Demonstrate technical improvements that will lead to water conservation at the farm;

* Provide financial incentives *to* encourage farmers to adopt water-efficient technologies;

* Address problems of water table drawdown by holistic approaches, encompassing both management of demand and methods to decrease the water recharge; and

* Provide equitable water distribution at the distributory and watercourse levels.

Ladies and gentlemen, I am pleased to note that the conference will cover a wide range of topics. related to canal operations, water management below the mogha, environmental management of irrigated lands, and institutional development. You would, over the next three days, listen to your peers from various organizations who are experts in their respective fields. I am sure you will tell us what the future holds for the Indus Basin sector which will obviously guide us in chartering the future course of action for better strategies for sustainable agriculture. I have gone through the list of topics on which you are going to dwell in the next couple of days and enlighten yourself with each others experience. I wish the conference a success.

Thank you

Pakistan Paindabad

DONOR SUPPORTERS
(L to R: Mr. Wim van der Kevie, Counsellor Development,
Mr. Ron Havinga, First Secretary (Rural Development) of the Royal Netherlands Embassy
and H.E.Mr. Pierre Lafrance, Ambassador of France.

PART OF THE AUDIENCE

SECTION II

ISSUES AND SUMMARIES OF PANEL DELIBERATIONS

This Section covers the issues that were identified for each of the four Conference Themes: i) Managing Canal Operations; ii) Water Management Below the Mogha; iii) Environmental Management of Irrigated Lands: and iv) Institutional Development.

These issues have been treated in a Issues Paper, which is presented herein. The other papers on the Themes have been compiled separately, which are presented in Volumes II to V.

The presentation of the issues in the Issues Paper, is followed by a Summary of the Panel Discussions which has been put together by the Rapporteurs for each Theme. This form of presentation highlights the issues as they were perceived and brings out the salient points that were made for dealing with them, along with the recommendations that were advocated.

Rather than reporting verbatim all of the submissions by the participants and responses to them by the Panel members, the Summary by the Rapporteurs helps to focus the attention to the main points at issue, and provides the rationale for the recommendations that are considered to be most appropriate.

THEME I: MANAGING CANAL OPERATIONS

ISSUES PAPER: ISSUES IN MANAGING CANAL OPERATIONS

by
Gaylord V Skogerboe[4] *arid Abdul Hafeez Qaiser*[5]

SITUATION

In any country of the world where irrigated agriculture plays an important role in the economy, there is a continual growing need to have irrigation systems improved for a variety of reasons. First of all, for many countries, there is a need to increase agricultural productivity to feed a growing population. Secondly, water is becoming more and more scarce for most countries, which is now becoming a major global concern. Finally, as the water resources become more fully utilized, water quality deteriorates and environmental concerns play an increasing role in development for all countries.

Irrigated agriculture is "site specific"; in other words, each irrigation system is different. This implies that prescriptive approaches being implemented across many irrigation systems in a country are likely to produce suboptimal results. Solutions need to be process-oriented, wherein a process serves as a guide that can be adapted to each situation.

Certainly, the Indus Basin Irrigation System does not represent a homogeneous situation. Instead, there is considerable variation in this huge system For example, the North West Frontier Province has the best situation in terms of water resources availability, which is reflected in higher water duties (8-12 cusecs per 1,000 acres), but this also results in a burden to operate the canal systems so as not to drown the drainage systems, nor waterlog the croplands The rapid exploitation of groundwater in the Province of Punjab by private tubewells, many of which are pumping moderately saline water that is salinizing a number of farms, also places a greater burden on the good quality surface water canal supplies to reach those lands that are experiencing salinity and sodicity problems. Recognizing that the Province of Sindh has very flat topography, there is a need to manage the canal systems in a much better manner than any other province to minimize waterlogging, which is also the case for the Pat Feeder Canal in the Province of Balochistan. The greatest problems of water scat city presently exist in Balochistan, which is most likely to become even worse unless water can be used much more efficiently.

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[4] Director, Pakistan National Program, International Irrigation Management Instilute

[5] Chief (Water Resources), Planning Commission

MAINTENANCE

Instead of continually improving, the Indus Basin Irrigation System is deteriorating! Professional Irrigation Engineers lament this fact -- they all recognize the situation. How could this occur to the world's largest irrigation system, the pride of Pakistan?

Efficient and effective O&M of irrigation facilities is a key to achieving sustainability in irrigated agriculture. The practice of deferred maintenance coupled with an ageing irrigation system has put sustainability at the verge of threat. The rapidly increasing O&M burden on the public sector is moving towards enormous economic repercussions.

The deterioration of the irrigation channels is most evident during canal closure in December - January. *Most* irrigation channels have 1-3 feet of sediment deposition, sometimes more, lying on the bed. Thus, the discharge capacity is reduced, but if retained, the water levels will be higher and the potential for breaches will be greater, which are so devastating to those croplands that are flooded due to these breaches.

Sediment deposition plays a major role in the equitable distribution of water, particularly along distributary and minor channels that are feeding the tertiary watercourse channels. In fact, sediment removal should be done in a manner that maximizes equitable water distribution.

In many developing countries, there is a credibility problem between the headquarters of an Irrigation Department and their field offices in that they recognize that providing more maintenance funds will not likely result in a commensurate amount of maintenance being done. Thus, funding alone is not the answer to this dilemma. A different approach is required.

HYDRAULIC OPERATIONS

One of the surprising characteristics of canal hydraulic operations is the degree of discharge variations that occur. A number of canals have been monitored by various organizations and the results are surprisingly similar. Commonly, there are 10-20 percent discharge fluctuations that occur each day, while occasionally a 50 percent discharge fluctuation occurs on some days.

Farmers are accustomed to these variations in flow rates. They frequently express their concern that the flow rate in the watercourse will significantly drop during their warabandi turn. However, this problem has many causes. including the stealing of water by some upstream farmer.

The cause of much of the discharge variations in canals and branch canals is that each cross regulator is independently operated. In other words, the gate operator has to open and close the cross regulator gates in accordance with the local hydraulic situation without knowing what is occurring at the next upstream cross regulator nor the hydraulic situation at the canal head works Also, the gate operator may not be fully aware of the impact **on** the next downstream cross regulator.

COMMUNICATIONS

The communications network for operating the canal commands is quite old. Thus, it is not too surprising that portions of this network are no longer functional. The installation of modern equipment is most likely a very cost-effective measure for improving canal operations.

SOCIAL DISEASES

The operators of the lndus Basin Irrigation System have always contended with the problems associated with heavy sediment loads, as well as the twin menace of waterlogging and salinity. There is always considerable discussion, but not much written, about the triple social diseases of : (1) political interference; (2) rent seeking; and (3) farmer anarchy.

The interaction of these social forces are most pronounced and evident in the operation of the secondary distributary and minor channels. There are serious distortions in water deliveries among distributaries. This situation is aggravated by inequitable water distribution to watercourses along many distributaries and minors. Finally, the warabandi on many watercourse command areas is impacted.

There is a recognition that the social aspects are the greatest hinderance to achieving the sustainability of completed works. Thus, any change in institutional arrangements must go hand-in-hand with a revolutionary change in human behavior and the required changes in the physical system. In other words, the reforms will not bring about the desired results without a combination of social reforms and physical improvements. The existing entities can be dressed with a new outfit, but it may not do any good until the root causes of "unsatisfactory human behavior" are removed.

ROLE OF FARMERS

There are a number of considerations in viewing the role of farmers in creating an erivironment for continually increasing agricultural productivity. First *of* all, while observing the productivity of irrigated agriculture in many countries scattered around the world, it becomes quite obvious that the best operated irrigation systems are managed by farmers, not by government agencies. For farmer-managed irrigation systems, farmers often employ highly competent managers, who in turn hire the administrative operations and maintenance staff. This is particularly true for large irrigation systems.

Irrigated agriculture, by its very nature, requires collective efforts. The productivity of an irrigation system is strongly linked to the strength and behavior of the organization managing the system.

JOINT MANAGEMENT

In the past, mostly engineering solutions were employed to solve the technical and managerial problems. These were, in fact, symptoms of a much deeper problem (i.e. Government control of the irrigation service). The institutional and social aspects of the irrigation system were neglected. Future strategies will address these issues.

Many countries are experimenting with increasing the role and responsibilities of farmers in managing their irrigation systems. In some cases, the entire irrigation canal command is turned over to a farmers organization. In other cases, joint management is practiced where the lower portions of the system are managed by farmers and the upper portions by the irrigation agency. In all cases, the agency continues to provide technical assistance to the water users organizations.

The Indus Basin Irrigation System is so huge that it is inconceivable that farmers could possibly manage this system. **At** the same time, there is no meaningful history of farmers managing secondary channel command areas, yet they have to manage their tertiary (watercourse) command areas. The important issue is that farmers need to learn how to work together in a productive manner to proceed beyond the management of the tertiary level.

Presently, there are experiments underway in learning how **to** organize farmers at the levels of minor and distributary command areas. For these efforts to have any chance of success, there is a real necessity for the provincial irrigation departments to enter into a formal or informal joint management agreement with the farmers organizations.

SUMMARY OF PANEL DELIBERATIONS ON ISSUES, OPTIONS AND IMPACTS FOR MANAGING CANAL OPERATIONS

by
Marcel Kuper, Rapporteur

The main issues and options for interventions that came out of the presentations were the following:

Issues	Options	Likely Impacts
Water distribution is not eauitable	Changing operational rules	Better equitability
Improving hydraulic operations	1. Improvement of communications network 2 Improve information system	1. Reduced variability 2. Increased confidence farmers, reliability of supplies
Water distribution does not match targets	Introduce performance assessment	Better accountability
Water allowances are not equitable	Modifying allowances	Equitable water rights
Reduced carrying capacity canals	Desiltation	Improved carrying capacity, improved water distribution
Increasing available water resources	Construction storage facilities	More adequate water availability

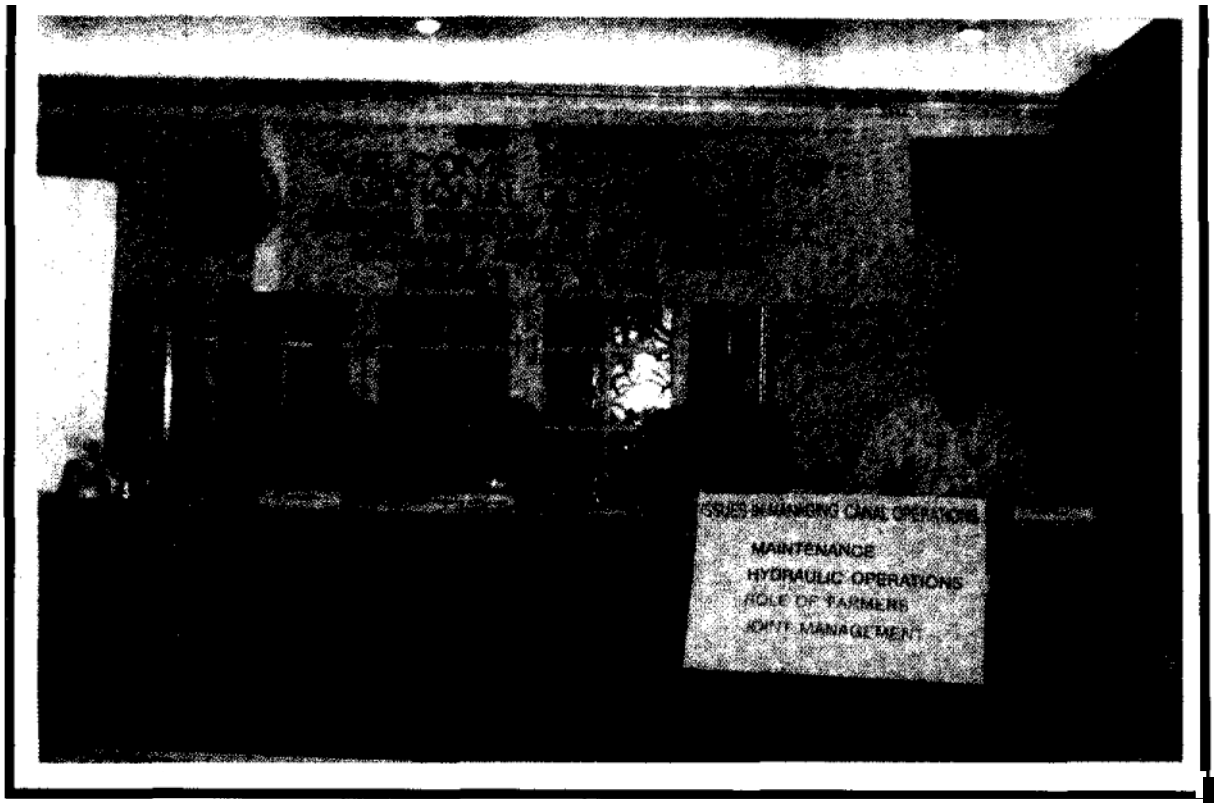
Of these different options, presently only the implementation of an information system is being tried in the Fordwah/Eastern Sadiqia area. The experiences of this pilot test are reported in one of the papers (Hafiz Ullah, et al.).

In the panel discussion, the objectives of the irrigation system were questioned. Should it be a supply-driven equitable distribution of water or move towards a demand driven system. This was not further discussed.

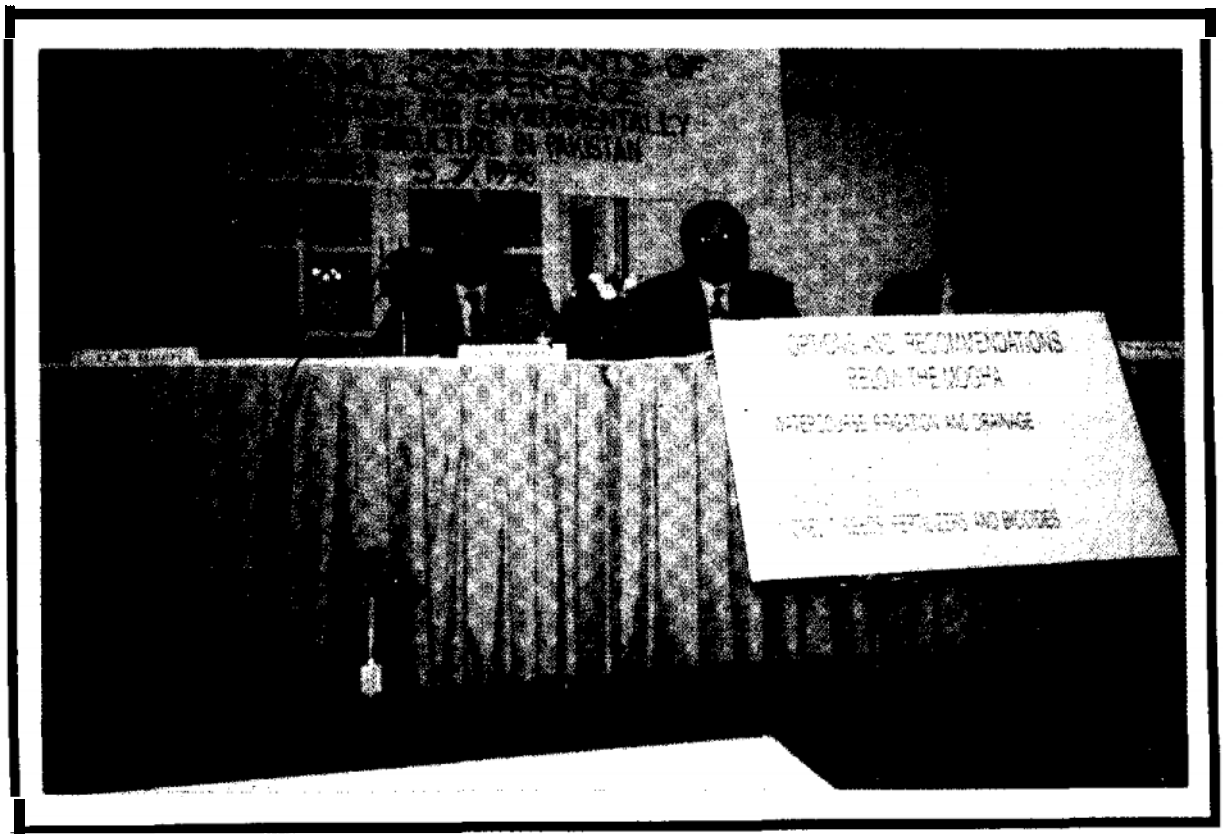
The role of sediment in reducing the carrying capacity of channels, resulting in maintenance problems, was emphasized.

Sedimentation of reservoirs was not addressed in the papers, but was put forward as a serious problem.

Finally, it was emphasized that the problems need to be resolved at the right level, You cannot ask the gate keeper to resolve the problems of the society.



PANEL ON MANAGING CANAL OPERATIONS
(L to R: Mr. S. Faiz Ahmad Zaidi, Dr. Hammond Murray Rust, Mr. Hafeez Qaiser and Mr. Marcel Kuper)



PANEL ON WATER MANAGEMENT BELOW THE MOGHA
(L to R: Mr. D.R. Birch, Dr. Amir Muhamad, Mr. Navaid Ali Nasd and Dr. M.S. Shafique)

THEME II: WATER MANAGEMENT BELOW THE MOGHA

ISSUES PAPER:ISSUES RELATED TO FARMERS' MANAGED IRRIGATION SYSTEM

by

M. S. Shafique[6], *Shahid Ahmed*[7] *and Mushtaq Ahmed Gill*[8]

Productivity and sustainability of irrigated agriculture in Pakistan mainly depends on the performance of the Indus Basin Irrigation System. As the contribution of the irrigated sector to the national economy plays a crucial role, the knowledge about the status of present system performance is immensely important for the managers and policy-makers of the country.

The phenomenon of either stagnant or declining yields of rice, sugarcane and coarse grains (Shahid et al., **1996)** has prompted many national and international agencies and experts to question the present performance of the system. Many researchers have listed a number of issues and constraints which cause a decline in the performance (Shahid et al., **1996;** Shafique, **1996;** and Asrar-ul-Haq, **1995).** This paper, however, presents only six most important issues (as viewed by the authors) along with options for deliberations by the participants of the National Conference to be held in Islamabad from 5 to **7** November **1996.**

EQUITY OF WATER DISTRIBUTION

Equity indicates the ability of a system to uniformly deliver water over space (Mohamed, **1987).** This issue **is** concerned with the uniformity of spatial distribution of water which is usually influenced by a number of potential factors.

Some of the factors which cause a non-uniform spatial water distribution along a parent channel (e.g., distributary or minor canal) may include (Asrar-ul-Haq, **1995):** (i) deferred maintenance; (ii) sedimentation; (iii) excessive withdrawals by outlets; and (iv) illegal water abstractions. At the tertiary level, the distribution is skewed mainly due to the operational spills and seepage caused by the lack of maintenance, weak and porous banks of watercourses, non-uniform topography of service areas, intermittent wetting and drying of delivery channels, etc.

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6 **Senior Irrigation Engineer, IIMI-Pakistan**

7 **Director, Water Resource Research Institute**

8 **Director General, On** Farm **Water Management,** Punjab

As the distribuataries or minor canals are still agency-operated, the equity concern is confined to watercourses only. While addressing the issue at the watercourse command level, possible considerations for discussion may include: (i) water allowances for avoidable or unavoidable losses; (ii) discrepancies in warabandi; and (iii) measures to curb rent-seeking for illegal water withdrawals.

Points for Consideration

Policy, Planning & Legislation:

(i) existing warabandi mechanism;
(ii) current basis for water charge assessment;
(iii) pricing policies for high-delta crops (e.g., sugarcane) which encourage illegal withdrawals from parent channels; and
(iv) volume vis-a-vis time based equity;

Technical:

(i) water loss rates in the formulation of warabandi.

Socio-economic & Political

(i) acceptance of water loss rates in the formulation of warabandi.

RELIABILITY OF WATER DISTRIBUTION

Reliability of water distribution indicates the ability of a system to deliver expected/ planned / designed water supplies in a given time span. In the context of Pakistan, a system that achieves steady state is considered reliable. However, if farmers are informed in advance about periods of canal closures or reduced flows, and those events occur as scheduled, the resulting water distribution will still be termed as reliable in spite of water deliveries being variable.

The issue of reliability of water distribution within farmers' managed (directly or indirectly) system will have to be considered at two levels: (i) the canal-outlet; and (ii) the farm level below the canal-outlet. In most cases, the last level is mainly influenced by the degree of certainty associated with the first level.

Points **for** Consideration

Policy, **Planning** and **Legislation:**

(i) change in the mandate of PIDs / user-orientation; and
(ii) seasonal planning by the managers of the main system and other relevant agencies, along with communication to users.

Technical:

(i) seasonality in river flows during winter and summer; and
(ii) information (regarding outlet and below canal-outlet) management for water users.

Socio-economic & Political:

(i) internal and external influences on distributary operations through priority setting.

ADEQUACY OF WATER DISTRIBUTION

In general, adequacy of water distribution indicates the ability of a system to deliver the right amount of water as required by crops. However, the irrigation system in Pakistan is not designed for an adequate water distribution as defined above. Asrar-ul-Haq (1995) reported that the canal supplies fell short 38% at 105% cropping intensity. In this context, ground water use is an important factor for consideration.

Points **for** Consideration

Policy, **Planning and Legislation:**

(i) resource & design limitations;
(ii) conjunctive use of surface and ground water; and
(iii) consideration for marginal benefits and costs associated with water supplies.

Technical:

(i) conjunctive use of different water resources (e.g., canal, rain, ground water, drainage & sewage water); and
(ii) substitution of water efficient crops (Rs./m^3 of water).

Socio-economic and Political:

(i) Regional influences and excessive / reasonable water allocation.

PRODUCTIVITY

The productivity issue may include concerns about low ratios of actual and target productivity on the basis of: (i) per unit of land; (ii) per unit of water; and (iii) per unit of time (seasons). The availability **of** water, as described above, affects the resulting productivity of irrigated agriculture. The productivity ratios will be different with various combinations of the water and non-water inputs.

Even if all concerns related to water availability are addressed, the overall productivity will also depend on the availability and level of access for different groups of water users to non-water inputs. As the water related issues are already presented, the discussion about implications and opportunities corresponding to non-water inputs will contribute in addressing the issue in a more comprehensive manner.

In addition to water, the current status of adequate, reliable and equitable access and availability of non-water inputs such as seeds, fertilizers and chemicals have a direct effect on the productivity of irrigated agriculture. In the absence of the functional regulatory measures, quality of the inputs available is another serious concern to be addressed.

Points for Consideration

Policy, Planning & Legislation:

(i) equitable access to non-water inputs; and
(ii) change in the role of line-agencies from authority to service.

Technical:

(i) regulatory role for timeliness and quality of inputs;
(ii) ground water regulatory framework vis-a-vis water rights; and
(iii) water control mechanisms (water pricing, water markets, etc.)

Socio-economic and Political:

(i) influence of a structured marketing system; and
(ii) acceptability of new water control mechanisms.

SUSTAINABILITY

Sustainability is concerned with the long-term aspects of irrigation system performance, which is *to* be accomplished with little or no adverse impacts on the physical, financial, institutional, health and other relevant conditions of the system. For example, a poorly managed physical irrigation subsystem is likely to have serious negative consequences such as waterlogging and salinity. Similarly, the on-going budgetary cuts due to the financial crisis in many countries are forcing'cutbacks on their O&M allocations to support increasing staff costs. This situation is expected to result in deterioration of the financial and physical conditions causing concern for the sustainability of many systems.

Points for Consideration

Policy, Planning and Legislation:

(i) balance between resource conservation and utilization;
(ii) financial sustainability of farmers' groups;
(iii) appropriate policy response towards waterlogging and salinity problems caused by high-delta crops such as rice and sugarcane: **(i)** pricing incentives; (ii) regulatory measures; and (iii) reclamation cess etc;
(iv) appropriate policy responses to waterlogging and salinity problems caused by localized excessive water ailowances; and
(v) control of groundwater extractions.

Technical:

(i) management of saline and sodic soils and waters;
(ii) conjunctive use of different water resources;
(iii) Farmers' contributions for O & M of irrigation and drainage systems; and
(iv) a sustainable water allocation per unit area (amount which prevents hazards like waterlogging and salinity) within each provincial water quota.

Socio-economic and Political:

(i) spatial distribution of farmers' social and economic power and knowledge about the management of saline and sodic soils, as well as water;
(ii) participatory irrigation and drainage management; and
(iii) regional influences on the water allocation within each province.

IRRIGATION EFFICIENCY

Irrigation efficiency of a system indicates the portion of water delivered from its source which is made available for the use of crops within the area served. In this context, a recent report published by the World Bank (1994) suggests that the overall irrigation efficiency of the Indus Basin Irrigation System ranges from 35 to 40%. The low efficiency results mainly due to the following factors (Asrar-ul-Haq, 1995): (i) uneven fields; (ii) inappropriate design of bunded units with reference to soils, discharge and crops grown; and (iii) excessive operational losses at the watercourse command level.

In this given context, the issues have to be addressed by discussing implications and opportunities associated with factors which lower the irrigation efficiency of the system. However, the concepts of local versus global efficiency, as well as sinks and non-sinks within an irrigation system, are to be considered.

Points for Consideration

Policy, Planning and Legislation:

(i) water rates based on water allocation instead of fields irrigated and crops matured;
(ii) water management improvements for brackish and fresh water zones in accordance with local and global efficiency scenarios;
(iii) commercialization of services such as farm design, precision land leveling, watercourse improvements with technical support from relevant agencies and irrigation advisory and technical services; and
(iv) role of water markets in the adoption of efficient water use technologies.

Technical:

(i) efficient water use methods; and
(ii) Integration of pressurized water application with surface irrigation methods and conjunctive water applications.

Socio-economic and Political:

(i) initial cost and energy requirements for efficient water use methods; and
(ii) acceptability of new water application methods.

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SUMMARY OF PANEL DELIBERATIONS ON ISSUES, OPTIONS AND RECOMMENDATIONS FOR WATER MANAGEMENT BELOW THE MOGHA

by

M.S. *Shafique, Rapporteur*

OPTIONS

The issues concerning ***Water Management Research Below the Mogha*** were presented at the Conference as per the following order: (i) Equity of Water Distribution; (ii) Reliability of Water Distribution; (iii) Adequacy of Water Distribution; (iv) Sustainability; (v) Irrigation Efficiencies; and (vi) Productivity. In this context, some important ***options*** suggested to address these issues are given below.

1. Strengthening of *Pakka Warabandi* by incorporating watercourse water loss rates and delivering water on an equitable basis.

2. Reliability of water distribution can be improved by making irrigation agencies accountable to farmers by transparent and agreed seasonal planning for water distribution.

3. Adequacy issue to be addressed by conjunctive use of different water resources and by substituting water efficient crops.

4. For the sustainability of irrigated agriculture, appropriate policy and technical measures were suggested which included: (i) pricing controls; (ii) imposing reclamation cess; (iii) review of excessive water allocations within certain canal commands; (iv) providing amendments for the reclamation of saline and saline-sodic soils; and (v) farmers' active role in the O&M of irrigation and drainage systems.

5. Irrigation efficiencies can'be improved by taking the following steps: (i) reviewing the existing basis for water charges; (ii) providing irrigation improvements for saline and fresh water zones according to the local and global efficiency scenario; (iii) commercializing irrigation improvement projects and technical services; (iv) use of efficient irrigation application methods; and (v) formalizing role of water markets.

6. Options proposed for productivity would include all those stated above and suggestions to let there be equitable access to non-water inputs and marketing facilities, along with a change of line-agencies into a service mode.

CAUTIONS

During the National Conference, the panel discussion was focused on the given issues and options. **As** a consequence of the deliberations, a set of **cautions** resulted which are presented below.

(a) The empowering of water users associations should be equipped with adequate checks to avoid any mis-use of the proposed new organizational arrangements.

(b) New irrigation water application methods should be developed that are within the reach of the small farmers having limited resources.

(c) The suggested use of the sulfuric generator at the time of amending sodic groundwater needs careful consideration as the salinity of the water will also be increased by adding sulfuric acid.

(d) There are hardly any interactions between the farmers and the government agencies for resolving most of the issues stated above.

RECOMMENDATIONS

In spite of the few cautionary comments about the issues and options presented for discussion, there were not any serious differences of opinion for improving irrigation management at the watercourse level. In this context, the following set of **recommendations** was read in the last session of the Conference.

1. There is great potential for adopting improved surface irrigation application methods For example, use of a bed and furrow system, as compared with the basin method for planting cotton, has demonstrated significant water savings and higher yields per unit of water and land.

2. For equitable and reliable water distribution, mechanisms based on flow measurement at canal outlets shouid be made to hold PIDs accountable for delivering the appropriate fair share of water to the farmers. .

3. Commercial options should be tested on a pilot level for providing irrigation scheduling and other relevant advisory services to farmers.

4. Water Users Organizations should be empowered to manage irrigation and drainage subsystems.

5. Appropriate mechanisms should be devised to prepare future water management improvement projects based on relevant research findings.

6. Irrigation improvement projects should be commercialized.

7. Ongoing water trading at the watercourse level should be reviewed and formalized.

a. Further research is required for the use of a sulfuric generator for amending unfit tubewell water and reclaiming saline-sodic soils.

9. More research effort should be dircted towards the conjunctive use of different water resources, as well as improved irrigation water application methods, in order to develop an increasingly more productive sustainable irrigated agriculture in Pakistan.

THEME III: ENVIRONMENTAL MANAGEMENT OF IRRIGATED LANDS

ISSUES PAPER: DRAINAGE AND THE ENVIRONMENT IN PAKISTAN

by
M.N. Bhutta [9] *and* W Wolters [10]

ABSTRACT

Millions of hectares of agricultural land in Pakistan suffer from waterlogging, salinity, or both, thereby severely restricting agriculture. Because the economy and society depend on agriculture for 50% or more, waterlogging and salinity are not just agricultural problems, but inipact the entire society. To combat waterlogging and salinity, tubewell drainage was started in the 1950s, and pipe drainage was introduced two decades later. Drainage has proved to effectively control water tables, but deep tubewell effluent has made some lands less productive due to mobilization of salts from deeper layers of the aquifer. The operatfon of both surface and subsurface drainage systems is a problem, as funds are not made available sufficiently. Re-use is sometimes possible to reduce the quantity of drainage effluent, augmenting water shortages at the same time, but the final effluent has to be disposed of into the Arabian Sea or into evaporation ponds. The experience with evaporation ponds is not entirely positive in Pakistan. Shallow drainage may be more environmentally friendly than deep drainage, but it has as major disadvantage a capital cost that is about ten times higher, in the current set-up. Until now, end-users have not been involved in drainage systems in Pakistan. Contemporary thinking is that it should be done immediately. Although generally accepted as a necessity, farmer involvement to the extent that they will pay for drainage will prove a difficult and lengthy process. The current strategy to combat .waterlogging and salinity appears to have three components: (i) water conservation measures; (ii) rehabilitation and extension of the surface drainage system; (iii) management studies to improve drainage management and institutions.

INTRODUCTION

Waterlogging and salinity are widespread in Pakistan: the area of lands in Pakistan with a water table depth in April-June (pre-monsoon) within 5 ft of the soil surface varies between 1.5 and 3 million ha, whereas Pakistan has almost *6* million ha salt affected lands, of which about half is found in the canal irrigated area. **An** area of 2 million ha is estimated to be abandoned due to severe salinity. The agricultural sector suffers dearly from these problems. About 75% of the population is directly or indirectly dependent on agriculture, and about half of the Gross National Product is directly or indirectly related to the agricultural sector.

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These facts illustrate that problems of waterlogging and salinity are not just agricultural problems, but that they do affect the country as a whole and ultimately the social fabric of Pakistani society, including a negative effect on e.g. health and education. The GOP, in its 8th Five Year Plan (1993-1998), has allocated a considerable amount of money, Rs. 38 billion, for investment in drainage, out of Rs. 55 billion for the entire water sector.

The salts in the Indus Basin are brought in by the rivers and their tributaries. The average annual inflow of salt, for roughly 145 Maf assuming an average water quality of 150 ppm is 33 Mton. The total salt load entering Punjab is about 15.8 Mton of which 2.2 Mton can be disposed into evaporation ponds. Of the remaining 13.6 Mton, about 2.5 Mton goes below Panjnad mostly during high flow and the remaining 11.1 Mton is stored within the Punjab. This implies that annually, an average of one ton *of* salt is added to each hectare of irrigated land (from NESPAK/MMI, 1993).

The average annual amount of salt reaching Sindh (Guddu Barrage) is about 19 Mton. Of this quantity 7.8 Mton goes to the Left Bank commands. The saline drainage effluent can be evacuated through **LBOD** into the sea. 3.2 Mton goes to the Right Bank commands and should be disposed of through the planned RBOD. The remainder 8 M ton flows through the Indus into the sea.

The above figures indicate that the salt balance of the Indus Basin is known in rough figures only, and cannot indicate where the incoming salts are actually deposited. However, it is clear that the Punjab is a closed basin with limited possibilities for salt disposal. The salt balance of the Lower Indus can be attained once the LBOD and RBOD are completed.

There **is** a continuing debate to which extent the salt-affected lands should be reclaimed by drainage associated with soil leaching (the 'engineering' approach) or made productive through the cultivation of salt tolerant crops or salt tolerant forages (the 'biosaline' approach). Promising salt-tolerant forage producing shrubs are from the genera Atriplex and Mariane. These salt bushes have the following advantages (IWASRI, 1994): (i) they are a significant feed resource produced on otherwise non-productive land; (ii) some species may survive afler complete annual defoliation; (iii) they can be used at times when other sources of forage are scarce; (iv) they have high (10-20%) crude protein concentrations.

The saline agriculture approach should be complementary to the engineering approach to drain and reclaim saline lands. Moreover, the available water resources are too scarce to reclaim all saline lands. For a long time to come, irrigated agriculture in the Indus Basin will have to deal with soil salinity. The approach should be that next to drainage and reclamation, cultivation should be adapted to the saline land conditions. Salt tolerant plants with economic value should be developed and introduced, while meeting local conditions.

In addition, there is a growing concern about the discharging of industrial effluents into drains (or even canals), which are transported to a river and then diverted into a canal at the next barrage. These mixed waters are used both for domestic purposes and irrigating crops. There are undoubtedly serious impacts on human health. Also, industrial effluents are likely to contaminate the groundwater reservoir. If the groundwater becomes contaminated, what will be the impact on irrigated agriculture?

HYDROLOGICAL EFFECTS OF IRRIGATION AND DRAINAGE

The effect of irrigation, a human intervention, on the natural environment is twofold: (i) it changes the land surface and the hydrology of the area; (ii) it affects the soil moisture-solute-groundwater regime of the area: water and solutes that would not be present naturally are brought to the area by means of canals and watercourses. Two important consequences of irrigation are the risk of waterlogging and the risk of salinization. Waterlogging occurs when more water is entering the area than is discharged. The groundwater table will rise, and eventually can approach the soil surface, thereby rendering the root-zone unsuitable for crop growth. Salinization occurs when more salts are entering the area than are leaving the area.

Not only the introduction of irrigation influences the salt balance of a certain area, already changes in land-use can have an influence on the natural salinity of an area. Generally, ecosystems are very sensitive **to** changes in the water balance. Consider an area with an annual rainfall of 500 mm, and an actual evapotranspiration of **480** mm. The long-term average excess of water is 20 mm per year. A simple water and salt balance calculation shows that when this quantity of excess water is not discharged by (natural) drainage, and the evaporation of wet and salty spots is 1000 mm per year, approximately 2% of the area will become saline. The effect of changes in land-use on salinity should not be underestimated as it has led to salinity problems in many countries in the world, e.g. in Northern America and Australia. Also the present salinity problems of the Indo-Gangetic plain in India may have a relationship with changes in land-use. Around 1950, 22% of India's geographical area was still covered with dense forest, but recent satellite surveys have shown that presently only half of this area is still forest (Mathur and Garg, 1991). Large tracts of 'usar' (hindi for barren) lands typically occur in low-lying basins between productive land.

Nevertheless, introduction of irrigation has a far greater influence on the natural environment than changes in land-use. One of the consequences very often is that a drainage system is a necessity for sustainable agricultural production through irrigation.

Salinity is usually dealt with as if supplied from the surface only. 'However, with historically low groundwater levels rising under irrigated areas, 'fossil' salts that have accumulated in deep soil layers are mobilized, and transported upward with the groundwater, in the direction of the root-zone. The salinity of such groundwater will create problems for farmers who install tubewells to supplement the often low canal

supply of irrigation water. Deep tubewells are less favourable than shallow tubewells in this respect. Shallow tubewells may have the added advantage that with the smaller groups of users the responsibilities for maintenance and operation are better shared than with the deep tubewells.

Salts are not the only solutes that may be mobilized by drainage. Selenium was discovered as the cause of deaths and deformities in aquatic wildlife in Kesterson Reservoir, California, USA (Summers and Anderson 1989). Much of the drainage water in parts of the San Joaquin valley is high in concentration of dissolved solids and contains selenium, molybdenum, boron and other elements. The origin of selenium as toxic element in the San Joaquin valley is natural, which means that treatment of the source is impossible. Because with sub-surface drainage the flow through the subsoil will extend to a depth of about one-fourth of the drain spacing, a ban on more sub-surface drainage could be a measure to prevent mobilization of the selenium.

RE-USE OF DRAINAGE WATER AND DISPOSAL TO EVAPORATION PONDS

Studies have been conducted on utilizing marginal quality water on various soil types under optimum crop and water management practices. Irrigation water quality criteria were developed to ensure that irrigation will have no long-term adverse effect on the soil, for sustainable agriculture. Nevertheless, in 1978 already, the Soil Survey of Pakistan warned that groundwater exploitation could lead to problems of sodicity for large tracts of land in the Indus Basin. Sodicity now is a threat to the sustainability of irrigated agriculture in Pakistan (IIMI, 1995).

Until recently the sodification hazard of agricultural lands was associated primarily with irrigation waters with sodium absorption ratios (SAR) in excess of 15 percent. Australian research showed that the 'effects of sodium on infiltration rates, hydraulic conductivity, crusting and hardsetting are manifested in measurable and often sizeable proportions down to very low levels far below those previously used to define sodic soils'.

The volume of drainage water available for potential reuse in Pakistan varies considerably in both space and time and is expected to increase as water tables are lowered through SCARP implementation. In addition to salts and trace elements leached from the soil, drainage may contain domestic sewage, industrial effluent and chemicals, such as fertilizers and pesticides.

Data on trends and patterns in drainage quantity and quality is a prerequisite for any proposed re-use scheme. Although some limited spot sampling has been undertaken in this regard, no long-term, comprehensive data exist. Available data is scattered having been collected at different times by different organizations using a variety of methods at sometimes ill-defined locations. Existing knowledge is not easy to access and analyze and much of the data is of unknown origin.

Increasing urbanization and population growth increase the likelihood that water draining from irrigated areas becomes polluted by sewage and industrial effluent. The direct use of untreated effluent for irrigation, which is being practiced by some farmers in Pakistan, frequently leads to damage to crops and could be a danger to public health.

Where good quality water is sufficiently scarce, there should be a high willingness to invest in low cost sewage treatment in order to produce effluent that can be safely reused for irrigation. Under certain conditions private financial returns to this kind of investment would be attractive.

Evaporation ponds are a means of disposing of saline drainage water for a number of command areas in the middle reach of the Indus plain, Punjab. Evaporation ponds are already in operation in two commands (Pat Feeder on the Indus right bank and SCARP VI on the Indus left bank). Other ponds are in an advanced stage of planning for ,another command (Fordwah Eastern Sadiqia South). Evaporation ponds may eventually serve a total area of **1** to 2 million ha. Data on their performance and environmental impacts is scarce. Monitoring of the existing ponds has been limited, However, these ponds have created waterlogging of nearby agricultural lands through groundwater seepage.

DRAINAGE IN PAKISTAN

SCARP **Tubewells**

In the 1950s detailed surveys were made of water table levels and salinity in the Punjab with collaboration of the US Geological Survey. These formed the basis for the SCARP program and the decision to go ahead with the public tubewell program. About 10,000 such wells producing approximately 3 cfs average were constructed by the early 1980s. The main purpose of the public tubewells was to combat waterlogging and salinity, but where the water was not too salty, it was used for irrigation. This demonstration led to a proliferation of private tubewells of 1 cfs and less by the farmers by the early 1970s and resulted in a reduction in plans for public tubewell installation particularly in fresh ground water (FGW) zones, where a SCARP transition program is attempting to hand over the pumping of ground water to the farmers. However, in saline ground water (SGW) areas, where tubewell pumpage cannot be used for irrigation, the tubewells remain in the public sector but these are plagued with technical and institutional problems effecting O&M.

Excessive private tubewell pumping, while increasing the cropping intensity in an environment of scarce canal water and lowering the water table, may deplete the FGW and allow encroachment of poor quality ground water. Waterlogging and salinity remain a hazard for the Indus Basin and threaten the livelihood of farmers, especially the smaller ones. Drainage rather than additional water continues to be priority number one

for the sustainability of the system. While this may be understood by planners and researchers, the farmers individually and collectively often appear pre-occupied primarily in securing additional irrigation water.

Surface- and Pipe-Drainage in Pakistan

Lack of well-defined natural drainage in the Indus Basin has caused a surface drainage problem that has been further aggravated by construction of roads, railways, flood embankments and the irrigation system. The existing surface drainage system is inadequate, although over the years more than 9,000 miles have been constructed. Shortage of funds for maintenance led to the present state of neglect.

Pipe drainage is a relatively new concept for alleviating waterlogging and salinity problems in Pakistan. It was introduced in the mid-seventies in East-Khairpur Tile Drainage Project, and since then some 100.000 ha have been put under pipes. This implies an average annual implementation rate of 5000 ha. Although'the first results of pipe drainage are encouraging, the rate of implementation, the cost of construction, and the cost of operation and maintenance are such that the government can ill afford to bear all the costs and the responsibility itself. Moreover the large public systems are increasingly hampered by problems of low irrigation efficiency, inadequate functioning of the drainage system, and deficiencies in operation and maintenance.

Impact of drainage on watertables and soil salinity

Many investigations have been conducted into the results of the implementation of drainage systems.

Bhutta et al. (1996a) reviewed the performance of pipe drainage in Pakistan. Their data analysis included drainage discharge, drain depth, lateral spacing, ground watertable, land use and soil salinity. They conclude that: (i) The investigated drainage systems are all capable of maintaining the water table at a depth of 1.0 to 1.5 meters below the natural surface, thus solving the waterlogging problem; (ii) The pipe drainage systems of East Khairpur Tile Drainage Project and Fourth Drainage Project reduced the sodicity/salinity in the soil profile and of the surface; (iii) The data of the Fourth Drainage Project indicated that abandoned land has decreased, and cropping intensities have increased due to the installation and operation of the (pipe) drainage system.

Bhutta et al. (1996b) discuss re-use of drainage water for irrigated agriculture. They found that the effluent of drainage systems, and especially tubewell drainage systems, is saline to a large extent, and severely hampers agriculture if disposed off into the fresh water river system of the Indus valley, the current practice. Environmentally safe disposal of drainage effluent requires more study. The poor water quality of some SCARP tubewells is one of the reasons for the rate of increase in sodic lands.

Often, the choice for a subsurface drainage system is between a tubewell and a pipe system. Tubewell drainage is common in Pakistan, and is known to effectively lower watertables, for a much lower capital cost than pipe drainage. But, tubewell drainage often has a negative environmental side-effect due to the mobilization of salts in the deeper sections of the deep aquifer underlying much of the agricultural lands.

To investigate the relationship between drainage technology and effluent quality, Wolters et al. (1996) compared a tubewell drainage system, SCARP II, with a pipe drainage system, Fourth Drainage Project, to detect possible trends in changes of groundwater **quality.** The comparison showed that the effluent quality of the tubewell system either remains constant or deteriorates, whereas the effluent of pipe drainage systems, and the related shallow groundwater quality, showed some initial improvement. This result is concurrent with the findings from other studies:

- For tubewell systems: Beg and Lone (1992), and Latif and Hussain (1992) concluded that overall, the percentage of wells with hazardous water quality remains constant and that the variations between the numbers of wells with either usable or marginal quality are not significant. There is little change in effluent quality, although the soil salinity status improved. Their studies moreover showed some probably very normal variations in effluent quality, caused by e.g. climatic variations or adjustments in the operation of the irrigation and drainage system in the area;

- For pipe drainage, **M.** Munir Ch. et al. (1992) report on a test at an area of 10 acres in the command of tubewell MN 93 in the Mona Reclamation Experimental Project, which had gone out of production due to waterlogging and salinity. The quality of the drainage water quickly improved after the installation of the system and start of cultivation. The data of the East-Khairpur Tile Drainage Pilot project of DRIP also showed a distinct trend of improvement from 1982 until 1990 (DRIP 1993). By 1990, the part of the area with groundwater of hazardous quality had decreased by more than half. Nevertheless, after 1990 a rapid decrease in quality was measured, caused by stoppage of pumps. Improvements were obtained rather quickly, but without operation of the system, the return to pre-project conditions was quick as well.

This may imply that 'shallow drainage' may be more environmentally friendly that 'deep drainage'. This is concurrent with the findings of Kamra et al. (1992) who report that a shallow drain depth results in lower salinity of effluent in the initial years of functioning of the drainage system. However, the capital cost may be a problem: very roughly, pipe drainage typically costs 1000 US$ per hectare, whereas tubewell drainage typically costs only 100 US$ per hectare. This may be the price to pay for a better environment.

But, all studies mentioned in this section confine themselves to changes in watertables and soil salinity. Much work is still to be done on the overall impact of drainage on the environment.

OVERALL ENVIRONMENTAL IMPACTS **OF** DRAINAGE IN PAKISTAN

In the preparation of the National Drainage Program, an inventory was made of all environmental impacts of drainage, the 'Drainage Sector Environmental Assessment' (NESPAK/MMI, 1993). The result of this inventory is given in Table I, where the impacts are sub-divided into the following headings: Hydrology; Water Pollution; Soils; Ecology; Socio-economic factors; Imbalances. The information in the Table also gives an overview of the probable direction and scale of the impacts. Impacts requiring mitigation are mentioned.

Little is yet known about most of these impacts, but recent IWASRI research has shown that in drained areas life was better than in un-drained areas. Higher income permitted, e.g., access to health care and schooling for girls (Kishwar, 1996).

Table I Direct Environmental Impacts of drainage in Pakistan (NESPAK/MMI, 19931

Group	Environmental Factor		Process or Variable	Probable Direction and Scale of Impacts
Hydrology				
1.4	Water table		Reduction of near surface water table	Significant reduction of water table
Water Pollution				
2.1	Solute transport	*	Mobilization of soil salt	Substantial increase
2.3	Organic pollution	*	Transport of organic pollutants downstream	Locally significant - negligible overall
Soils				
3.1	Soil salinity	*	Leaching of salts from agricultural soils	Major increase
3.2	Physical properties	*	Development of sodic soils	Locaily severe - moderate increase overall
3.3	Saline groundwater		extent and depth of saline groundwater reservoirs	Locally important-minor/moderate positive overall
3.5	Organic material recycling		Oxidative decomposition of organic wastes	Substantial increase in all drained areas
3.6	Nitrogen fixation		Nitrogen acquisition by plants	Substantial increase in all drained areas
3.7	Nutrient availability		Operation of tree - mycorrhyzal association	Substantial increase in all forested areas
Ecology				
5.1	Projeet lands	*	Habitat change in waterlogged and saline lands	Substantial change. detrimental to aquatic life
5.2	Wetland birds	*	Availability of resting, feeding and breeding sites	Negative and positive - balance probably minor negative
5.3	Wetland aquatic fauna	*	Habitat changes for aquatic species	Negative and positive - balance probably minor negative
5.4	Wetland vegetation	*	Changes in plants growing in wetlands and drains	Locally severe negative
5.5	Peripheral lands	*	Effect of reclaiming land on adjacent habitats	Negative and positive - balance probably minor negative
5.6	Rare and protected species	*	Effects on specific sites important to rare species	Locally severe negative
5.7	Riverain forest resources		Effects of habitat changes on riverain forests	Locally minor positive
5.8	Irrigation forest resources		Effects of habitat changes on irrigated forests	Locally major positive - overall minor positive
5.9	Mangrove forests		Effects of drainage disposal on estuarine and coastal mangroves	Locally minor positive - overall nil
Socio-economic Factors				
6.1	Employment		Changes in employment opportunities	Substantial increase. mainly indigenous workers
6.2	Land productivity		Changes in agricultural productivity	Substantial increase
6.7	Nomadic groups	*	Access to land and benefits of nomadic herders, etc	Substantial negative
6.9	Housing		Effect of drainage on stability of Kutcha housing	Moderate positive
6.10	Secondary employment		Generation of secondary employment after drainage	Substantial positive
6.11	Livestock nutrition		Access to fodder, especially n the dry season	Substantial positive
6.12	Archaeological sites		Effects on stability of archaeological remains	Substantial positive
Health				
7.1	Domestic water supplies		Access to uncontaminated water sources	Potential substantial increase, but subject to investment
7.2	Sanitation	*	Effects of changes in human habitats on sanitation and consequent risks	Substantial negative
7.3	Housing and shelter		Availability of land for settlement	Moderate increase
7.4	Nutrition		Effect of agricultural changes on human food supplies	Substantial increase but inequitable distribution likely
7.7	Water contact diseases of man	*	Changes in patterns of human contact with contaminated water	Major increase in exposure
7.8	Vector-borne diseases of man	*	Changes in vector attack opportunity	Major increase - i.e. major and negative
1.9	Diseases of livestock	*	Changes in exposure to disease vectors	Major increase - i.e. major and negative
Imbalances				
8.1	Flood risk		Effect of drainage channels on local flood risk	Locally moderate positive
8.3	.Aquatic weeds	*	Changes in distribution of weeds in wetlands and drainage channels	Major increase likely

STRATEGY TO COMBAT WATERLOGGING AND SALINITY

The now emerging long-term strategy, vital to sustain irrigated agriculture in the Indus Basin and to keep the system in balance, appears to be based on:

- Water conservation measures to increase availability of water at the farm gate, increase agricultural productivity and reduce recharge to rising water tables - including lining of conveyance channels, improved on-farm water management, institutional changes for O&M system control and ownership through total involvement of the farmers and water rates rationalization by considering canal water into a 'tradeable' good;

- Rehabilitation and extension **of** the surface drainage system to clear salt inflows and water obstructed by irrigation and road infrastructure - including ideas for extension of the outfall drain to the Arabian Sea, and tributary drains down from the chak level:

  Studies for the better management of the system, including institutional studies to establish autonomous provincial water authorities and area water boards, with farmer participation, groundwater laws, modeling studies on salt movement, mining of ground water and salt build-up in FGW areas, studies on disposal of saline drainage effluent and drainage studies in SGW areas.

To tackle the urgent problem of waterlogging and salinity - which is the result of a multitude of factors, including: human intervention in nature, financial neglect, mismanagement, decay of institutions, lack of planning and learning from research, exclusion of the end-users as active stake holders in the management of the system - a mid-term strategy has emerged from the National Drainage Program. This strategy essentially relies on drainage, implemented along side the long-term measures, as the single most important operation to bring the Indus System back into balance that can then be maintained **by** the adoption and institutionalization of the measures of the long-term strategy. Environmental impact mitigation of the negative effects of the drainage operation should form an essential part of the program that proposes surface drainage and subsurface (pipe) drainage schemes as well as small schemes to alleviate localized drainage and public health problems.

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SUMMARY OF PANEL DELIBERATIONS ON OPTIONS AND RECOMMENDATIONS FOR ENVIRONMENTAL MANAGEMENT OF IRRIGATED LANDS

by

Pierre Strosser, Rapporteur

TECHNICAL ASSISTANCE TO FARMERS

The panel discussion addressed two important issues related to technical assistance for farmers.

(i) Who would provide this technical assistance to farmers?

OFWM and extension services are organizations that could provide technical assistance to farmers. However, both orgnizations need to be strengthened (human resources development, training, etc). At the same time, for irrigated agriculture, there is a strong need to have a collaborative effort between OFWM and extension services, in order to provide special services focused on irrigation management at the watercourse level and combined water and salinity management at the farm level.

The private sector, NGOs, and farmer organizations (FOs) should also be involved in this issue. However, their specific role (whether developing, testing, providing technical messages) were not further specified.

(ii) What would be the content of the technical assistance7

Although messages to be delivered to farmers are available on the research side, there is a lack of effort from researchers to translate these messages into useful extension messages that can be disseminated to farmers. To do *so,* there is a need to have research adapted to farmers' needs, along with a need to strengthenldevelop the link between research and extension services, as well as training institutes.

Researchers must recognize the constraints (physicallsocial) under which farmers operate and determine management practices that can be adopted within these constraints. It is not one message that is to be provided to farmers, but a range of messages (or packages of messages) adapted to production strategies and constraints of different types of farmers under different conditions (large versus small, rich versus poor, good versus poor access to water resources). It is important to ensure that the options proposed can effectively be implemented by farmers (for example, the advise to

use gypsum to tackle sodicity may be scientifically sound but useless if there is no gypsum available in the market!).

Non-technical assistance may also be required to complement the traditional technical packages that are proposed to farmers (for example, accounting, management, etc).

(iii) Towards implementation strategies

In order to develop and deliver better (adapted) packages of messages, some constraints faced by researchers must be removed. In particular, funds must be allocated in priority to field research. This will ensure researchers and farmers have direct contacts, and researchers develop an appreciation for farmers needs and options.

Farmers should pay for the technical services they receive and this money could be used to pay extension staff and development of new messages. However, no agreement was reached during the panel discussion on the issue of payment by beneficiaries.

Modalities for change have not been clearly spelled out. The discussion did not lead to many concrete proposals. The only one (that is heard for every proposed change) is to start with a pilot project.

COMBINED IRRIGATION AND DRAINAGE MANAGEMENT

(i) Issues

Several points were made regarding what is efficient irrigation and how to reduce drainage, starting from the crops, or from the source, and the factors that should be included in the definition of efficiency (including leaching fraction, economic aspects, etc).

The appropriate level (scale) at which irrigation and drainage should be combined needs to be carefully assessed. Not only scale in terms of hydrological boundaries, but also scale regarding the actors involved in the management of irrigation and drainage (at the large scale, drainage is still the role of the government, whereas at the local scale, farmers organizations would be involved for more sustainable solutions).

(ii) Proposed solutions (to better combine irrigation and drainage?)

A few solutions were proposed for combined management: lining of canals, to review the allocation of canal water and limit allocations based on irrigation and drainage aspects (combined control of irrigation and drainage), use of drainage water for irrigation (to close the cycle), improved irrigation practices taking into account water quantity and quality issues, and cascade irrigation (to reduce the final quantity of disposal water).

Other solutions were more directed towards irrigation issues (e.g. to increase the storage capacity in the Indus Basin Jrrigation System) or drainage issues (e.g. biological drainage).

However, before starting to discuss combined management, there is a need to have better knowledge about the actual situation regarding supplies, waterlogging and salinity. There is an urgent need to upgrade information available to assess the present situation. This effort requires the involvement of various institutes such as SSoP, WAPDA, PID, etc. A first step is to test a methodology to collect this information in the Fordwah Eastern Sadiqia Irrigation and Drainage Project.

MAINTENANCE OF DRAINAGE FACILITIES

Several points were discussed under this heading. In summary, several problems related to the maintenance of drainage facilities are important.

(i) Construction of drains

Inappropriate location of drains leads to quick deterioration of the drainage facilities. Also, there are problems of delivering a well functioning drainage system (accountability at the construction stage), and a system that is adapted to the capability (financial, skills, etc) of the people (government, farmers) that are asked to manage the drainage system.

(ii) Allocation of funds

The funds allocated to maintenance of drainage systems are not sufficient. Also, managing the drainage system is not a priority of the irrigation department (and available funds are mainly used to pay the salaries of staff). Also, there is no proper procedure to allocate these scarce resources for an optimum maintenance of existing facilities.

(iii) Role of farmers

Farmers should be involved in the maintenance of drainage facilities, but up to which level? The National Drainage Program has proposed that farmers would operate and maintain drains with less than 15 cusecs capacity. However, special machinery will be required, and there is a need to develop this machinery. Also, training and education will be needed.

Again, the idea that end-users should pay was discussed. Also, other potentially affected people such as industries, villages and cities, etc, may have a financial responsibility. However, existing legislation may require modifications for the implementation of this mechanism.

(iv) Research

Research on the management of drainage facilities does not exist in Pakistan. No institute is properly monitoring the functioning and performance of drainage facilities, nor investigating methods and tools for optimum management of the drainage system. Funds need to be allocated for research on these issues (see the example of Egypt where research on the management of drainage systems is well developed).

GROUNDWATER MANAGEMENT

(i) The institutional set-up

As mining of the aquifer is an increasing phenomenon (for example, seven canal command areas are under this situation in the Punjab), there is a need for regulation, establishment of guidelines, and and institutionalization of the groundwater sector.

But who is to look after the groundwater sector? Although the idea to create a special organization may be appealing, it would be more appropriate *to* keep the existing institutions and not to add an extra body. Let's not add one more institution!

Water Users Associations could also be involved in the regulation of groundwater pumpages in collaboration with PIPD. This would also make these associations more sustainable.

(ii) Research

Research on groundwater use is required. The issues discussed included: interaction between aquifer and streams, development of appropriate water quality criteria (to be specified for different environments to take into account the heterogeneity of situations in the Indus Basin), artificial recharge of the aquifer, and sustainable rates of withdrawals.

(iii) Technical assistance to farmers

Although it had not been discussed under point 1, groundwater should be part of the package (technical assistance) to be provided to farmers. There is a need to advise farmers regarding different tubewell design options (discharge, bore depth, diameter of pipe, etc), management of poor quality groundwater (which parameters to include, inclusion of leaching fraction, etc), expected impact on salinity/sodicity, etc. Afler, farmers will do whatever they want anyway!

(iv) Towards integrated water resources management?

Several levels of analysis were discussed during the panel discussion: to look at canal water and tubewell water together (conjunctive use); on where to allocate both resources in an optimal way for high productivity and sustainability; to include rainfall in the analysis of conjunctive use; and to look at recharge of the aquifer.

The discussion moved from an analysis of groundwater issues towards a proposal for integrated water resources management. And this integrated water resources management should take into consideration the limitations related to the resources themselves (for example, available groundwater). In this context, there is a need to develop a common platform to plan and evaluate integrated water resources interventions (however, questions such as who, how and when were not put on the table).

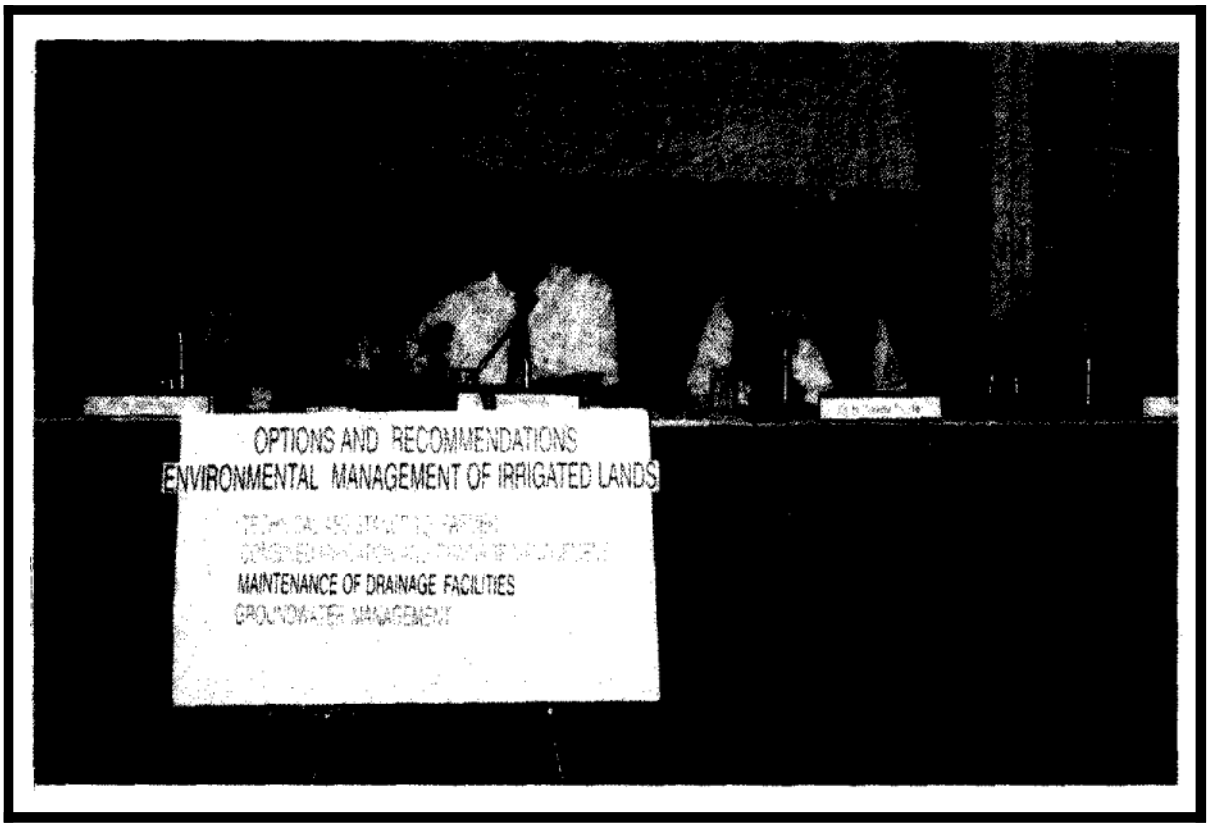
OTHER ISSUES

The management of the irrigation system is to be considered in the context of macro-economic policies that significantly affect farmer's behaviour and irrigation water use. For example, if end-users are asked to increase their financial contribution to maintain the irrigation and drainage facilities, or to receive technical assistance, then prices of commodities need to be increased and adjusted to world prices.

General issues with regards to the involvement of users was also discussed. Should farmer associations include water users or water owners, considering tenancy practices in Pakistan?

Issues	Options	Implementation
Salinity and sodicity in Pakistan Problems of sodicity increasing. Use of groundwater of poor quality Heterogeneity of situations.	To reduce existing constraints faced by farmers (canal water supplies, credit, access to required inputs). Specific messages related to use of groundwater of poor quality and potential reclamation measures. Site specific solutions.	All Provinces
Combined management of irrigation and drainage Inefficient (separated) management of the water sector?	Technical solutions. Need for appropriate assessment (which methodology) of the actual situation in terms of water supplies, waterlogging, salinity and sodicity	Pilot test in FESS
Maintenance of drains Poor status & performance. Lack of interest in O&M. No specific procedure for optimum O&M.	To allocate financial resources. To develop approaches for optimum allocation of resources. Involvement of farmers (with appropriate training). To develop research program: how to manage; optimum allocation of funds; and machinery required for farmers.	LBOD FESS

Groundwater management Mining of aquifer. Use of poor quality groundwater Still unknown answers.	Legal and institutional framework. Technical messages to farmers on ground water use and conjunctive management. Research: development of appropriate water quality criteria (site specific); recharge of aquifer; behaviour of aquifer (reiationship with streams); and appropriate tubewell design criteria.	Punjab Rechna Doab
Technical assistance to farmers Lack of appropriate assistance provided to farmers regarding environmental management.	To strengthen the link between OFWM and extension services. Training on environmental issues to staff of these agencies. Researchers to focus on field research. Analysis of constraints to deliver messages adapted to farmers' conditions. From one message to adapted packages. Involvement of other actors (NGO, private sector, FOs). Beneficiaries paying for technical assistance (?)	**Ail** Provinces
Integrated management **of** water resources Lack *of* proper information for planning. Implementation of integrated management. Evaluation of options	Development of an appropriate (spatial) information system. Platform for integrated water resources management. Research focused towards development of tools to assess impact, towards integrated approaches. Training in the **use** of improved technologies/methodologies (e.g. GIS/RS).	Collaborative effort between afferent nstitutes, tested in FESS LBOD and other locations as opportunities arise



PANEL ON ENVIRONMENTAL MANAGEMENT OF IRRIGATED LANDS
(L to R: Mr. Dr. M. Alam Mian, Dr. W. Wolters, Dr. M. Nawaz Bhutta and Mr. Pierre Strosser)

PANEL ON INSTITUTIONAL DEVELOPMENT
(L lo R Mr. Amanullah Hussaini Jagirdar, Dr. Amir Muhammad,
Mr. Tariq Banuri, Mr. D.J. Bandaragoda)

THEME IV: INSTITUTIONAL DEVELOPMENT

ISSUES PAPER: ISSUES IN INSTITUTIONAL DEVELOPMENT FOR IRRIGATED AGRICULTURE IN PAKISTAN

by

D. Jayatissa Bandaragoda[11] and *Gaylord V. Skogerboe*[12]

RIVER BASIN DEVELOPMENT

Conceptually, there are a few basic guidelines in developing the water resources in a major river basin. First of all, in the early days of development, when the river basin is sparsely populated, people need water for domestic purposes, but for arid areas, they also need water for producing food. Basically, the water needs of the people can be satisfied by moving water from the river or its tributaries to the people, which was often adjacent to their sources of water. In other words, physical works are required, which is often referred to as "hardware development".

As the population *of* a river basin increases. there is an increasing demand for more hardware development, but the need to consider numerous other complementary measures involving economics, management and policies begin to grow in importance. As the water resources became more and more utilized, there is an increasing milieu of "software development" measures that have to be considered and then implemented in conjunction with hardware measures.

Finally, as the water resources approach full utilization (say 85-95%), the development efforts have to be guided completely by software measures. In fact, hardware **is** only used to support software development. Thus, the strategy for increasing water resources utilization is entirely focused on software solutions with hardware only being used to support the successful implementation of software.

The major issue concerns the status of water resources development in the Indus Basin. Water utilization is approximately 75%. How much more emphasis should be placed on software development than has been so far considered?

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SOFTWARE DEVELOPMENT

The development of irrigated agriculture in most places, even in the last few decades, has focused almost entirely upon the construction **of** water delivery and water removal subsystems. This preoccupation with the installation of "hardware" results from a naive single-discipline approach to water management (Wiener, 1972). and one discipline cannot begin to solve the complex physical, economic, and sociological problems involved. Probably the greatest deterrent to improved water management in most irrigation systems today is the inordinate focus on the water delivery and removal subsystems and the almost complete neglect of other requirements. In reality, though, especially in irrigated agriculture, we come face to face with a wide gap that frequently exists between "hardware development" and the development of all the other requisites for increased agricultural production, namely "software development."

The approach that has been applied to irrigated agricultural development in the past is characterized by separating the development of water resources from the management aspects of water resource utilization. Therefore, the record shows development being emphasized greatly while management is most often neglected. This orthodox approach has been used almost exclusively in the western United States and other developed countries with reasonable success (but is no longer acceptable). However, as the water resources become more fully utilized, the necessity for meeting new water demands (along with physical, socioeconomic, and political problems of water quality degradation) require that much of the conventional wisdom of the past be questioned. It should also be obvious that many other countries have neither the time nor resources many western irrigated regions had **to** utilize in their development. Pressures created by rapidly rising populations and corresponding water scarcity will force them at some point to re-evaluate their approaches.

In contrast to the mere development of water resources approach, the "management" approach attempts to achieve water development objectives by applying a variety of measures after studying the entire system, thereby attempting to modify the total system to meet new and changing demands as well as estimated future demands. Therefore, instead of constructing new engineering works to meet new demands, the focus should be upon water resources management, with construction works considered only 'as a tool when necessary to meet water management objectives (Wiener, 1972). Unfortunately, in most cases, water management and the marly disciplines required to produce efficient management are relegated to the postanalysis of engineering works, which aggravates not only the implementation of technology, but really constrains or makes extremely difficult the implementation of a host of services requiring strong institutional measures (Skogerboe, 1991).

AN INSTITUTIONAL LESSON

USAID funded an On-Farm Water Management Pilot Project (OFWM) from July 1976 to June 1981. The major target was the improvement of 1,500 watercourses scattered throughout Pakistan. The major emphasis was upon earthen improvements by the farmers, followed by brick-and-mortar lining of 10 percent of the watercourse length. The lining could be located anywhere along the watercourse, which was expected to be through the village (for health and social reasons) or at the head of the watercourse. Almost universally, the lining was done at the head in order to gain support from the farmers located in this area, who otherwise would not have benefited. Prior to watercourse improvement, the water losses were measured and this information was shared with the farmers. In addition, considerable effort was expended in developing training courses for OFWM staff. Eventually, there were also research activities associated with the program.

The Water Management Research Project staff **(4-7** faculty) of Colorado State University (CSU) were in Pakistan from June 1970 to November 1979, when they had to depart because of the Pressler Amendment. At their time of departure, the highest priority research activity was to sustain and strengthen water users associations so that they would maintain their improved watercourse. A part of this effort was to provide a legal basis by having each provincial assembly enact a Water Users Association Act. This finally occurred during the period 1980-82.

Surprisingly, the target of improving 1,500 watercourses was achieved by June 1981. Then, the World Bank provided loan funds for OFWM-I in July 1981. This was followed by OFWM-II and presently OFWM-III. In addition, the Asian Development Bank has also been providing loan funds for very similar projects. Also, Canada and Japan have been supporting OFWM projects.

The OFWM program has been very popular with farmers. They have been clamoring for this program. Certainly, this has been one of the most popular development activities in Pakistan. Unfortunately, this highly successful program has been steadily degenerating through the years.

Presently, watercourse losses are not measured by the OFWM staff. Also, farmers no longer rebuild their earthen watercourse. Instead, the focus is almost entirely upon watercourse lining. This emphasis **is** also recognizable by the almost total lack of sustainable WUAs. A common statement is that WUAs have nothing to do after watercourse lining is completed. This is true because the only purpose in organizing the farmers was to get the lining underway. There was very little concern about creating sustainable WUAs that would maintain their improved watercourse, along with making more effective use of any water savings through improved water management (including agronomic) practices. From the very start, the major emphasis was focused upon the targets for improved watercourses. This emphasis was reinforced by the donors. In the end, the emphasis was largely confined to watercourse lining.

The most important lesson to be learned from the OFWM program is that when the emphasis is upon civil works, then the institutional component is relegated to such a low priority that it is unlikely to be successful. In future development projects, the institutional component needs to lead **the** way with the physical component following in a manner that supports the institutional component.

On-Farm Water Management became a misnomer as the program steadily degenerated into a Watercourse Lining Project. There is still a tremendous need to reach the farms in Pakistan. They have been ignored for too long. In fact, an integrated approach is needed, starting with the operation and maintenance of the canals and branch canals, overcoming the enormous inequities that occur along distributaries, improving the management of watercourses, and assisting farmers with improved irrigation and agronomic practices. **All** of these activities, and more, are needed *to* overcome the present situation of a rather stagnant agriculture.

INSTITUTIONS AND INSTITUTIONAL DEVELOPMENT

In popular use, the term "institutions" usually refers to organizations, and the term "institutional development" often implies just the creation of new organizations. However, according to the definitions oflen used by analysts, institutions are basically the rules-in-use, and therefore, irrigation institutions can be described as the **sets** of working rules for supplying and using irrigation water (Ostrom, 1992).

In that sense, institutional development should mean more than establishing new organizations; rather, it should mean also improvements in the existing working rules and organizational structures, aimed at achieving improved management performance. Enhancing coordination mechanisms, improving management accountability, re-orienting the organizations and updating the legal framework are all covered by institutional development. It should also mean eliminating or reducing the dysfunctional elements of the existing institutional structure. For instance, many commentators have expressed the view that no performance improvement can be achieved without curtailing corruption, which is also part of the rules-in-use that pervades the society.

NEED FOR INTEGRATED INSTITUTIONAL DEVELOPMENT

Only an integrated approach can solve system-wide problems. The operational and maintenance deficiencies in the entire watershed system, which includes barrages, reservoirs, main and branch canals, distributaries and watercourses, converge on the farm level eventually, causing low agricultural performance. Any institutional solution, therefore, should necessarily address all of these management problems and should

cover the whole system. Isolated institutional interventions targeted at selected problems or subsystems are unlikely to produce desired results. For example, even the best water users organization trying to improve water distribution at the distributary level will be constrained by operational problems in the branch or the main canal. Similarly, no one agency, however efficient it may become, can solve all the problems of irrigated agriculture. In identifying the need for an integrated institutional development approach for improving Pakistan's irrigation performance, the following key issues can be considered:

* Complexity of Rules-in-Use

Since irrigation is associated with fairly complex social systems, the institutions operative in the context of irrigated agriculture in rural societies are profoundly complex. The major part of this complexity lies in the society itself; farmers are of different distinct social groups with different sets of goals and objectives, and different alliances. The formal rules designed to govern their conduct in an orderly manner give way to flexible informal rules. For instance, a recent study in a sample of twenty-two watercourses in the Punjab did not find a single pucca warabandi in practice as officially designed (Bandaragoda and Rehman. 1995). Similarly, forces of tradition, such as feudalism, caste and biraderies have a greater influence over people's lives than the written codes of law. In these deep rooted informal behavioral patterns, giving or accepting a bribe has become an accepted norm rather than a crime punishable by law. Taking more water than assigned, or tampering with irrigation structures, are routine occurrences.

By nature, institutions are intrinsically inter-linked. In the present context, these linkages are criss-crossing various categories and groups of people, adding to the complexity. For instance, some farmers are more closely linked with agency staff than with the farming community; people shift their political alliances when their feudal lords change parties Politicians from rural electorates have an urban bias in their policy preferences. Because of this inter-linked network of relationships, a change in one institutional aspect requires or generates corresponding changes in others. Giving recognition to this concept means that the planners need to think of an integrated package of institutional reforms, rather than of isolated items in an ad-hoc manner.

* Redefinition of Roles and Re-orientation of Attitudes

Recently, the water users' participation in operating and maintaining water resources infrastructure has been advocated as the main focus of the needed institutional reforms. Popular participation is believed to be a strategy to increase the probability of establishing infrastructure people want, in ways people can and will manage them (Mienzen-Dick et al, 1995). This approach implies a new role for the

water users. They are expected to have a major attitudinal change from being mere "beneficiaries" of government assistance to sharing responsibility for managing infrastructure. More importantly, the water users have to change to a new situation in which they think and act as groups rather than individuals.

The success of this approach requires a redefinition of the roles of the other actors as well. Redefinition of roles while focusing on users' participation implies that the government's operating agencies and their staff will have to empower the water users for undertaking new management responsibilities; the regulatory and enforcement agencies and their staff will have to recognize these changed roles of various actors; the agriculture extension agencies and their staff will have to support the organized water user groups; and the big landlords and other rural-based influentials will have to acknowledge a new power base emerging in the water users' organizations.

- Incentives to Satisfy Multiple Interests

Most of the different (but inter-linked) institutions are related to different stakeholders of irrigated agriculture. The economic, social and political viability of a package of institutional reforms would depend on its ability to satisfy the overall interest of these stakeholders.

Some of the stakeholders obviously benefit from the status quo and, therefore, resist change more than the others. For instance, some influential landowners gain from the existing situation of inequitable water distribution; they are the most vociferous opponents of institutional reforms. Similarly, the water users in the head reaches of a distributary, who gain from inadequate maintenance, may be the reluctant participants in collective action. The case of some agency staff may be the same with respect to changes in the present institutional structure.

For the majority of stakeholder groups, a potential for improvement in the existing (socio-economic) situation will be the critical incentive for accepting change. Is there a potential for improvement in terms of efficiency, equity, cost recovery and accountability, the four most quoted criteria of benefits of institutional change in water resources management? Finally, is there a potential for improvement in the returns to investment in the system as a whole?

PAKISTAN'S CONTEXT

Crafting of irrigation institutions was seen as an on-going process involving the users and suppliers of an irrigation system throughout the design process (Ostrom, 1992). The institutions were to match the unique combination of variables in a given system. In this sense, the combination of variables in Pakistan would include the following (Bandaragoda and Firdousi, 1992):

- skewed land ownership pattern
- increasing number of small landholdings
- majority of water users are illiterate, poor and small landowners
- lack of information sharing
- centralized irrigation bureaucracies
- lack of accountability of officials
- political interference
- disregard towards operational rules
- inadequate maintenance
- inequitable water distribution
- stagnant crop yields

What would be the institutional development package that would best match this combination of variables in Pakistan?

IRRIGATION AND POVERTY ALLEVIATION

What does irrigation do to the rural poor? This is a major issue of water resources management in developing countries. The National Commission on Agriculture commented in 1988: "Input subsidies and price supports for cash crops worked more to the advantage of the large farmers, ... In fact, most of the increases in production resulted from the minority of large and medium farmers, ... The overall institutional support has not adequately benefited all crops, nor all categories of farmers". This situation seems to have remained largely unchanged. The number of small landowners has been steadily increasing due to fragmentation, while the land distribution pattern has remained highly skewed.

In Pakistan, the average per capita income in rural areas (where about 70% of the population live) is less than half that in urban areas, and value added per worker in agriculture (which employs about 50% of the work force) is less than one-third of the rest of the economy (Hamid and Tims, 1990). Absolute rural poverty dropped by only one-third in twenty years, a much lower rate compared to achievements in some States of India (John Mellor Associates and Asianics Agro-Dev, 1994).

A more recent evaluation pointed out that poverty considerations were not a priority in Pakistan's irrigation development projects (World Bank, 1996). "While the projects helped alleviate poverty through their effects on farm production, they also provided large and unnecessary transfers of public resources to some of the rural elite". In effect, On-Farm Water Management Projects, the Irrigation System Rehabilitation Project and the Command Water Management Project have all tended to favor the more affluent farmer groups.

In this context, how can new efforts in irrigation development and improvements in the irrigated agriculture sector help the sizeable number of relatively poor people? Can there be an institutional remedy to correct the growing imbalance?

LACK OF RESEARCH INPUTS FOR POLICY

In the recent past, there have been several attempts to include research as a component of development projects in Pakistan. The Fordwah Eastern Sadiqia (South) Irrigation and Drainage Project and the National Drainage Project are two examples. While these attempts have started to pay dividends, the investments in research generally, and in research related to institutional aspects in particular, are much less than required at this stage. Pakistan's expenditure is reported *to* be lower than the average of all developing countries and less than half the levels in newly industrialized countries in Asia (John Mellor associates and Asianics Agro-Dev, 1994). The research effort on institutional aspects is undoubtedly much less.

In the absence of a reliable research base, designing an integrated institutional development package becomes a difficult task. Usually, the attention given to the institutional problems remain at the level of a string of general statements about their importance, and it is implicitly accepted that institutional development is a *"soft"* subject, one which can be handled in the course of normal operations by engineers, economists, financial analysts, or whoever happens to be involved. "Since institutional development is everybody's business, it often becomes, in practice, nobody's business" (Israel, 1987).

CONCLUDING REMARKS

In this paper, the authors have attempted to identify a few important issues as perceived by them, and therefore, this is not an exhaustive list of issues related to institutional development for irrigated agriculture in Pakistan. Also, the paper has not proceeded to deal with any options, assuming that subsequent presentations would accomplish that task.

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SUMMARY OF PANEL DELIBERATIONS ON ISSUES AND RECOMMENDATIONS FOR INSTITUTIONAL DEVELOPMENT

by

D. Jayatissa Bandaragoda, Rapporteur

ISSUES

Some of the important issues presented at the conference as perceived to be associated with the needed institutional development for irrigated agriculture in Pakistan included:

1. Lack of emphasis on ***software*** development (management orientation) in an environment where water resource utilization is approaching an upper limit;

2. Consistent over-emphasis on ***hardware*** development (civil works orientation) being pursued;

3. Failure of the target-oriented water users' associations in the on-farm water management program and related difficulties in achieving program impacts;

4. Isolated versus integrated institutional and physical interventions;

5. Complexity of rules being used in the context of irrigation management;

6. Redefinition of roles and reorientation of attitudes following the introduction of institutional reforms;

7. Lack of incentives to satisfy the multiple interests of various actors in irrigated agriculture;

8. Mismatch of the existing irrigation institutions with the prevailing system variables;

9. Lack of inter-linkages between irrigation, existing relevant institutions, and rural poverty; and

10. Lack of a research base for the designing of integrated institutional reform packages.

RECOMMENDATIONS

During the lively discussion that was initiated by the Chairman, the panel speakers generally showed a consensus on two main streams of ideas. One was related to a common agreement that grass root level involvement in management decision-making would be the most urgent institutional change in Pakistan. The other was again a majority view that haphazard and hurried action to create new organizations would be a suboptimum solution to present problems in Pakistan. The following points emerged during the discussion to explain these two main ideas.

1. As institutions are basically to facilitate appropriate collective action within the society, a preferred approach in institutional development for improved irrigated agriculture would be to first promote the users' participation in irrigation management, and then, use the water users organizations as a vehicle to achieve further decentralization of government irrigation organizations.

   The water users organizations (WUOs) can monitor the performance of the government irrigation organizations, thus bringing about an element of accountability. The WUOs should assist in the process *of* modifying government organizations gradually. There is an urgent need to "salvage" the existing government irrigation organizations from the undue social pressure that is crippling them and making them ineffective in the application of operational rules and maintaining performance-oriented discipline among their staff. This can be achieved by a persistent growth of appropriate collective action. Initially, the government organizations need to be awaken into a state of "inertia". Otherwise, any new organizational structures hurriedly installed would be subject to the same crippling forces.

   There is prudence in starting from "what it is" and proceeding to "what it ought to be", while being sensitive to the working rules of the game, or of the informal system, rather than the formal or normative system.

2. When organizational restructuring is attempted. care should be taken to ensure that the new institutional arrangements are not subverted by the same factors that led to the collapse of the old systems. No useful purpose will be served if the leadership of the new organizations is going to be handpicked on the basis of patronage. The notion that there will be no, or less, political interference on para-statal bodies, as compared to government departments, is totally incorrect, as in the past some Corporations, Boards and Authorities have been equally affected by undue influence.

3. In due course, afler an uninterrupted process of a gradual development in institutions, a fairly integrated institutional system should be in place. This means that all of the elements of the institutional framework should reinforce one another (e.g. while the WUOs should take maximum responsibility that is possible for part of the composite irrigation system, the government organizations must provide the institutional support that is necessary for the WUOs to function effectively, etc.).

4. Transparency and accountability should be the basic criteria of institutional performance.

5. All of the partners involved in managing irrigation systems must recognize and benefit from the multi-disciplinarity of irrigated agriculture. The specialized groups in one discipline should learn to appreciate the other disciplines. The emphasis that is currently needed on "software development" will be realized only when the technology (hardware) is applied to play its supplementary role (e.g. the existing physical systems may need to be changed or modified to suit the needs of effective users' participation).

6. To give effective control to WUOs, it is necessary to ensure that there is a strong legal framework, in which the changed roles of the restructured government organizations are fully explained.

SECTION III

CONCLUDING RECOMMENDATIONS

by

Muhammad Badruddin, Gaylord V. Skogerboe and M.S. Shafique

Following the summary presentations by the rapporteur for each theme (see Section II), a concluding session of the Conference was held. For this event, some of the major recommendations that had been stated during the Panel Discussions were displayed on the poster boards. Then, the majority of the time was spent on open discussion from the Conference Participants.

The recommendations that follow are a synthesis of the major recommendations discussed during the concluding session. An attempt has been made by the editors to place these recommendations in a somewhat logical sequence, but this is rather difficult to accomplish. These recommendations have been placed under the following four sequential topics: (1) planning principles; (2) organizational roles; (3) system operations; and **(4)** salinity management.

PLANNING PRINCIPLES

- *PRESENT HIGH WATER UTILIZATION IN THE INDUS BASIN REQUIRES INCREASINGLY MORE EMPHASIS ON SOFTWARE DEVELOPMENT.*
- *INSTITUTIONAL MEASURES SHOULD LEAD AND CIVIL WORKS FOLLOW; OTHERWISE, INSTITUTIONAL DEVELOPMENT IS RELEGATED TO A VERY LOW PRIORITY AND PRACTICALLY NOTHING OCCURS.*
- *THE DESIGN AND IMPLEMENTATION OF ANY IRRIGATION DEVELOPMENT PROJECT REQUIRES SERIOUS CONSIDERATION OF MEASURES TO COMBAT THE SOCIAL DISEASES OF POLITICAL INTERFERENCE, RENT-SEEKING, AND FARMER ANARCHY.*

ORGANIZATIONAL ROLES

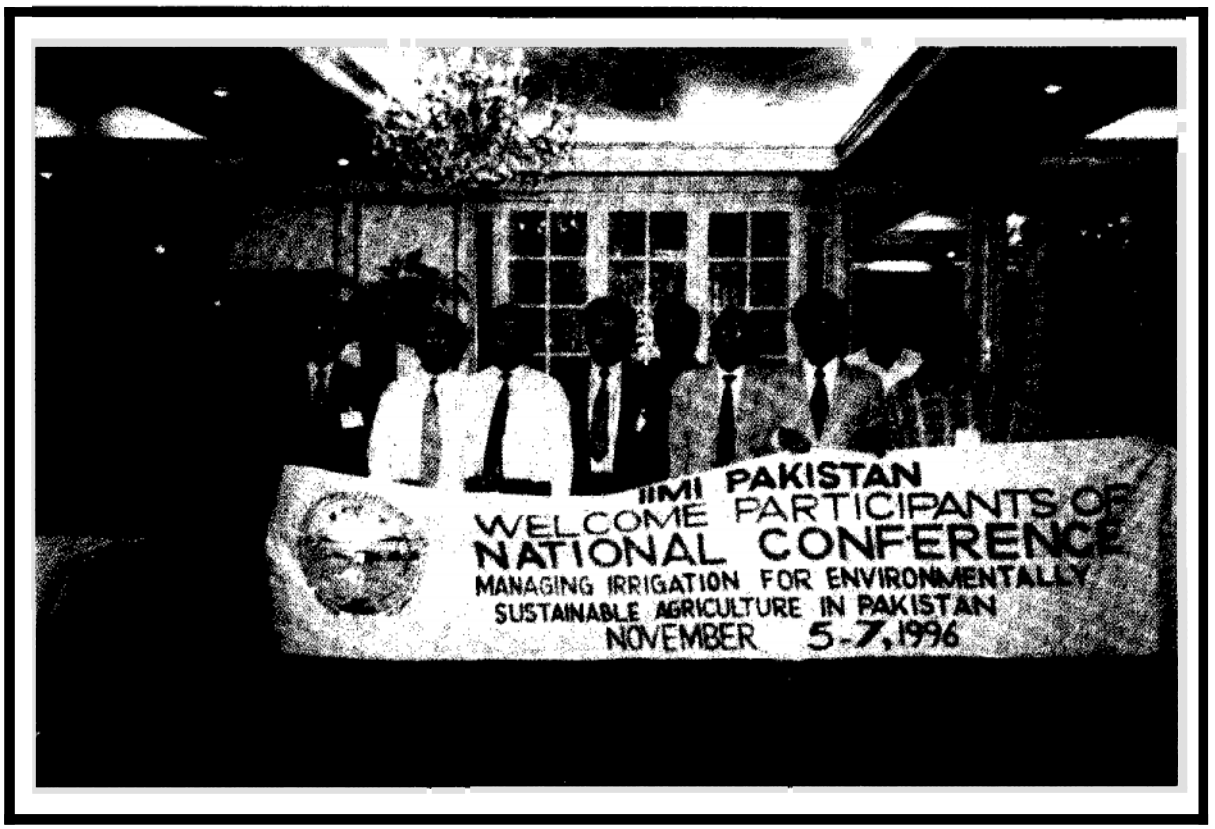
- *THE MOST LIKELY HOPE FOR INCREASING AGRICULTURAL PRODUCTIVITY AND COMBATING SOCIAL DISEASES IS TO ASSIST THE FORMATION OF WATER USERS ORGANIZATIONS AT BOTH THE WATERCOURSE AND DISTRIBUTARY LEVELS.*
- *IN EACH CASE, THERE IS A STRONG NEED FOR A JOINT MANAGEMENT AGREEMENT BETWEEN THE PROVINCIAL IRRIGATION DEPARTMENT AND THE DISTRIBUTARY WATER USERS ORGANIZATION.*
- *BOTH GOVERNMENT IMPLEMENTING AGENCIES AND RESEACH ORGANIZATIONS NEED TO STRENGTHEN THEIR CAPABILITIES AND DEVELOP OUTREACH PROGRAMS FOR PROVIDING MORE MEANINGFUL ASSITANCE TO ALL FARMERS.*

SYSTEM OPERATIONS

- *INSTALLATION OF A MODERN COMMUNICATION NETWORK THROUGHOUT THE INDUS BASIN IRRIGATION SYSTEM IS CERTAINLY NEEDED AND SHOULD PROVE TO BE HIGHLY COST-EFFECTIVE.*
- *THE EFFORTS OF THE PROVINCIAL IRRIGATION DEPARTMENTS IN EXPLORING THE USE OF MANAGEMENT INFORMATION SYSTEM TOOLS IS ENCOURAGED AND SHOULD BE CONTINUED.*
- *NATIONAL PROGRAMS ARE URGENTLY NEEDED TO OVERCOME THE DETERIORATING IRRIGATION AND DRAINAGE INFRASTRUCTURE RESULTING FROM A LACK OF APPROPRIATE MAINTENANCE, AS WELL AS INEQUITABLE AND UNRELIABLE WATER DELIVERIES RESULTING FROM THE SOCIAL DISEASE TRIPLETS, IN ORDER TO MOVE THE PRESENT STAGNANT SITUATION INTO A MUCH MORE PRODUCTIVE AND SUSTAINABLE AGRICULTURAL SYSTEM.*
- *SYSTEM OPERATIONS SHOULD MOVE TOWARDS A MORE COMPREHENSIVE INTEGRATED WATER RESOURCES MANAGEMENT, INCLUDING BOTH SURFACE AND GROUND WATERS (CONJUCTIVE USE), AS WELL AS MANAGING SEDIMENT AND SALINITY.*

SALINITY MANAGEMENT

- *A SALINITY MANAGEMENT PROGRAM ADDRESSING WATERLOGGING REQUIRES HIGHLY EFFECTIVE OPEATION AND MAINTENANCE FOR BOTH THE IRRIGATION AND DRAINAGE FACILITIES; OTHERWISE, THE BENEFITS ARE SHORT-LIVED.*
- *A SALINITY MANAGEMENT PROGRAM ADDRESSING SECONDARY SALINIZATION RESULTING FROM THE USE OF POOR QUALITY GROUND WATER SHOULD BE FOCUSED FIRST OF ALL AT THE FARM LEVEL AND THEN HIGHER LEVELS OF THE IRRIGATION AND DRAINAGE SYSTEM.*
- *A SALINITY MANAGEMENT PROGRAM SHOULD INCLUDE A COMPONENT OF STRONG RESEARCH SUPPORT TO THE IMPLEMENTING AGENCIES.*
- *A SALINITY MANAGEMENTPROGRAM SHOULD BE IMPLEMENTED IN SUCH A MANNER AS TO ALSO STRENGTHEN THE PROGRAM FOR ESTABLISHING WATER USERS ORGANIZATIONS.*



THE ORGANIZERS OF THE CONFERENCE

LEFT TO RIGHT:

Kenneth R Shams
Prof. Gaylord V. Skogerboe
Zahid Hameed
Shakeel Rehman
Muhammad Akram Khan
Mohsin Hamid Dar
Muhammad Badruddin
Muhammad Asghar
Zaheer Anwar
Mazhar Ali

ANNEXURE-1

NATIONAL CONFERENCE ON MANAGING IRRIGATION FOR ENVIRONMENTALLY SUSTAINABLE AGRICULTURE IN PAKISTAN

5-7 November, 1996

Holiday Inn Islamabad

Day 1 **Tuesday 5 November**

Session I **INAUGURATION**

08:35	Arrival of the guests and registration
09:10	Guests to be seated
09:15	Arrival of the Chief Guest Dr. Amir Muhammad
09:20	Recitation from the Holy Quran
09:25	Welcome address by the Director, IIMI-Pakistan
09:40	Address by Dr. Zafar Altaf
09:55	Address by Dr Amir Muhammad
10:10	Address of the Ex-Minister Food, Agriculture & Livestock
10:30	Tea followed by the departure of the Chief Guest

Session 2 **MANAGING CANAL OPERATIONS:**

Chairman: Dr. Hammond Murray-Rust, WAMA Project

11:00	Issues in Managing Canal Operations - Gaylord V. Skogerboe and Hafeez Qaiser
11:20	Analyzing the Impact of Alternative Operational Rules on Water Distribution - Marcel Kuper, Xavier Litrico and Zaigham Habib
11:40	Introduction of an Information System for Facilitating Canal Operations - Mian Hafeezullah, Mushtaq A. Khan, Paul W. Vehmeyer
12:00	Performance Assessment of an Irrigation Systems: Application to the Fordwah Branch Canal System - Zaigham Habib and Marcel Kuper

12:20 **PANEL DISCUSSION ON MANAGING CANAL OPERATIONS**

	Dr. Hammond Murray-Rust	- Moderator
	S. Faiz Ahmad Zaidi	- Panel Member
	Hafeez Qaiser	- Panel Member
Rapporteur	Marcel Kuper	

13:00 **Lunch and Prayer Break**

Session 3 **WATER MANAGEMENT BELOW THE MOGHA**

Chairman: Or. Amir Muhammad

14:00 Issues Related to Farmers' Managed Irrigation System
- M.S. Shafique, Shahid Ahmad, Mushtaq Ahmad Gill

14:20 Water Allocation and Distribution at the Watercourse Level: Review of IIMI Research
- Saeed ur Rehman, Pierre Strosser and D.J. Eandaragoda

14:40 Impact of Irrigation Water Supply on Farmers Decisions and Agricultural Production
- Pierre Strosser and Khalid Riaz.

15:00 Participatory On Farm Drainage for Improved Water Management and Increased Agricultural Production
- Ch. Muhammad Ashraff and Rana Khurram Mushtaq,

15:20 **Tea Break**

15:50 Pressurized Irrigation Systems for Increasing Agricultural Productivity in Pakistan
- Shahid Ahmed, Muhammad Yasin, M.S.Shafique and Akram Khalown

16:10 Improved Surface Irrigation Practices
- M.S. Shafique, Nisar Bukhari, Ineke M. Kalwij, M. Latif and M. Munir Chaudhry

16:30 **PANEL DISCUSSION ON WATERCOURSE AND FARM MANAGEMENT**

	Dr. Amir Muhammad	- Moderator
	Mr. Navaid Ali Nasri	- Panel Member
	Dr. David R. Birch	- Panel Member
Rapporteur	M.S. Shafique	

17:15 Adjourn for the day

Day 2 Wednesdav **6** November

Session **4** ENVIRONMENTAL MANAGEMENT **OF** IRRIGATED LANDS

Chairman: Dr. Bashir Ahmad Chandio

09:00 Drainage and the Environment in Pakistan
- M. Nawaz Bhutta and W. Wolters

09:30 Salinity/Sodicity in Pakistan: Experiences and Findings
- Ghulam Saeed Khan

10:00 Advances in Understanding the Impact .of Irrigation Management of Salinity, Sodicity and Soil Degradation in Pakistan
- J.W. Kijne, Marcel Kuper

10:30 Tea Break

11:00 Usee of Geographical Information Systems to Develop Reclamation Programs to Mitigate Salinity in Pakistan: Example from the Chishtian Sub-Division.
- Salman Asif, Ch. Kararnat Ali, Mobin-ud-Din Ahmad and Pierre Strosser

11:30 The .Application of an Integrated Approach to Assess the Impact of Changes in Irrigation Management on Salinity, Sodicity and Agricultural Production: Preliminary Results.
- Pierre Strosser, Marcel Kuper, Zaigham Habib, Khalid Riaz, and Gaylord Skogerboe,

12:30 Lunch and Prayer Break

14:00 Predicting Temporal Variations in Groundwater Salinity of Pumped Water in Rechna Doab, Punjab, Pakistan.
- M. Aslam

14:20 Issues in Spatial Analysis for Salinity Management: A Synthesis Across Irrigation Units of Lower Chenab Canal System, Punjab, Pakistan.
- Gauhar Rehman, Asghar Hussain, Mobin-ud-Din Ahmad and Hassan Zia Munawar

14:40 Resource Use and Productivity of Irrigated Agriculture in the Rechna Doab, Punjab, Pakistan.
- Waqar A. Jehangir, Nazim Ali and Faizan Ali

15:00 Predicting Sustainable Irrigated Agricultural Adjustments, Across the Lower Chenab Canal System
- Abdul Rehman, Gauhar Rehman, Waqar A. Jehangir and M. Aslam

15:20 **Tea Break**

15:50 **PANEL DISCUSSION ON ENVIRONMENTAL MANAGEMENT OF IRRIGATED LANDS**

Dr. Wouter Wolters	-	Moderator
Dr. Muhammad Alam Mian	-	Panel Member
Dr. M. Nawaz Bhutta	-	Panel Member
Rapporteur Pierre Strosser		

17:00 Adjourn for the day

Thursday 7 November

Session 5 **INSTITUTIONAL DEVELOPMENT**

Chairman: Dr. Amir Muhammad

09:00 Issues in Institutional Development
- D. Jayatissa Bandaragoda and Gaylord V. Skogerboe

09:20 Review of IIMI Experiences in Social Organization for Irrigated Agriculture in Pakistan.
- D.J. Bandaragoda, Zafar Iqbal Mirza, Yameen Memon, Mehmud ul Hassan

09:40 Review of On-Farm Water Management Experience in the Context of Water Users Organizations
- Mushtaq Ahmad Gill and Zafar Iqbal Mirza

10:00 Current Policy Perspectives on Institutional Reform for the Irrigated Agriculture Sector
- Abdul Hafeez Qaiser

10:20 Some Alternative Institutional Changes For Irrigation Management
- Muhammad Afzal

10:40 **Tea Break**

11:10 PANEL DISCUSSION ON INSTITUTIONAL DEVELOPMENT

Dr. Amir Muhammad	-	Moderator
Mr. Amanullah Hussaini Jagirdar	-	Panel Member
Mr. Tariq Banuri	-	Panel Member
Mr. Hafiz Qaiser	-	Panel Member
Rapporteur D.J. Bandaragoda		

Session 6 **OPTIONS AND RECOMMENDATIONS**

Chairman: Gaylord Skogerboe

12:00	Summaries by Rapporteurs		
	Managing Canal Operations	-	Marcel Kuper
	Water Management Below the Mogha	-	M.S. Shafique
	Environmental Managemenf of Irrigated Lands	-	Pierre Strosser
	Institutional Development	-	D.J. Bandaragoda
13:00	Lunch and Prayer Break		
14:00	Synthesis of Options and Recommendations		
15:30	**Conclusion and Tea Break**		

ANNEXURE - 2

NATIONAL CONFERENCE ON MANAGING IRRIGATION FOR ENVIRONMENTALLY SUSTAINABLE AGRICULTURE IN PAKISTAN

November 5-7, 1996

LIST OF PARTICIPANTS

FEDERAL MINISTRIES & AGENCIES:

Ministry of Food, Agriculture & Livestock:

1 Mr. M. Izhar Khan, Joint Secretary
2 Mr. Kaleem ullah Sherazi, Deputy Secretary
3 Dr. Imtizaj Hussain, Senior Consultant
4 Dr. Zakir Hussain. Cotton Commissioner
5 Dr. Baz Muhammad Khan, Director General OFWM
6 Dr. Moeen Rauf, Agriculture Economist
7 Mr. Inatullah Khan, Dy. Agri. Development Commissioner
8 Dr. Akhlaq Hussain, Director National Seeds Registration Dept.

Ministry of Water & Power:

1 Mr. S. Faiz Ahmad Zaidi, Joint Secretary (Water)
2 Mr. Fazlur Rehman Siddiqui, Engineering Advisor

Planning Division:

1 Dr. Naveed Ali Nasiri, Joint Secretary
2 Mr. Hafeez Qaiser, Chief (Water Resources Section)
3 Dr. Munawar H. Shah, Deputy Chief
4 Mr. Rashid Ali, Deputy Chief
5 Mr. Sarfraz Ahmed, Assistant Chief
6 Mr. Muhammad Zubair Zafar, Assistant Chief
7 Mr. M. Arshad, Research Officer
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2 Mr. Muhammad Zaman, Project Director

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3 Mr. Arjan Das Oad. Subject Matter Specialist, Ag. **Ext.**
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3 Mr. Sher Afzal, Project Director, PHLC

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2 Project Director, (OFWM) OECF

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3 Mr. Ruhul Amin, Program Leader
4 Mr. P.M. Moshabbir, Program Leader
5 Dr. Muhammad Yousaf, Program Leader
6 Dr. Muhammad Shafiq, Principal Investigator
7 Dr. Rakhshan Roohi, Programme Leader
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3 Dr. Muhammad Abid Bodla, Principal Research Officer

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5 Dr. Wouter Wolters, Team Leader, NRAP
6 Mr. J.A.C Knops, Drainage Expert, NRAP
7 Dr. Muhammad Akram Kahlown, Project Director, MREP
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2 Prof. Muhammad Tariq, Vice Chancellor, NWFP Agricultural Univ.
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4 Dr. Akhtar A. Hai, Research Economist, Univ. of Karachi
5 Prof. Arshad Aziz, Professor, Univ. Engg. & Technology, N.W.F.P.
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IIMI-PAKISTAN

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9 Ms. Cristiana H.D. Klein, Associate Expert
10 Mr. Muhammad Badruddin, Senior Executive
11 Ms. Zaigham Habib, System Analyst
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14 Dr. Waqar Ahmed Jehangir, Agricultural Economist
15 Mr. Gauhar Rehman, Civil Eng. GIS Specialist.
16 Dr. M. Asghar Cheema, Sociologist
17 Mr. Zafar Iqbal Mirza, PAD Secondment
18 Nissar Hussain Bukhari, PAD Secondment
19 Mr. Saeed-ur-Rehman, Sr. Field Research Economist
20 Mr. Abdul Rehman, Secondment WAPAD
21 Mr. Mahmood ul Hassan, Field Research Scientist
22 Mr. Hafiz M. Nafees, Field Research Engineer
23 Mr. Mushtaq Ahmed Khan, Civil Engineer (Hydraulics)

IIMI-PAKISTAN PUBLICATIONS
RESEARCH REPORTS

Report No.	Title	Author	Year
R-1	Crop-Baaed Irrigation Operations Study In the North West Frontier Province of Pakistan (Volume I: Synthesis of Findings and Recommendations	Carlos Garces-R D J Bandaragoda Pierre Stmsser	June 1994
	(Volume II: Research Approach and Interpretation)	Carlos Garces-R Ms. Zaigham Habib Pierre Strosser Tissa Eandaragoda Rana M. Afaq Saeed ur Rehman Abdul Hakim Khan	June 1994
	(Volume III: Data Collection Procedures and Data Sets)	Rana M. Afaq Pierre Strosser Saeed ur Rehman Abdul Hakim Khan Carlos Garces-R	June 1994
R-2	Salinity and Sodicity Research in Pakistan - Proceedings of a one-day Workshop	IIMI-Pakistan	Mar 1995
R-3	Farmers' Perceptions on Salinity and Sodicity: A case study into farmers' knowledge of salinity and sodicify. and their strategies and practices to deal with salinity and sodicity in their farming systems	Neeltje Kieien	May 1996
R-4	Modelling the Effects of Irrigation Management on Soil Salinity and Crop Transpiration at the Field Level (M.Sc Thesis - pulished as Research Report)	S.M.P. Smets	June 1996
IR-5	Water Distribution at the Secondary Level in the Chishtian Subdivision	M. Amin K. Tareen Khalid Mahmood Anwar Iqbal Mushtaq Khan Marcel Kuper	July 1996
IR-6	Farmers Abilify to Cope with Salinity and Sodicity: Farmers' perceptions, strategies and practices for dealing with salinity and sodicity in their farming systems	Neeltje Kielen	Aug 1996
IR-7	Salinity and Sodicity Effects on Soils and Crops in the Chishtian Sub-Division: Documentation of a Restitution Process	Neeltje Kielen Muhammad Aslam Rafique Khan Marcel Kuper	Sept 1996
R-8	Tertiary Sub-System Management: (Workshop proceedings)	Khalid Riaz Robina Wahai	Sept 1996
R-9	Mobilizing Social Organization Volunteers: An initial Methodological Step Towards Establishing Effective Water Users Organization	Mehmoodul Hassan Zafar Iqbal Mirza D.J. Bandaraaoda	Oct 1996

Report No	Title	Author	Year
R-I0	:anal Water Distribution at the Secondary Level in the 'unjab, Pakistan (M.Sc Thesis published as Research :eport)	Steven Visser	Oct 1996
R-11	)evelopment of Sediment Transport Technology in Pakistan: in Annotated Bibliography	M. Hasnain Khan	Oct 996
R-I2	Modeling of Sediment Transport in Irrigation Canals of Pakistan: Examples of Application (Thesis published as Research Report)	Gilies Belaud	Oct 996
R-13	Methodologies for Design, Operation and Maintenance of rrigation Canals subject to Sediment Problems: Application o Pakistan (M.Sc Thesis published as Research Report)	Alexandre Vabre	Oct 996
R-I4	Government Interventions in Social Organization for Water Resource Management: Experience of a Command Water Aanagement Project in the Punjab, Pakistan	Waheed uz Zaman D.J.Bandaragoda	Oct 996
R-15	Applying Rapid Appraisal of Agricultural Knowledge Systems RAAKS) for Building Inter-Agency Collaboration	Derk Kuiper Mushtaq A. Khan Jos van Oostrum M. Rafique Khan Nathalie Roovers Mehmood ul Hasssn	Nov 996
R-16	Hydraulic Characteristics of Chishtian Sub-division. Fordwah Canal Division	Anwar Iqbal	Nov 1996
11-17	Hydraulic Characteristics of Irrigation Channels in the Malik Sub-Division, Sadiqia Division, Fordwah Eastern Sadiqia Irrigation and Drainage Project	Khalid Mahmood	Nov 1996
R-18	Proceedings of National Conference on Managing Irrigation for Environmentally Sustainable Agriculture in Pakistan	M. Badruddin Gayiord V. Skogerboe M.S. Shafique (Editors for all volumes)	Nov 1996
R-18 1	Volume-I: Inauguration and Deliberations		
R-18.2	Volume-It: Papers on the Theme: Managing Canal Operations		
R-18 3	Volume-Ill: Papers on the Theme: Water Management Below the Mogha		
R-18.4	Volume-IV: Papers on the Theme: Environmental Management of Irrigated Lands		
R-18 5	Volume-V: Papers on the Theme: Institutional Development		