SYNTHESIS OF LESSONS LEARNED FOR RAPID APPRAISAL OF IRRIGATION STRATEGIES

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WMS REPORT 22

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This study is an output of Water Management Synthesis Project under Contract AID/DSAN-D-0058 with United States Agency for International Development

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PREFACE

This study was conducted as part of the Water Management Synthesis Project, a program funded and conducted by the United States Agency for International Development through the Consortium for International Development. Utah State University, Colorado State University and Cornell University serve as lead universities for the project.

The key project objective is to provide services in irrigated regions of the world for improving design and operation of existing and future irrigation projects and give guidance to USAID for selecting and implementing development options and investment strategies.

Contact the Water Management Synthesis Project for information about project support or research findings.

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FOREWORD

This report is the output from a "Lessons Learned" Workshop held between June 6-8, 1983, at Utah State University in Logan, Utah, which was sponsored under the auspices of the USAID Water Management Synthesis-I (WMS-I) Project. Senior experts in irrigation development representing seven different disciplines participated in the Workshop. (A brief vita of each participant is included.) The purpose of the Workshop was to explore and synthesize the participants' combined experience in rapid appraisal of irrigation development strategies. The three-day Workshop was an exciting experience for the participants and we hope that this report will allow you as a reader to at least share in part of this excitement.

It was intended that a consensus would emerge based on the collective experience of the participants which would define the elements and structure for collecting, organizing and disseminating a procedure for rapid appraisal of irrigation strategies. Underlying this consensus would be agreement as to need for such a procedure and the intended audience. What emerged from the discussions was a set of unresolved topics and issues which the participants recognized as possible points of departure for effective action in the improvement of irrigation project operations. Often, consensus was achieved in identifying an issue; however, what was frequently unresolved was the way to address the issue. Therefore, this report stands as a working paper.

The participants have pointed to critical issues and possible approaches to solutions of problems inherent in these issues. The group did not try to restate what is generally known nor debate the impossible. Rather, out of their combined perspectives they have verbalized approaches to identifying issues which they suspect will give needed insights into problems and the greatest return for developing effective irrigation strategies.

The entire meeting was audio-taped, and most of the contents of this report are excerpted from the tapes. In order to retain the flavor

of open discussion, the material is presented as actual (slightly edited for clarity) statements by the participants. The statements have been arranged topically in four sections to facilitate reading and comprehension. However, this still leaves places in the text which are somewhat discontinuous and where subheadings have not seemed appropriate. It is hoped that this will not prove too disconcerting nor troublesome.

Section I deals with the issues which arose in relation to the purpose of and audience for Lessons Learned. Section II presents technical topics related to Lessons Learned by the participants as members of WMS-I Technical Assistance teams (which more often than not required rapid appraisal), as well as in their combined professional experience. Section III, a case study from India, is offered as an example of how Lessons Learned might be organized and presented from the disciplinary perspective of an engineer. Section IV contains Appraisal Approaches developed by the Workshop participants. These approaches consist of statements by the participants of how they personally do rapid appraisal. In addition, the participants contributed questions from their own disciplinary perspective which they ask themselves in their effort to rapidly scope out or appraise the how, what, why and by whom in a given situation. Furthermore, they also presented the questions they want answered by team members in other disciplines.

In conclusion, the value of this document is that it highlights the topics, issues and approaches which this group of experts consider important in rapid appraisal of irrigation strategies based on their own "Lessons Learned." The style of the presentation should give the reader the opportunity to draw on expert insights while retaining the flexibility to mold and build them into their own individual store of "Lessons Learned" for use in rapid appraisal. The Workshop participants all felt they gained immensely from the exchange of ideas and believe that the report will prove helpful in sharing this very intense experience with others interested in improving irrigated agriculture worldwide.

VITAE OF PARTICIPANTS

JACK KELLER
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Dr. Jack Keller, Professor, Agricultural and Irrigation Engineering, Utah State University, assumed the appointment of Department Head in July of 1979.

He received a B.S. Degree in Civil Engineering from Colorado State University. His Master's Degree was earned in Irrigation Engineering from Colorado State University. Utah State University granted Dr. Keller a Ph.D. Degree in Irrigation Engineering.

He is presently the Co-director of the Water Management Synthesis Project. He has taught for 25 years. His research specialties include drainage, sprinkle and trickle irrigation. Dr. Keller has served as a consultant on numerous jobs and has been a foreign consultant in over 30 countries in South America, Africa, the Middle East and Asia. He was Team Leader for teams that reviewed AID's Irrigation Programs in four Asian Countries during 1980.

Dr. Keller has written six irrigation handbooks and texts, 75 other publications and reports in the irrigation field. At present he is a member of a number of American and International professional societies and is a Registered Professional Engineer in Utah and California.

CLYDE E. HOUSTON
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Clyde E. Houston, Consultant to Irrigation and Drainage, is the principal of Clyde E. Houston and Associates, Davis, California.

He received a B.Sc. Degree in Civil Engineering from the University of Arizona. Upon graduation, he became a county agent advising farmers on agricultural water management. Subsequently, he worked for theU.S. Department of Agriculture and the Soil Conservation Service in California, Nebraska and Nevada.

As Extension Irrigation and Drainage Engineer at the University of California at Davis (UCD) for 12 years, Mr. Houston trained over 200 farm advisors who assisted farmers throughout the state in improved agricultural water development and management. He also served as Assistant State Director of the Agricultural Extension Service at UCD, where he administered and coordinated programs of over 70 multi-disciplined, statewide extension specialists headquartered at Davis.

Mr. Houston became the Chief of Water Resources, Development and Management Service, Land and Water Development Division, for the Food and Agriculture Organization (FAO) in Rome, Italy, in 1970, where his responsibility was to ensure coordination of all water disciplines and to provide a complete FAO agricultural water program from the inventory of the resource through its development to proper management by the final users in nearly 150 field projects.

Mr. Houston is the author or coauthor of more than 150 publications and has carried out professional work in over 50 countries. He is a Life Member of the American Society of Civil Engineers and the 1980 recipient of their Royce Tipton Award for notable contribution to irrigation and drainage, worldwide. He is a Registered Professional Engineer in Nevada.

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Dr. Helen M. Ingram, Professor of Political Science at the University of Arizona, obtained her Ph.D. in Public Law and Government from Columbia University, and her undergraduate degree in Government from Oberlin.

Dr. Ingram is a scholar in water resources policy and the author of numerous books and articles about water resources in the Colorado Basin. She has also been a member of a number of teams to study international water resources problems in Africa and Latin America.

She has 10 years of teaching experience and has held the Milton R. Merrill Chair at Utah State University where she was a Visiting Lecturer. She has also been a Senior Fellow for Resources for the Future and the Director of the Institute of Government Research at the University of Arizona. Her specialties in teaching and research are in the areas of public policy with an emphasis on water, energy, recreation and the environment; and American policy with emphasis on legislatures and representation.

Dr. Ingram has authored or coauthored two books and over 45 chapters, articles and research reports, and coedited three books. She is presently a member of numerous American and International professional organizations.

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Dr. Dan L. Lattimore, Associate Professor, Colorado State University, is the Communications Coordinator for the Water Management Synthesis-II Project.

He received a B.A. from Texas Christian University in Journalism and Economics and an M.A. from the same institution in Economics. He also has an M.R.E. in Education Administration from Southwestern Seminary and a Ph.D. in Mass Communications from the University of Wisconsin.

Dr. Lattimore's professional experience includes eight years as a public information specialist on various USAID water management projects, and he has taught public relations for 15 years.

He has produced several films and video tape productions and has coauthored two books and several articles. He is a member of several professional and honor societies.

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Dr. Allen D. LeBaron, Professor of Economics at Utah State University, earned his Ph.D. in Economics from London University and his B.S. in Accounting from the University of Utah.

He has taught for 20 years in the areas of basic economics, history of economic thought, research methods and environmental economics. His research has largely centered on modeling and analysis of the agricultural sector of various countries and public land and water policies in the Western U.S.A. He has overseas experience in over ten Latin American and Caribbean countries and in Iran in the areas of agricultural sectoral planning and analysis and on-farm water management. He acted as co-director of the Office of Sector Planning in the Bolivian Ministry of Agriculture for two years.

Dr. LeBaron has authored or coauthored four books and nearly 100 articles, reports, monographs and other publications, several of which are in Spanish. He is a member of the Western Agriculture Economic Association and the Eastern Economics Association.

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Dr. Raymond E. Meyer received his B.S. Degree from Kansas State University in 1959 in Technical Agronomy. He was granted a Ph.D. in Soil Physics from Oklahoma State University in 1963.

He worked for two years with the Agricultural Research Service in Starville, Mississippi. He was an Associate Professor of Agronomy at Texas Tech. for eight years; an Agronomist for the International Potato Center in Peru for five years; and Soils Specialist for a USAID contract with Utah State University, "Developing Appropriate Irrigation Water Management Practices for Peruvian Farmers," which lasted for three years.

Dr. Meyer is presently Soil and Water Management Specialist for USAID, working especially in the area of rainfed agriculture. He manages the Dryland Management Synthesis Project and the Soil Management Support Services Project.

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Dr. Jon R. Moris, Professor of Anthropology at Utah State University, received his Ph.D. and M.A. Degrees in Anthropology from Northwestern University and a B.S. in Zoology from Seattle Pacific College.

His areas of professional specialization are rural development, social aspects of irrigation, applied anthropology, social aspects of livestock development, agricultural administration and village-level extension. His interest in water development goes back to his experience in Kenya connected with the Mwea scheme and other subsequent assignments in East Africa, where he served on several rural development projects before coming to Utah State University in 1976.

Dr. Moris has extensive teaching experience. He also has administrative experience in several international projects as well as extensive applied international development experience. He has authored or coauthored ten specialized articles on rural development, agricultural education and agricultural program management in less developed countries, as well as four books.

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Dr. Dean F. Peterson is Professor Emeritus of Civil and Agricultural and Irrigation Engineering at Utah State University.

He has a B.S. in Civil Engineering from Utah State University and an MCE and DCE (Civil Engineering) from Rensselaer Polytechnic Institute. He also holds Honorary D.Sc. degrees from Utah State University and Mahatma Phule Agriclutural University, India.

His current expertise is in Irrigation Agricultural Engineering, Irrigation Systems, International Development, Water Resources Planning and Water Resources and Hydraulics Research. He has taught for 28 years; been Head of Civil Engineering at Colorado State University; and been Dean of Engineering, Chairman of the Utah Center for Water Resources Research and Vice President for Research at Utah State University.

Dr. Peterson has served as Technical Assistant in the Office of Science and Technology, Executive Office of the President, and as Chairman of the Committee on Water Resources Research for the Federal Council for Science and Technology. He was also Director of the Office of Water for Peace at the U.S. Department of State. He has further government service as Chief, Soil and Water Division, Technical Assistance Bureau and as Director of the Office of Agriculture, Development Support Bureau, for USAID. He also served in India for two years as the Agricultural Research and Irrigation Advisor for USAID.

Dr. Peterson is the author or coauthor of over 115 publications, has received various awards and honors and is a member of a number of American and International professional societies. He is a Registered Professional Engineer in Utah, Colorado and Wyoming.

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Dr. Bryant D. Smith is the Assistant Project Director of the Water Management Synthesis-II Project, Agricultural and Irrigation Engineering Department, at Utah State University.

He received his B.S. from Utah State University and his Doctorate (Jur. Doc.) from the University of California at Berkeley in 1970. His major fields of study were law and economics.

For 12 years he has specialized in economic development problems of less developed countries. His clients have included U.S. government agencies, foreign governments, international organizations and private international companies. His work has involved in-country visits to 28 countries in Latin America, Africa, Europe and the Caribbean.

Dr. Smith's professional activities have included project design for Agricultural and Industrial Development and the Development of Project Design and Evaluation Methodologies for use by USAID Missions. His project design experience has been concentrated in the development of projects involving agricultural production, processing, input supply and international and domestic marketing systems. The focus of his experience in the development of methodologies for project design and evaluation has been in the area of post-harvest food chain activities. He has also provided advisory services for government policy development including less developed country public policy and U.S.A. and European government policy emphasizing their impact on agricultural and industrial development in developing countries.

Dr. Smith has authored or coauthored nine publications.

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Dr. Thomas F. Weaver holds a B.S. Degree in Agronomy from Pennsylvania State University, an M.S. in Agricultural Meteorology and a Ph.D. in Economic Development from Cornell University.

He has seven years of overseas experience in South and Southeast Asia, Guatemala and the Dominican Republic. During a two-year stay in India he investigated irrigation system alternatives. As a Visiting Professor at the University of Malaya in Kuala Lumpur, he carried out field research in rural development, rice culture and irrigation and small holder rubber. His supervision of student thesis projects cover a broad range of production and marketing issues in both annual and perennial cropping.

In recent years Dr. Weaver has worked for the Canadian Government evaluating the Prince Edward Island Development Plan. He has worked for nine years in the Agricultural Economics Department at the University of Rhode Island teaching and performing research. He served on the team that reviewed AID's Irrigation Programs in India, Bangladesh and Thailand in 1980.

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Nancy L. Adams is a Ph.D. candidate in Agricultural and Irrigation Engineering at Utah State University. Her dissertation topic is "Organization and Synthesis of Some Critical Lessons Learned in Irrigation Development Assistance - for Training, Rapid Appraisal and Project Design." She also holds a B.S. and M.S. in Irrigation Engineering from Utah State University.

Ms. Adams served as Advisor to the Egyptian Team Leader, Assistant Team Leader and Irrigation Engineer to an Egyptian Team Leader for an interdisciplinary applied research project on irrigation water management in the Nile Delta. The research team consisted of mostly junior Egyptian engineers, agronomists, sociologists and economists who were being trained while working on the project. She has also worked briefly for the Soil Conservation Service and as a Research Aide on an irrigation scheduling project at Utah State University where she helped develop a successful corn growth and irrigation scheduling model.

Ms. Adams' area of specialty is in developing and implementing effective strategies for improved irrigation project water management. She has taught a graduate level course on Project Planning and Evaluation, emphasizing concepts and practices of effective interdisciplinary team work for irrigation system design and management. She has also lectured for the International Irrigation Center at Utah State University on the subjects of multidisciplinary irrigation project development, focusing on problems and possibilities for management improvement in irrigation development, and techniques for management problem resolution.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SECTION I

ABOUT LESSONS LEARNED

INTRODUCTION

This section details the issues which arose in relation to the purpose for Lessons Learned and the proposed audience. The emerging consensus was that Lessons were for technical experts who were in a position to make recommendations to political decision-makers and to technical personnel who would be designing and implementing irrigation project improvements.

The means for documenting, organizing and disseminating the Lessons were also discussed. The only emerging conclusion was that a taxonomical approach would probably not be too useful. Other means considered were manuals, briefings, seminars and other forms of training. The use of video as a potential tool was also discussed.

Finally, this section contains discussion of the experience of working on interdisciplinary teams. There is also a focus on what it means to specialize in irrigation, especially from the standpoint of engineering and social science.

LESSONS PURPOSE AND AUDIENCE

JACK: The purpose of Lessons Learned is to generate a continuing growing statement of how we approach systems, how we function as a team and what we've found in irrigation development that is unique.

TOM: The question is how to do it; how to carry it out; how to do it physically. How can we stylize facts and hypotheses about irrigation and irrigation development: How things are, how things might be and what we should be looking at? How do we collect all of this; how do we incorporate this into training programs; and how do we incorporate building the training into Lessons Learned?

HELEN: From Lessons Learned we want to be able to identify characteristics of irrigation agencies as central to the success or failure of projects, including characteristics of personnel, structure, decision rules, access of users, and we want to be able to relate types of bureaucracy to physical and social environment.

DFP: The purpose of Lessons Learned is to develop irrigation experts who have the ability to go with the circumstances and have trained insights as well as an openness to learning.

JACK: It seems to me we have two levels of Lessons Learned: (1) global things that aren't going to fit an index or anything; they're a way to look at things, a way of viewing the world in engineering or other disciplines; and (2) detailed types of information.

BRYANT: One way to approach Lessons Learned is to separate out the elements, see the commonality and uniqueness and then determine where we can move -- we gradually see a pattern emerge, and that's a Lesson.

JON: It's really to get new conceptual ways of conceptualizing the business -- the concept that rehabilitation is really deferred

maintenance is an example.

If teamwork works, we're going to come up with a whole number of these new ways of thinking about irrigation systems through the process of our teams -- different, new concepts that we weren't using before that we want to make available to the wider world.

BRYANT: Lessons Learned will be useful to the degree that it is refined and gives some substantive direction to people in the international donor club. In my view, this means that the most powerful thing we could do would be to come out with a Lessons Learned Manual that synthesizes everything that's been said here and publish it and circulate it to these people. Then we could even go to the point of holding regional seminars. We can also use it in a systematic way through the Missions that we're involved in and with new people who go out on Water Management Synthesis (WMS) teams. As this network of people is drawn into the WMS process through the Missions, then it would be effective to generate some kind of orientation manual which would be updated to expand upon and synthesize the Lessons Learned. I think it could have a very substantial influence. We've tried to do that in certain respects through the trip reports. My own view is that very few people really read through a trip report. With Lessons Learned, we'd probably have a better chance of people sitting down and learning the Lessons Learned, which are an amalgamation of all the Lessons from all these reports, than probably any other single thing we could publish.

We've got to come out with a report that really substantively treats the issues, but I don't think that we're trying to tell this as the last word. Rather, it is kind of the reference point from which intellectual discussion takes off. Somehow, I think this is a rather free-wheeling, open and speculative type of thing, and that's what we're publishing. Here it is, and let this be a departure point for additional thinking in the field.

DAN: Why do we want to retain the Lessons, for whom, and what do we want to do with these Lessons?

JACK: Lessons are for anybody who's in development: For experts who tinker -- to give experts access to additional information and to give newcomers a better starting place.

RAY: Yes; and specifically, for those experts who decide whether to put money into the country.

TOM: The people who are supposed to really learn the Lessons are the people we debrief just before we leave. The question is, are we getting our Lessons through to them? The impact of the team depends on who's at the debriefing.

BRYANT: We're also doing it for professionals who are going to be drawn into the WMS process and become rapid appraisal experts. Part of this program is to develop the expertise of drawing new people into the program for increasing the pool of experts for water management worldwide.

JACK: Let's refocus that again. If we have Lessons Learned, who are the Lessons Learned for? Which group needs the Lessons? Do sociologists need lessons from irrigation? Or do political scientists? What we have ended up with is that the engineering fraternity or the group doing the managing, the planning, the development, and the operation of these systems needs the Lessons: The Lessons are more focused toward impinging on that planning, implementation and management group, whoever that group might be.

Would it be fair to say that what we're talking about is that the disciplines are working in some sort of a unit to really end up with a multidisciplinary effect that is going to be managed and operated by an engineering group?

HELEN: You know, social scientists really need these Lessons, too. There is very little literature relating physical systems, like irrigation systems, to human behavior. If we could do this, it would be a very substantial improvement on what our separate disciplines can do,

and it would be relevant to the real world.

DFP: I don't think we should classify the audience in a disciplinary way. Anybody who's involved in irrigation development is going to need the Lessons Learned.

JON: One of the key sets of people arise in terms of funding. Half the benefit is to educate donors, because donors are the one group in a position to put pressure on planning teams from above, and sometimes they do it in foolish ways.

BRYANT: I think that the principal group that we're going to affect, regardless of who we think we would like to affect, are going to be the relatively small group of people in international donor agencies who deal with irrigation projects.

CLYDE: We talk about having the Lessons for the administrators, but I think the nitty gritty are the guys who are going to have to do the job, going to have to make the plans, make the investigations. They're going, to have to recognize that there are anthropological and sociological aspects, and there are not many of them that do.

LESSONS DOCUMENTATION

JACK: An important consideration is how to collect, organize and communicate useful Lessons. We can use a journalistic or interview approach and get a story. But we don't want just a whole bunch of statements, so we need some system of organization to this extraction, like a taxonomy, which integrates duplication. And finally, we need a mechanism to communicate the Lessons Learned to others.

Collecting Lessons

TOM: There are two levels of things: Things that we learn that we never knew before, and things that we knew before and saw other examples of.

JACK: One thing we might want to collect is a density function -- how often we are running across certain kinds of things in a given context. Another question is what really gem of a unique thing did we find this trip that really changed our whole conceptual framework. We might want to do this in a post-trip interview.

Prior to an interview, the person to be interviewed would be sent a sheet. They'd be asked what they saw, and where some of the interesting things they saw might fit. It's not that the engineers are going to have to explain marketing, for example. The economist on the team is going to be the one that probably picked up on marketing anyhow.

HELEN: With an interview schedule, I might miss insights or distinctions about the part of the total structure I am dealing with on this mission. We need to be able to identify the issues and to look at whether the structuring of the project needs to be modified.

BRYANT: We could tape the debriefing; that's one place the team leader tries to put into context the prioritized important of the issue, the Lessons Learned.

TOM: On-farm water management has not been well documented. On-site television may be useful; there were some very unique moments on these trips.

JON: Also, we really do hit the question of strategy, because for me, I would much rather have four cases in different parts of the world than three cases clustered in one region.

Organizing Lessons

DFP: Problems in irrigation are not in agronomy, nor the realm of other physical sciences, nor in irrigation organization; rather, they are systematic and research must be done by inference. A classification system is needed, but not one so rigid as to lose creativity. Given this background, a proposal for a taxonomy for irrigation systems research follows:

Research objective.--To improve the effectiveness of irrigation systems; that is, to improve agricultural production through irrigation, assuming that satisfaction with the irrigation system is a function of production.

Research premises.--To accomplish the objective, research must be done on actual irrigation systems. The system must include both the hydraulic delivery subsystem and the agricultural production subsystem including the human elements of both; that is, the physical plus human plus institutional. The task is to systematically record information about systems and find the linkages between the information and the behavior of the system. Figure 1 at the top of the next page shows a model of the system.

Need for classification.--If we are to develop a science of irrigation systems, then we need to formulate some kind of classification of irrigation systems to which performance and intervention variables can be related. With such a classification, even though rudimentary, the wide experiences and insights gained through WMSP-II, Lessons Learned, could be systematically organized.

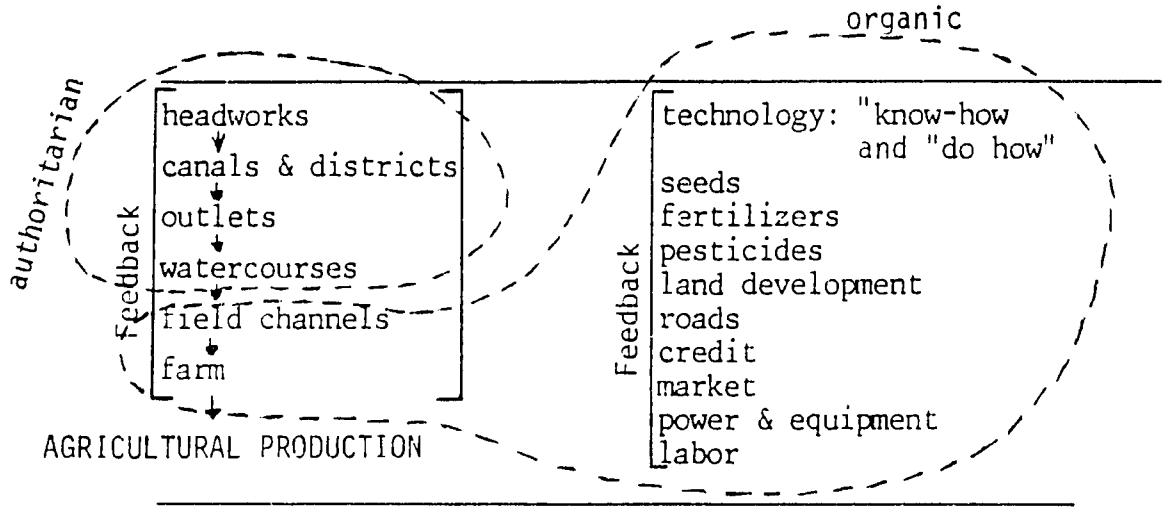

Figure 1. Model of irrigation system showing the authoritarian hydraulic delivery and the organic agricultural production subsystems.

Elements of a classification system (taxonomy).--This is visualized as a primary set of multidimensional vectors, each further defined by secondary vectors or scalar indicators. We need to agree on a primary set and search for the simplest, most meaningful secondary set in each case and define each element. We also need to keep simple and yet be definitive vis-a-vis irrigation. As with all classification systems, this one is hierarchical. Hopefully, we can keep to two or at most, three tiers. The proposed taxonomy is presented in Table 1.

Goals and purposes.--We need to have our goals in mind in irrigation development and development in general. We think these include four broad categories: production, social well-being, geopolitical stability and political incentives. As to purpose, it seems clear that the purpose of an irrigation system is to increase agricultural production -- a point sometimes forgotten.

TOM: I'm resisting a taxonomical list. Maybe people without sufficient experience shouldn't be going, or we should take people who are inexperienced and include them. Creative insights are the core. You

Table 1. Taxonomy for Irrigation Systems Research.

Secondary / Primary	INTERNAL or PHYSICAL	HUMAN: Intelligence Knowledge Action		INSTITUTION: Set of Rules and Behavior Patterns	POLICIES
CLIMATE SOIL WATER SUPPLY	Arid Semi-arid/Summer rain Soil types Groundwater potential	Rain witch doctors	Politicians Bureaucrats Lawyers	Water resource planning International and national treaties Conservation and environmental policies	
HYDRAULICS	Headworks Canals Outlets Watercourses Field channels Farm layout	Planners Designers Contractors Operators Farmers District engineers Watermaster	Politicians Bureaucrats Educators Extension	Design philosophy and criteria Operational hierarchy Construction Planning Water users organizations Allocation of water: Law Operation of hydraulic system -- decision rules	
AGRICULTURAL PRODUCTION	Seeds Fertilizers Amendments Water Equipment: Machines/animals Land	Farmers Family Hired labor	Politicians Bureaucrats Bankers Entrepreneurs Commisars Extension agents Landlords Lawyers	Subsidies Regulated pricing Storage, markets and transport Credit, banking system Traditional cropping patterns Land tenure and ownership Water rights	
ECONOMIC, POLITICAL, SOCIAL					
IMPACTS					

can't manualize experiences. You cannot get experience without actually going and doing it.

BRYANT: A taxonomy is useless for those with experience, but may be useful in a classroom. Perhaps we ought to focus on particular Lessons Learned in particular situations and work with people who already have a background.

HELEN: Core questions vary from a disciplinary perspective, and that's hard to contain in a taxonomy.

DFP: Water Management Synthesis is an art having some organized set of information that moves around. "There is a way to dialogue even art."

HELEN: It would be helpful if we took a really simple irrigation system and described it in this taxonomy.

TOM: We need to consider what are state variables and control variables -- what's manipulable.

TEAM: Another category, "Economic, Political, Social," is needed. Put another category called "Policies" across the top. "Impacts" is another category. (These have been included in Table 1.)

TOM: My concept of a classification system is that it needs to be operationally relevant; that the categories have to make a difference.

JACK: We need to be able to classify both levels of Lessons -- the sort of major insights as well as the Lessons that give us a density function of the sensitive places the recommendations center around on evaluations.

DAN: It is important to maintain enough flexibility in organizing Lessons so team members feel free to comment on areas other than their own through the interdisciplinary process.

TOM: I have a sense that I would understand some classification systems very well. I think that I might have some trouble with others, but I'd really like to know about them.

BRYANT: When we take any one Lesson, it usually cuts across all of those lines.

JON: I just don't think classification systems give you the essence. The taxonomy presented is useful in a summary way of saying, "Look, this is the topography we're going to be wandering around in." However, I see the evolution of systems as being of crucial importance, and this is basically a non-evolutionary model. It does not include things that happen early vs. things that happen late.

JACK: A worrisome thing to me is that we each have a base that we work on and that what we're finding out in terms of our particular Lessons or activities is always, first of all, referenced against that base as well as the site conditions. So it looks like we have to know the background, we can't just take one of these points and not know the background it was laid on.

JON: We could organize Lessons the way Dean did it -- take a particular topical interest and relate it to the case that you think shows the Lesson the best. See "India, a Case Study," pp. 79-90 herein.

HELEN: Irrigation development and system operation are political issues. Influence and political connections are involved, and unless I get a chance to describe these parts of the system, then the sophisticated linkage between users and decision-making won't be met. I need to make certain that in the description of the system at least some of these political parts get in, so that when we ask the question, "How far do users reach up the system and exert influence," it's not a simple-minded question.

A social science hypothesis is that the way the system develops has a lot to do with how it operates and whether or not it's a top-down or a

bottom-up system. I'm impressed that we don't know where the arrows go, and I agree that the arrows shouldn't be in this thing because it's a typology, but the information about sequencing somehow or another has got to be put in here. For example, we don't know if the pressure to get the thing started came from planners in the World Bank or the demand on the part of the users, and it matters for how this thing operates.

DFP: So a valid indicator that you want in the classificaton set is, where does public responsibility end and private begin; where is the interface between the farmer or his organization and the canal bureaucracy?

JACK: In thinking about a taxonomy, we need to ask how the Lessons suggested fit against what's being said; to test our own Lessons against what it is we're doing. I'm beginning to have a problem here as I see that the organized system of doing things seems to expand immensely in each individual discipline.

I'm wondering if we don't need three-dimensional form: (1) the static or state environment, including the physical and social-economic, institutional, etc.; (2) the control environment, the same elements again, but ones we can control; and (3) laying on top of that a hydraulic system and an agricultural system with the motivating force to make that system run being the marketing possibilities for the system product.

In other words, it's a people system that's laid on top of this environment, and it doesn't function unless there's a motivating force to function it. It's people the whole way. The whole thing that holds it in place are the people -- the farmers in the sense of making the agronomy work, and the bureaucracies in terms of making the hydraulic system continue to function. And the taxonomy doesn't indicate these foci.

TOM: In recent years I've been talking to farmers trying to find out what their classification system is in order to see what their operational units are and how they make decisions. I've found

situations in which the farmers have as few as six hectares and they have over 30 different classifications that are operationally significant to them.

DFP: That's one reason farmers don't like to consolidate their holdings. Some lands are good for rice, others for grazing, and farmers like to maintain diversity of opportunities.

TOM: No one has categories that aren't operationally significant to them. If you pass on to me your classification system, and here is the political scientist who gives me her classification system, I look at it and say, either I understand it or I don't understand it, and I can start interacting with her, finding out how she views the world. And each one of us in a discipline across this room has our own disciplinary classification system.

ALLEN: As my experience changes through interacting with you, my boxes change. We take those things with us wherever we go or whatever we're doing, and everything's pretty much on its own. We do that on a case by case basis. What gets transferred comes out of how the teams intermix all this knowledge together some way.

BRYANT: The taxonomy should kind of emerge out of the experiences each person develops, their network of roots.

JACK: I'd like to entertain suggestions as to how we can organize our thoughts into some global categories.

BRYANT: Categories should include: (1) advice to donor agencies and administrative programs; (2) organizational problems in developing countries in administering irrigation projects; and (3) value of training scholarships.

TOM: I don't think I would do anything more than make a list -- these are the elements that if we had a classification system would be somewhere.

I would really like to have the classification system from someone in another discipline which they made up independent of me or my input, as a way of enhancing my understanding of the way they see it, and for them to have mine enhancing their understanding.

DFP: An alternative way we might think about organizing Lessons Learned would be by planning, design, construction, management and operation, implementation, irrigation systems in agricultural production, and so on.

TOM: I want to know whose Lessons they are -- and I want Keller's Lessons Learned -- give me them all!

Communication Lessons Among Development Personnel

TOM: One Lesson for me was that people aren't learning from each other on how to do an integrated rural development project. They are not trading experiences between themselves.

The whole question of the need for training requires a cross-disciplinary approach, and we have very few cross-disciplinary people. How do we take Mission people, agency people of any sort and make them cross-disciplinary people in the sense that they can manage these projects?

People in the Missions are not able to read a consultant report and really know what they've got, so they end up with consultant report on consultant report. How can we make them cross-disciplinary capable in irrigation systems? They're hard working, diligent people and they don't know what we know, i.e., how good we are. So they really don't know what they can rely on.

BRYANT: A potential solution is to create regional experts. The agencies would have some kind of in-house experts on a regional basis who would come in when a specific project was designed and help on it.

HELEN: Training involves a pedagogical question of whether to present a slice of reality and assign roles or whether, with a lot of experience, to build a theory which indicates probabilities of consequences given certain actions.

BRYANT: Another question is how do we get Lessons to assist the people who will go out in the future? We could spend a day at the Mission and use a taxonomy as a basis for generating discussion and defining issues.

HELEN: Or a handbook might be useful.

TOM: We could develop a multi-media spectacular -- an experiential training week. At another level, success or failure on dissemination depends on what happens in the briefing -- who's hearing it, and how the message is getting across. TV material could be used to facilitate that debriefing.

CLYDE: I don't know whether we're communicating: We've got to get to the administrators in regard to what has to go into an irrigaton project -- why you have to have marketing, hospitals, transportation, good seeds, fertilizers. We [FAO] developed this handbook and took in all the facets that go into successful irrigation development, from seed, fertilizer, pesticide, equipment, transportation, research, extension, marketing, processing, health and schools, production incentives, credit facilities, to favorable tenure and the irrigation itself, with the idea that [the administrator] should know, if he's the one approving or disapproving. Well, it was a good idea except I don't think it worked, because I don't think the guys read it, from what we could gather. The sub-ministers did, or the ones down below may have read it and passed on a few things to them.

DAN: Dissemination does not equal communication.

BRYANT: Try sending a video tape and see how long it takes for people to look at it. We can disseminate even video information and have no

guarantee it's going to be opened any more than a book.

CLYDE: The technicians don't have all the information they need either, the technical information. So we started this irrigation and drainage paper series. We have a couple out of about 35 or 40 that are good. From our experience these were accepted, they're used. Now this to me is successful. We were able to get to the technicians. I don't think we were able to get to the administrators.

Then we started to think about the farmers; that's when we got stuck -- but that's where I think video is the answer, and I don't think it has to be a perfect job. It doesn't have to be right on that site. It can be things like Washington State's soil moisture movement movie, any of these things to educate farmers in better use of water.

HELEN: Don't we have to have a market for information just like we have a market for everything else? The reasons why politicians aren't interested in this is it's not about an issue.

DAN: We did a readership study for WMS-II. We sent out questionnaires to see what they like, what they don't like, what they'd like to see more of and what would be better for them.

JON: The Cornell participation material has just circulated everywhere; whereas Berkeley has this decentralization in local government, good work materials, but nobody's seen them. We really have to sort of establish a flagship. We have to get a reputation that circulates in the discipline in which you're producing a series, and I think Cornell did that the most effectively of our three schools.

CLYDE: We've had meetings, symposiums, seminars, and it's hard to tell what people get: (1) for ministers or sub-ministers we tried to explain why they need, or if they need, irrigation development, and all the ramifications that go with it; (2) we had technicians come and we went into more of the technical phases; and (3) well, then we thought about farmer meetings . . .

What the administrators want is a trip. Technicians want a trip, too, but they know they can get something out of it, but it's very hard to get specific, designated persons. Meetings for the technicians are very good, because they know they are there for a purpose. Farmers -- there are just too many farmers to have farmer meetings unless we can get back to this video.

HELEN: We also have to make certain that criteria for training require minority people.

JON: There are two sets of people to involve in training: Those very capable people, and the favorite daughters and sons who have a political advantage in the first place.

Two tracer studies done for the International Rice Research Institute (IRRI) showed that most of the trainees at IRRI were promoted out of technical fields into policy-making administrative fields. Technical training should include a major aspect of policy and the sorts of issues we've been talking about today.

RAY: There are two things, at least, that we could come out with: Something that would sort of sell the social science field to do more research in this sort of thing so you can get the delivery sysem; and selling some of the Lessons to the donor group.

I would think that something that WMS should be able to do at this point with Lessons Learned is to develop something that I can at least give to that Mission and say, "If you're pushing it or not pushing it, read this document and keep this in mind while you're monitoring the situation." So it does get fed into the planner group from a donor agency, not the planning group for building a system, but the planning group that decides whether even to go ahead with a project. So then these planners have a means to feed it to the planners for the system.

If I were to send something, say to Somalia, for the Agricultural Officer to keep in mind, what would I send him? Would I send him something like, "The bureaucracy has to be responsive downward?" Would

I send him something like that? No. Or how about, "If you look at current systems, you can see that rehabilitation is deferred maintenance. You have to be able to put maintenance into the system or else you have to rehabilitate later." This sort of thing would be useful. Would I send him something like, "Experience shows that the user should reach up the system as far as possible; keep this in mind when you look at the system. Marketing, think this through, and the goals of irrigation projects, you have political goals, social goals, food production goals?" Would I send him these sorts of things, which are essentially your global topics, really? Are these the sort of things I should send him that he should keep in mind, and can I keep it that simple or not? Or am I just putting him in hot water, because if I send him a thirty page document, he'll never read it?

BRYANT: I think we have to face the fact that we cannot send out a little package of Lessons Learned that's going to help Somalia. There is no simplistic answer for them, and I don't think you would ever reach for that kind of a simplistic answer.

DFP: Well, I was thinking of giving the Lessons to the professional teams of the Water Management Synthesis Project.

TOM: I would like, maybe from everybody, for you to give me that one thing which you've written that you kind of feel like, "Hey, I'd really like you to know that -- it'll help you understand my views."

JON: Everything we're saying now I'm trying to gear in to get prepared, so I feel much better now about being able to do a halfway decent job on future assignments.

RAY: I had really expected to take something away from here that would be more explicit. I think as an AID project we had to be aware that even if we send out something simplistic, it's very necessary, because if we don't send out anything, it'll just keep going like it always has.

CLYDE: I think that whatever comes out of this can be disseminated to other organizations and it will be quite valuable to them.

Communicating Lessons by Video to Farmers

BRYANT: In Peru there was a tremendous concentration of activities and funds by donor agencies to increase extension service to farmers in water management: teaching farmers how to use water, the use of video technology to really educate farmers. To do this the video has to have content that is really useful to the farmers. It can be of benefit even if the farmers are not literate, and it reduces the costs of doing things on a one-to-one basis.

DAN: Looking at the audiences of a lot of our communication, we find that we're doing very little to communicate with the farmer user organization, the farmers themselves. That's because it's much more difficult because we're dealing with a much larger mass of people and we're dealing with more language barriers.

JACK: We might be able to use radio or TV now that it is moving in so very, very rapidly, it appears to me, in third world areas. Farmers here listen to market news, while farmers in Peru don't know the price of potatoes. Also, we might somehow get farmers together with farmers by the communication system.

HELEN: A question arises of what people expect to get out of TV -- information, entertainment, or both. There is also the issue of who are the target farmers. Mass media takes the choice of who gets that information away from the bureaucratic network, but the communications channel may still have biases.

DAN: With TV education, it will be more likely that the opinion leader will adopt new methods, not just someone who was chosen. Nevertheless, there are problems. There has to be broadcast quality equipment and

some way of editing; the people doing the interviewing have to know the language, and there has to be a broadcast facility.

CLYDE: One effective technique might be to show pictures of what people are doing that is working here, say five minutes every morning.

DAN: It takes some staff.

JON: What's difficult to do is to keep it down in the low cost, sort of boot strap journalism, end.

DAN: Doing an interview and just editing and picking out sections is apretty simple technique. With video, we take it and turn around and play it back.

TOM: Someone should do it -- who could go into the country and really do it?

DAN: It's going to be made by private contractors in India.

TOM: One possible format would be that used on the public program, "This Old House." It's a kind of discussion that goes on about the problem that they're trying to solve. In the process of listening and watching, I'm not only learning how to do it, but I'm learning the nature of the decisions that had to be made to decide what it was we wanted to do.

DAN: For a polished production, it is going to take a fairly polished producer/director type person, and that's a fairly highly paid position. There is studio production and field reporting, studio orientation vs. electronic news gathering. On the other hand, we can take the news aspect of it and we can go out in 30 minutes and get back on the air, I've seen it done.

HELEN: We're assuming all sorts of incentives on the part of the recipients to do better, that the recipients will decide they want the information when the access is open to them. Such assumptions may not hold true.

TOM: One thing that struck me -- when we write up the document if we don't agree with what's being said we have a real opportunity to say I don't like that, and talk about it back and forth. When you make these tapes of the projects and so forth, to what extent are team members given the opportunity to say, "I don't like that?"

JACK: One of the things that bothers me about using video production with our regular field activities is that it would be terribly intimidating. We're already intimidating a bit.

TOM: We could leave the people out of it. We could capture a lot of really useful things without ever taking a picture of a single person. If we want to get into farmer group organizations, it becomes a little more delicate. Primarily, I'm thinking of taping the physical systems and the discussions that are going on between members of the team and their counterparts.

JON: Another option is to have the cameraman come the second day.

THE TEAM EXPERIENCE

JACK: From my experience, it is useful to arrive a day early with a working agenda to get acquainted and organized as a team. We must know what we want, although we don't necessarily need to know how to get there at the onset. We've found that it is really effective for the team to have its mind set on doing the task with high energy.

TOM: On a team, what we really need to know is what the members from other disciplines know and what they don't know -- what's accepted knowledge, and what's controversial, i.e., "What's the cutting edge? What are the questions you are asking?"

HELEN: The important thing on a team is being self-conscious about your discipline in order to identify the parts of the multidisciplinary system and their interfaces.

TOM: I'm not sure we get to each other very well. I've kind of come to the conclusion that most people don't understand irrigation systems, which is part of what you were saying about system analysis being kind of an art system. Many engineers don't understand how water is allocated past the farm outlet. They don't understand that system. Agriculturalists don't understand how water is being managed by the people above the outlet, and there's no super manager who sees the whole thing.

CLYDE: Interdisciplinary work is getting closer, and there's a long way to go. Still, we've got to ask questions to find out what we don't know.

HELEN: On interdisciplinary teams in a third world context, what we need host country counterparts for is to explain to us what kind of project is this, to what extent is it political, what is its real purpose -- the kind of questions you try very quickly to get a fix on.

The host people are essential for that, and if you degrade them to being simply "gofers" to collect data for you, you don't get that kind of insight, nor do they take you seriously enough to become candid and to give you these kinds of responses.

JACK: Each person on the team has a different agenda. I think the team leader is responsible for checking on everybody, but I don't think everybody on the team should be checking on everybody. What we tend to do is to go together some and split up some -- getting that confidence in each other. A way to function is by evening discussion about what everybody learned, creating a continuous dialogue that builds on the team's insights over the period of the assignment. On our teams, we don't really come to consensus, we come to acceptance and rejection.

HELEN: One of the things I learned here is how much I have to learn from other disciplines and how much we can really work together.

JACK: Why did this group do that?

HELEN: Because that was very much what you said we had to do.

JACK: Is there just an openness and expectation that that's what we're going to do?

HELEN: Yes. One of the insights which Dean gave me is how one goes about the work you're supposed to do: Figure out what you're doing first and then write the report. Scope the work so that there is time to sort of mess around in the data and talk to one another and wander about, and then leap in. Because once you've set yourself to the task of writing that section of the report, it's very hard to get off it. It's like after you've decided to design something, you know, you kind of have everybody else go away.

Biases in Disciplines

BRYANT: Two things are important in a team experience: The quality of people who are involved in the exchange, and the amount of time they have to dedicate to the effort.

HELEN: Engineers are by nature optimistic. Anthropologists tend to be terribly conservative about social change. When you get a political scientist, you get a cynic. And the better they are at their disciplines, the worse they are about their bias.

Sociologists are interested in social structure, but lack understanding about the process of negotiation and bargaining. The fundamental bias in sociology is for the underdog and a concern about elitism. In political science, we tend to believe government should be activist. Economists would like to leave everything to individual choice.

TOM: Sociologists are great after the fact. They can identify social groups. If you ask them how to make something happen, they're next to worthless.

DFP: Agronomists are locked into the Latin Square!

TOM: Agronomists believe that more is better, as long as yields are increasing, put more on, where the economist says, "Wait! Does it pay?"

JON: Agronomists are trying to eliminate sources of variation to get the conclusive experiment, so they're going micro where everyone else is going macro.

JACK: Agronomy goes all the way from the soil scientist to a production person.

HELEN: Geographers, especially social and economic geographers, make very good connecting people.

JON: They're producing better quality materials than the rest of us are recognizing, but there's a real communication gap. The real trouble with geographers is nobody reads them but other geographers.

IRRIGATION SPECIALTY IN DEVELOPMENT - THE ENGINEER

TOM: I was trying to understand where irrigation engineers come from on the whole issue of development. I can start asking very similar questions about putting in a fertilizer factory scheme that we are bringing up about putting in an irrigation system. When we decide, "Okay, I'm going to specialize in irrigation," what does that mean? What does it mean for an economist to say, "I'm going to understand irrigation?" It really means, among other things, that I'm going to understand, to try to understand what the engineers have to say, the design factors, and how those design factors feed back up through all of the rest of the physical and socio-economic system.

JACK: Engineers come from two places. One side of engineering is not planning, it's just pragmatically doing. It's a process of implementation and that's where most engineers come from. Basically, the credibility for the most part comes from the ability to do that well, and to handle the things, the obstacles to putting the physical works in place. Some engineers are in the planning business. There's a tendency for them not to be too holistic in viewpoint, even though they get into planning. They move into the planning phase with mathematics and try to mathematize using optimization techniques and modeling. They're going to play the probabilities if they get into the whole thing, the sensitivity, and they tend to overlook the farmer who dies because the probability didn't work.

CLYDE: There are the designers, and they're like the builders. Their attitude is, "This is what the planner says we should have, and so this is what we have!"

JON: As social scientists, our tendency is to conceptualize the constraints and sense of continuing commitments from the past that we have to relate to, and I think that's where both economists and engineers agree; they tend to say, "What's the optimum solution for

today?" Sociologists tend to think of reciprocity, which means we may do sub-optimal things on a day-to-day basis in order to maintain that continuity and commitment.

DFP: Irrigation engineering in the Western U.S.A. has traditionally included a soil-and-water agronomic base with an agricultural production objective in contrast to irrigation engineering in other countries, which is restricted to the water supply and distribution facilities.

JACK: Earlier engineers were from a farm background, so they'd internalized the social structure. Where the engineers weren't equipped was when they were transported to a bureaucracy, or to a new country, and they thought all social structures were the same as the one they came from.

RAY: That's a major problem in some countries -- city boys trying to design irrigation systems.

TOM: So bringing it back to this, what you guys [engineers] want to get out of this thing, right, is insights from us that you can use in expanding your understanding between all the elements, between what you design, what you put out there, and the whole system out there. What I'm trying to get from you [Jack/engineers] is the flexibility that there is, how the system can be adjusted, what am I locked into: What do I have to accept, because there's no way to move around it? What is control and what isn't control? What's been mind-expanding for me is when you [Jack] tell me there are alternatives, which no one had ever told me that engineers had.

So what you [engineers] want to get from this system, for example, is information from Jon which will be useful to you; i.e., you want to understand where the decision to put the project in came from, understand why we're here in the first place, and then use what Jon has said or things that the economist has said, to design some layout. That's what you're hoping to pull from it. And you also want to know, and we're going full circle here for me, because now I get to an

earlier point, you want to know what I can tell you for sure, and what I can't tell you. And that's what I want to know from you!

JACK: There is bad engineering. Good engineers have no tolerance level for bad engineers, because we realize that bad engineering puts an additional burden on getting this difficult thing, this social enterprise, to work. You know, we looked at Bakel as kind of a simplistic example, bad pumpsets, mismatched pumps using a lot more energy than they needed to, penstocks that were breaking, barges that were tipping over, all those things. It's difficult enough to hold a complex system in place, and then to have all of these physical problems going on on top of it makes it more difficult.

TOM: Okay, Bakel is a good example of how trading information really contributes to the whole. You [Jack] told me, here's the situation on the pumpsets and so forth, and I began to understand what the problems were, and then I tried to design an incentive system, an economic incentive system based on the real world economics which will achieve the policy objective.

TOM: In the Gal Oya [Sri Lanka], now, engineers are really being responsible to the farmers. And, what I think happened is that the higher administration, the bureaucracy, said to the engineers, "Okay, if mistakes are made it's not your fault." So what the engineers have to answer for has been changed. The engineers have been given permission to be responsive to the farmer.

JON: I find that I'm at variance with people from Latin America or India. For instance, listening to the Indian engineers, I just envy them. Would that in Africa we had those problems that occur when there is an institutional network.

JACK: One way we can work and we have worked, from an engineering side to the social science and economic side, is that we do have a feeling for the degree of sophistication different technologies require: the

labor, management, and maintenance requirements.

We can select a technology that requires more or less bureaucracy, but then we assume an efficiency. We don't understand this well in our technologies, so it's something we can work on together and learn how to do more creatively. That's a big piece of what's possible here with Lessons Learned. In fact, that's where the Lessons Learned can impinge in an effective way on system design.

The Lessons Learned will help us develop better institutional capacity to run systems, or know what kind of institutions are needed to have systems be operated more effectively.

HELEN; I never could understand why engineers always treated social science as a constraint before this morning. I mean, now, I know! It's not that they're fundamentally wrong-minded. It's that that's the way they have to do it when they finally have to go down and build the thing. You look at their job, and that's the only way they can do it!

JACK: The social sciences haven't really been able to deliver very much. First of all, they didn't have the opportunity, so they didn't build up the delivery capacity; and now they're suddenly asked to deliver. They don't have any capacity, because there's been no interest in their perfecting it. What's pushed the interdisciplinary thing hardest of all is the fact that the world is strung out very thin on its financial backside, and we have projects that are working so poorly that they aren't paying their way. Going broke is a real catastrophe for the country, so the development persons need to know whether the project may put the country in the position to go broke as well as giving some benefits.

JON: It seems to me that some of the frustration is just inherent in the different levels of generality. You know, for you as an engineer, the nice thing is if you deal with soils they're knowable. You deal with water flow and you know how it behaves. So I think there is a tendency to use deterministic models. The trouble with us social scientists is we have to deal with all the sources of variation pooled, so we're in a stochastic universe. It's just different, you know, maybe forty different variables feeding in, and so the engineer comes and says, "Well now, predict how the land tenure's going to affect our scheme."

DFP: The kinds of things that I'd like to receive advice about involve the complex question I cited yesterday: How do we get some institutionalization going between the public outlet and the farms? What can the social scientist, or anybody, say given this very complex setting? Is there anything we can do to accelerate evolution in this area? Maybe the answer is that we don't know, or maybe it is that if certain steps are taken, the institutionalization is more likely to happen than if they aren't. I think all this comes back to the question

of how institutional changes can be generated, especially where institutions are very weak? What tactics and strategy do we use?

JON: You don't sort of get those eight or ten basic Lessons, and I would say that's what you should expect from us. It's very hard for us to do, but what you are really looking to social scientists for are those sorts of key nuggets of insight: Okay, if participation's a problem, these are the buttons to press, or what buttons to press if you want to make bureaucracies downward accountable. And good social scientists are so worried about the high level of uncertainty in those generalizations, they won't make them.

SECTION II

ISSUES IN RAPID APPRAISAL OF IRRIGATION STRATEGIES

INTRODUCTION

In this section technical topics related to Lessons Learned by the participants as members of WMS-I Technical Assistance teams as well as in their combined professional experience are presented. These are issues from which the participants expect the greatest returns will emerge for developing effective strategies for improving irrigated developments.

PROJECT PURPOSE - SELECTION CRITERIA AND CONSEQUENCES

JACK: I visualize that projects are built for economic, social welfare and security reasons, all of which are political in a sense. If we know the emphasis, we can better realize the desired benefits instead of treating all projects as though we expect an immediate positive rate of return. And when I know the purpose, I don't point out how stupid the project is all the time!

It helps me immensely as a technician to know what game I'm in. I want to get the context of the project -- why are people thinking about this project, why is the project here, what's going on, what's its history and what do people think is going to happen to it.

HELEN: New starts are partially administrative, partly political, and represent the desires of people or, at least, of politicians who get some of their support from people. Powerful people have a say in where projects are located and how far along the construction gets before resources are drained off to start another project. Thus, one question which arises is the relationship between administrative and political decision-making about locating and funding projects.

CLYDE: That should be the politician's problem. We're technical people. We're saying what can and should be done. The decision of whether or not to have a project is not made by technicians.

DEAN: Technicians ought to tell the politicians the consequences.

HELEN: For WMS work, you begin with questions about the nature of the project -- to what extent it is political. Then you determine the role of the analyst and the team, knowing that it costs less for team technicians from outside to take the heat than it does local decision-makers.

The technician's job is to provide politicians with information about the cost of decisions. The task is not to place them open to

blame or failure, but to identify the errors in ways so that people who have run the thing can do it better. Also, remember that all projects are political, requiring financial support, and local support, and that people get expectations and hopes and reputations, and all of that is political.

BRYANT: All the politicians know is that here's an area, and they want an irrigation project that benefits those people.

HELEN: And the constituents are yelling for it.

TOM: Once the project has started, we forgive all the sunk costs. When the problem is that the economics aren't there and they want the project, we have to tell them to what to do to get the most they can. The hard problem is that they want the project.

JACK: It would be better to optimize the subjective functions rather than always the benefit-cost ratio -- to allow for a large secondary benefit and let the project be a good project. That is, optimize the function of making the best of it rather than justifying the whole thing.

BRYANT: We may want to get a project with the least negative internal rate of return. This is often, in fact, what's really happening. Good advice may be to look for a minus 10 rate of return instead of minus 40.

JACK: Economic projects always seem to be attractive, but there are also strategic projects and social projects. These last may require massive social change. Ultimately, if we can clarify the real objective for the project, we'd do a better job. For social projects, an engineer would design things differently with more self-help, more input from people and more indigenous materials, as opposed to full concrete lining, construction crews and the assumption that the farmers will be on-site in one year and the production up in the third year.

Projects designed more for the social benefits would end up, in the long run, being more economic, but we can't change the benefit-cost ratio or the economic appraisal. WMS-I can't. We can only accept it.

TOM: WMS-I has NEVER tried to justify a project. It's a waste of time to go back and try to justify the benefit-cost ratio. For example, the river is about the only resource Senegal has to develop. They are going to put in the dam on implicit faith that electricity is good -- and we just have to go ahead.

JACK: We're really obligated to give the next suggestion, not just to say, "This is no good." The secret to being effective is to say it like it is, to point out alternative directions and to leave room for the political scurrying that has to go on to reorientation. Let people have a way to move to the next thing. It seems to be very effective if people have a way to go and a place to go and a really strong logic to get there.

R Y: One alternative is to separate the subsistence part from the production part, the social (welfare) versus economic.

JACK: One question to ask about projects is, is there an operation strategy? And if there is a strategy, what is it?

DEAN: The Mission writes some strategy statements. Another political issue in irrigation development is the tradeoff between making some kind of lesser opportunity available to more people as against making a better opportunity for fewer people.

RAY: Politicians need political science data regarding the number of beneficiaries for the project and technical data on the probable returns in order to make decisions about what can be done to get the best results. It's often a political decision, and we are not always going to get technical benefits, so we need to begin to understand how we can measure social and political benefits.

For example, in Peru, the politicians weren't given the right economic data nor the right political science data, so the number of beneficiaries is very minor for the size of the project. It's much less than they thought. They just thought, well, they'd put money in there and it would be a lot of benefit and nobody thought it through. Nobody!

We could say the same thing for Senegal. There are 800 million dollars put into that dam. That dam's going to be built. It isn't a financially feasible project. AID's not going to put money in. The World Bank's not going to put money in. It's mostly the Arabs putting money in. But they're not going to get the return. Once they decide to build a dam and think their technical analysis is still right, all they can do is go ahead and get the best return that they can.

We have to do these sorts of things, but the point is nobody has told them up front that this is really a political decision. They aren't going to get the technical benefits. They haven't ever had the right economic analysis nor the right social analysis. They don't know who's going to benefit, what it's going to cost to do the resettlement and all this. Nobody has given them the knowable facts and realities.

TOM: We say it like it is, because we're coming in from the outside. The value of second opinion consulting is that someone is able to come in and tell the truth without guarding a vested interest.

TOM: Two Lessons I have learned are that there is competition between Mission people for pushing projects and that other countries haven't done any better or worse with irrigation than AID has.

CLYDE: The international organizations are political, completely political, and within the international organizations there are a lot of jealousies. We have a lot of cultures talking about the same thing.

Every organization wants a project in a country. You never hear a country say, "No, I'm sorry, I know you want to give us three million dollars, but we don't have the people to handle those counterparts." Further, it isn't popular to go back and see what they did. What's popular is to get another project. There is also an attitude of, "Why should we do something when we know that these other contributing countries' bilateral programs are going to do it for us?"

Every development has encountered political problems -- we can't get away from them, like we discussed. But I still maintain that as technical people and when recommending procedures to technical people, we should approach it with a legitimate offer of the completely honest technical aspects of a project and let somebody else make the decision as to the benefit of the electorate.

BRYANT: One thing I learned is how well local institutions have learned to play ball with the donor institutions, they give grand performances. I really think that efforts should be made to circumscribe political considerations to develop some kind of flexibility in the procedure that allows the politics to be expressed but within some reasonable bounds. A critical issue is the degree to which we can entwine political considerations and procedural requirements. It may be useful to have technical review boards to dialogue with the political decision-makers the various consequences of alternatives and how they might accomplish the same political ends at less cost. International organizations have review boards. The optimal

way is to get all of the donor agencies together to exercise their clout.

HELEN: Politics can teach important things about demand and feasibility, and it is a mistake not to examine whether a project has a lot of political support -- we distort that process by subsidies. If technicians come in and say to people, "This is what you ought to want," but the people haven't convinced themselves that's what they want, then technicians are making a terrible mistake to say, "That's what people should get, and that is all people are going to get money for," because then failure is built in.

RAY: The whole process is really an obligation of funds -- of dumping money anywhere you can. No one person in a donor organization is generally involved with the same project from start to finish; thus, the reward system is not based on project success, just on its initiation.

HELEN: The problem is augmented, because it's a standard technique in organizations to make certain that their field offices are not co-opted by local residents, to rotate people quickly.

BRYANT: It strikes me that one of the ways to solve the allocations problem is through overall regional allocations of money.

HELEN: It can be allocated according to general criteria and with the local people deciding what to do with it. As an example, see the Dominige-Monyhan Bill.

TOM: The British meant the irrigation projects to pay, not just to distribute water, and to achieve that built-in flexibility needs to be a fundamental criterion. At any rate, let's go on doing the best that we can with the reality that we encounter when we get there. This allocation issue, we can't address that!

JON: Where a project is located can also be categorized as being in

essence political, and the project's location can cause it to fail.

CLYDE: A problem of a different political nature is that once a plan of work is set up and everybody approves it and then it's budgeted, it's like moving a cemetery to change that plan of work. Also, sometimes the longer we're there, the more we find out that we can't do it, because we've been listening to the people who say we can't. If we're only there a short time, we can throw out ideas.

PROJECT EVOLUTION

JACK: Irrigation systems follow an evolutionary process, a growth process toward opportunities. A system does not evolve by law, but by creation of an environment that entices it to grow where we want it, toward the optimum output or somewhere near. Farmers are opportunistic; they are going to move toward their best opportunities; if the system isn't interesting to the farmers, then efficiency's a hollow word. It seems that if the irrigation system evolves, really the bureaucracies, the whole system is evolving: The farmers are evolving; the physical system is evolving; and the bureaucracy that's running it is evolving.

TOM: We have to see an irrigation system in its time and place to understand it and our prescriptions will vary depending upon when we see it.

JON: Economists fit well with engineers, because they both load everything into the first one-third. Get the system built, and look for the benefit streams. The rest of us have to deal with the remaining two-thirds of the system's life, and it seems that what's happening is that benefits to careers are all front loaded.

Unfortunately, in that last sort of one-third of project life is when the social system needs support. Marketing problems arise, and all the technical interfacing difficulties are ferocious in that last one-third, and that's where the present system of expertise pulls back and starts looking for new projects.

JACK: To me, it's quite a step mentally when an engineer realizes that the system is really evolutionary, that it's evolving. An engineer basically doesn't think that way. Irrigation implies the use of something as well as the construction of something, and since there's the use as well as construction, there's an active, dynamic system.

Seeing the system as evolving breaks me out of seeing it in the same old way. I think our problem is we don't really see what we're

looking at. So one thing we can do in our Lessons is to flesh out the evolutionary stages: the evolution of the irrigation system itself; evolution of bureaucracy, evolution of the water law.

HELEN: One item on project evolution is how to turn a construction bureaucracy into a management bureaucracy, and why they would want to change.

JACK: Naturally, they have to turn around, because they run out of things to construct or else run out of money to construct with.

PROJECT ALTERNATIVES - FLEXIBILITY AND POSSIBILITIES

RAY: Since we know it takes three generations, why do we tend to make these projects inflexible? We fix the farmers into a situation they can't get out of. For example, we don't allow them to sell the land, etc., even when they don't have credit, labor or management ability for their size farm. We need to build in flexibility. There doesn't seem to be any overall national planning to set priorities or justification for projects. You don't really have a range of possibilities.

JON: Within a project, the socio-economic system aspects tend to emerge after four or five years. Therefore, some typical project problems come from making strong assumptions during project design. Being a disipline means that you learn to accept the basic working assumptions of your field; however, as you look at longer lengths of time, it's the basic assumptions you make about the environment that give you good or bad results.

One of the assumptions we make is about labor pricing, about fair labor being available in the system. I'm not saying that's wrong. It's just that it's not going to happen over a 20-year period. The value of labor will increase. The warning is that it's going to be dynamic, and maybe that explains why maintenance tends to fall off. Thus, it is essential to go for flexible designs.

JON: Another Lesson I would make is that issues like the predictable division of effort are always left as residuals. It's only after the crop is halfway up that we really start worrying about all these other things.

TOM: Built-in flexibility should be a fundamental criterion. Wisdom tells us to set up a system that gives flexibility which allows the cultivators to grow whatever crop is most economically feasible.

HELEN: Flexibility is critical, because part of what an irrigation

system is is a learning process. You try things and discover they do or do not work, and then try others; irrigation systems evolve. So we need to leave room for the learning process, for the flexibility to adjust to events as they occur. Our inability to predict human creativity argues strongly for the importance of leaving room for it.

CLYDE: First, you can't change the systems. Second, if you've made a mistake the farmers are dead. We don't follow through on our programs.

DEAN: There is a danger in over-designing a project. With regard to C.S.U.'s Pakistan Water Management Project, which was left quite open, the USAID Director said that's what made it a great project, "If they had come here knowing what they were supposed to do, this project would never have succeeded."

TOM: If I had a manual of the technological opportunities or alternatives and their implicit organizational implications and the social scientist could describe the social implications to me, then I could marry the technology with the social system. Let's not try to manipulate the social system. We have a whole history showing the gestation of irrigation projects takes 20, 30, 40 years while people are trying to manipulate a social system. They can't do it to fit a technology. So why not ask the sociologist to tell me what's there and then fit the technology to it.

For me, then, that means that in my analysis the organizational component or elements as they exist take on a tremendous importance. Before I might just say, "Well, stick those under the table." But when I look at the discount rate, time path, and flow of benefits, and I find I have to push those off to the future because of the long gestation period, that really gives me a different technological fix and changes my recommendations and whole thinking, because I know something about the interface of organizations and technologies.

Now it may turn out that you come back and you say, "Well, you know, this technological organization stuff, it's all air anyway, and it doesn't work," and then I've got to change my whole premise. You know,

for example, maybe all these sprinklers that you can roll over the ground are not sound engineering, and maybe I'm not really sure about that. But that to me is kind of a learning which comes out of understanding where the other disciplines are and then trying to integrate that with your own. So that the cross-disciplinary thing on the team requires you to have some people who know what they're doing. You have a Keller who knows the engineering, and others who know this and that. And then if you have other people coming along who are interested in learning from that and can pick out what's going on, that's okay.

To say it again: Maybe you can get the technology to push it past the organizational problem. If you really understood the technology and what was implicit in its organizational implications, and then if you really understood what the existing social system was, and maybe sociologists could tell me this, then maybe I could really get things to happen.

A project in the end would still be situational, dependent on the culture, the climatic areas, technological limits, so no matter what you generalize across any of your experiences, you better have your mind on looking for the special case that exists in every one of the systems you look at, because there's always some new special case.

A question arises as to how flexible the engineer is. The engineers really got into arguments among themselves as to what was appropriate. Engineers do not do alternative design comparisons in situations, because they have made an a priori economic evaluation in many of these systems. Nevertheless, some interesting arguments occurred over what distribution systems could be, and there were a lot more alternatives than met the eye. Once the engineering alternatives are known decisions based on economics can follow.

Rainfed Agriculture

RAY: Rainfed potential is very important when looking at irrigation projects. We usually compare rainfed with no technology to irrigation

with high tech. We don't really plug in the cost of delivering improved agronomic technology.

JACK: Rainfed is not uniform; there are a whole range of rainfed conditions. The best buy for the dollar would come out of rainfed, by far and away, in terms of averages, but averages do not account for the human suffering during drought. There's something else going on here, and maybe it's the political impact of irrigation projects.

TOM: Rainfed has so much variation in it that the technology you develop for any area may be applicable to a relatively small area, as compared to a technology for an irrigated area.

Community Systems

TOM: There's a statement that community systems are working better, and I don't know that I've seen evidence for that. The advocates seem to have looked at situations with a lot of different physical characteristics and then concluded that the difference was in organization, and it seems to me that they didn't pay any attention to the physical differences.

JACK: I think maybe the supposition really comes from the fact that the farmers develop and operate the community systems themselves and that they pay their bills for the water they use. Somehow or another they have less support, and yet they're still functioning; therefore, they're good. Whether they really are better, I'm not sure.

HELEN: This conclusion comes from a desire for responsible organization and a desire for community decision-making processes where people commit to do things and they follow through with them; an irrigation system which is built up by the people themselves making arrangements and developing capital and coming to agreements in a responsible organization. When you impose development from the outside, whether it's international development or simply development from the

nation to an undeveloped region of the state, you come in without that sort of basic agreement and demand among people. So you end up having difficulties when it comes to getting agreements about how to share water, how to settle conflict, how to maintain structures, and other things. In that sense, community based systems have already proven that they have the basic wherewithall to do development, and in that sense they've already passed some tests and I expect are better from a social point of view, simply because these communities have already gone through that social process.

HELEN: Also, if there's a conflict over water allocation, they know how to settle it. Water is one of those fundamental resources. After providing police protection and fire protection, one of the first things primitive communities do is figure out how to develop water supplies and to allocate them. To some extent the process of building community organizations to make those kinds of decisions is part of the process of building a community, i.e., an ability of people to work together over a large number of things.

My values are in the direction of leaving some of this responsibility to communities, because it is part of the building social cohesion so that they can have community self-determination.

PROJECT IMPROVEMENT AND SUCCESS - AGRICULTURAL PRODUCTIVITY

JACK: Projects fall into two categories: (1) "new" projects to improve agricultural output from agricultural development; and (2) "old" projects to rehabilitate agricultural output.

Since the objective function of a project is not to deliver water, but irrigated agricultural production, the farmer is the ultimate manager. We often overlook the fact that using water well takes more labor than using water poorly; for example, irrigation increases weed problems, and in turn requires even more labor (except in paddy rice). There are also power requirements and soil tillage practices which require machines and animals.

When I see projects, these things are not mentioned -- we just assume that we provide water, and people will use it to have good things happen. Nobody knows how many people are going to do it, etc.

ALLEN: Some LDC nations, especially in Latin America, and possibly in Africa, have the physical resources to be self-sufficient in food production (although the quality and types produced might not quite satisfy local tastes).

The world food economy, at least in grains, is so intertwined that few nations are really so shut off that they have to be self-sufficient; and a lot of these countries, measured by international prices, are high cost agricultural operations in lots of crops, so it may be more economical to import. Nevertheless, they can still choose to be self-sufficient. It's just that there's a certain cost involved.

So you might say, "Well, wouldn't the foreign exchange savings be worth a national effort to be reasonably efficient in substituting imports?" Maybe it's not as cheap, in money terms, to continue importing, but given the exchange difficulties it is better to be somewhat inefficient. Given these possible realities, what are the possible alternatives?

First we need to determine whether the nation can afford to pay for whatever it is importing for the foreseeable future. If the answer is

yes, then that's fine. If it's no, then we've got to find some way to obtain foreign exchange and we have to ask ourselves, "Well, what's best -- push agricultural production for export or push the non-agricultural sector?"

A nation already reasonably self-sufficient in food production, or one that has high cost production and marketing costs relative to the international price of imports, may find it difficult to absorb substantial increases in production related to irrigation or any agriculture development project.

The facts to remember are that available domestic or export markets set strict limits to replicability of "successful" projects, and allowing for upgrading tasks and higher incomes, the domestic market (demand) for food commonly expands at a rate of 4 to 5 percent per year. This places a real challenge in front of rural development project designers, because farmer incomes may actually fall as productivity rises (unless designers hit a really good export market) and families may be driven from the land. On the other hand, the existence of under-utilized land, on a frontier or otherwise, may offer subsistence opportunities to a growing population which may eventually capture wealth effects from rising land values over time.

Some generally larger or more densely populated nations may be able to absorb any amount of increased food production that development projects could reasonably provide. If this is true, the main issues in project design might be confined to technical, financial and implementation factors. In reality, there is virtually no situation involving productive type projects where markets can be ignored. Given the interaction between the need for realistic markets, prices for the farmers, normally low elasticity of demand for food in smaller countries and the long run potentials for increased farmer income out of all those interrelationships, designers tend to put in fairly "high-powered" crops to get the benefits experienced on the projects up, and the available markets can seldom absorb those kinds of crops in very large quantities.

Regarding differentiation between productive, consumptive and public subsidy projects, we need to determine the role irrigation can reasonably play in achieving the social, economic and political goals

associated with adequate national food supplies and improved rural income. To do this, the following issues need to be addressed:

1. How much food is going to be needed and what do domestic supply trends really look like? What do export markets look like?
2. Are all easily developed irrigation options gone? Are all the cheap sites gone? Are costs skyrocketing?
3. What are the rainfed possibilities? Might rainfed be more cost effective than irrigation?
4. What would it take to improve the current irrigated performance? How much would the improvements fill the food deficit if there is one?
5. What do answers to the above questions imply with respect to new irrigation developments versus new or improved rainfed developments?
6. Is a reasonable division of public versus private effort implied? What developments will stand on their own financial feet? What subsidy will be involved, how will the benefits be distributed, and who will bear the cost? What decision rules should guide policy? Should direct beneficiaries pay costs? If not, should we expect social benefits to be at least greater than the social costs; or is some other measure (pork barrel, for instance) to apply?
7. Where subsidy is involved there might be a tendency to ignore the social costs of ever-increasing expensive irrigation projects; because, for one thing, the techicians involved in pushing them don't pay the costs. Hydrologic efficiency, the idea of getting everything you can out of the last drop of water, is not the same as economic efficiency.

There appear to be some domestic situations that require irrigation expenditures from the welfare standpoint regardless of anything about cost effectiveness. These involve BASIC human needs arguments.

Public expenditures tend to be "consumptive." Not all consumptive expenditures are subsidized (for example, householders may be willing to pay full costs of water development for lawn watering purposes), but

many are. Also, a special effort in a dry zone may be warranted because "the people need the water" or the nation may want to foster development, even "uneconomic" (think of the Western U.S.A.) development, in all regions.

No matter how socially desirable public expenditures are thought to be, all subsidy has to be paid for in some way. If a nation is floating on a pool of oil, then of course you can build irrigation projects or subsidize agricultural development in the rural sector until hell freezes over -- in Latin America and the Middle East, a lot of the agriculture does not stand on its own two feet, speaking of purely economic measurements. It is also possible to pay for irrigation systems by export of any crop or product or by means of "value added" earnings, as in the case of Japan.

If these options are not open, the subsidy must come from the domestic economic sectors that are productive enough to bear the subsidy. The critical question is where such sectors are and where that type of production can be found. The "rich" class is ordinarily not large in number and can't or won't bear the costs if they can be avoided. The umbrella over the above comments is provided by loans, especially international ones, and now it is quite clear that even the nations thought to have considerable repayment ability can get into trouble.

To close the circle:

1. It's better for development projects to be able to pay their way. The World Bank and other donors are taking this approach more and more. The general credit of the nation is not enough, or at least the bank doesn't want its projects to add to already high foreign debt problems.
2. This puts pressure on irrigation developments due to the high costs and often low levels of achievements for monies expended.
3. WMS Project emphasis probably will pay off quite well if it tends to elevate project performance.

JCN: In irrigation, the big payoff is really on fertilizer

applications; where you bring in the irrigation it means you can start applying large amounts of fertilizer and show crop response.

TOM: The really fundamental dilemma involved with increased agricultural production is that, everything else being equal, if you increase agricultural production, the consequences are going to be that farmers' costs are going to go up and farmers' revenues are going to go down (individual revenues) and the only way you can change or prevent that is to have demand change, which comes about through either population growth or increases in incomes that change the market size.

ALLEN: I'm afraid you're going to constantly come out with that result except in those cases where you could hit a really good export possibility for rural people, an agriclutural type export. On the other hand, you may get subsistence opportunities to absorb population, then the road goes by and the land becomes valuable and the grandchildren benefit from the increase in wealth of free land.

HELEN: And in the interim, we mignt learn more about how to cope with some urban problems that we're dealing with really poorly now, just in terms of social organization, education in urban environment, and so on.

RAY: We also need expertise in new projects and in agrarian reform of how to do parcelization, how to do reallotment of parcels. If the allotment is too large, the farmer doesn't have the credit to do it, he doesn't have the inputs, he doesn't have the management and he doesn't have the labor. We must consider project financing -- just a supply of water is not enough, we don't get the benefits out of the project. We have to have this complete extension effort. We simply don't have the infrastructure either -- AID has been bad about this in a number of cases.

It would be better to put some of the capital costs as counterpart funding rather than technical assistance, because then we wouldn't build a project past the capacity of a country to absorb it. It may be most

costly to do it piecemeal, but overall it may be less costly if the benefits of the project arise earlier.

The type of land ownership, etc., is very critical in determining whether a project is successful. Size of parcel is important as far as determining input requirements.

JON: Agriculture appears to be a partial exception of saying you have to go for bigger units and get the people off the land -- agriculture may require increased labor per unit of land under improved practices.

TOM: Never forget that irrigation systems are really part of some sort of integrated rural development process, and the risk issue is important. Economists have a whole set of literature on that.

RAY: I don't think that the problem or the constraints are really agronomic. If you look at yields, of course, irrigated projects never come up with the production they're supposed to. We really have not learned how to reach farmers who work small plots of 1 to 2 ha or less with a learning curve for any sort of technology.

DEAN: In India, the production recorded by the crop reporting service was greater during drought than during what they called "sufficient" water -- they were getting greater yields than previously.

JACK: Water and social tension, which are a function of the amount of water available divided by the amount of water the most economic cropping program would require, is another issue.

RAY: Technical assistance requires a lot of inputs, and it doesn't do much good to say you need these inputs if they aren't available.

JACK: It seems that it's not a matter of delivering more information to farmers. The problem is there's something else missing here. The reason the farmers aren't responding could be the fact that they don't know how to sell what they produce or they can't get credit to produce it or they are not really sure it's all going to work. No one else is really taking the risk.

RAY: If the price is there and the farmers are assured that price will stay there for three or four years, they'll take the risk, they'll get that production up. It's not an agronomic constraint. I think the marketing proolem is much harder, too. In Peru, you can almost plot the distance from a city, from a market, against what the yields are in those irrigation projects.

JON: Location is a critical factor. Probably half of the irrigation projects in East Africa should not have been built, because they're far enough from demand that they're going to have marketing problems right from the beginning.

Irrigation projects generate very powerful vested interest groups which want to keep the price differential wide enough to cover costs. There's a whole article on a project in Muda and it says it's a wonderful success. In the very last paragraph they mention that when the government changed the artificial price structure for rice to make it more free market, riots broke out among the farmers.

JACK: Irrigation development is not something that's pushed on, but it's something that is sucked up. It's pulled on. The farmers don't pull it in unless they have markets to sell the stuff they don't need to feed their families. You're either going to be in a subsistence economy

or a market economy. The only thing I know that's going to attract irrigation development is income generation, which implies there have to be markets.

TOM: In a way, the hydraulics link with the markets. If I have a hydraulic system which has a lot of flexibility, then I can get my water any time and I can choose when to crop or to double or triple crop, depending on the kinds of marketing choices that are available. So the choice of hydraulcs is critical in developing the market strategy.

CLYDE: I think there are instances where you should use one common type of equipment, then when something goes wrong the farmers can replace it. They'd have spare parts. There are so many countries selling farm equipment, like in Iran, when Warren was there, he wanted every manufacturer in there with the tractors, and everybody had a tractor. The trouble was no Iranian could afford to have a parts department, so there were broken down tractors in ditches all over the place, just because spare parts were not available.

BRYANT: Do you think most irrigation projects at the design phase think through the marketing issues?

TOM: I think that they think them through as well as they think through the water distribution issues.

BRYANT: Tom's saying that thinking through marketing issues is an obvious thing, and any economist would do it. What [Jack] is saying is that in the field the practice is falling short of what seems to be the obvious theory.

TOM: The farmer will understand the value of water and use it if it has value.

DEAN: We shouldn't necessarily depend on what he has to pay for it. The farmer is interested in opportunity value and user charges. Water pricing and the law do not make the farmers use water well. What makes them use it well is by having it be valuable to them, so it's the availability of water that counts.

Tax incentives are really negative water pricing to me. The Lesson is that the incentive to use water well is because it's worth something to you, not because it's going to cost you something.

ALLEN: It's usually better to think in terms of paying for the facilities.

JACK: The bottom line to me is that it costs money to use water well.

RAY: The amount that somebody has at risk is much greater when he's using water well.

TOM: If the project has a production goal, then stick the price on the water and let the person capable of paying use it.

JON: There is a high risk factor with an unreliable system.

ALLEN: One way to get equity is don't provide quite enough, and then people will be careful how they use it.

TOM: Project planners often treat water as if it were free, with no application or costs.

BRYANT: It is really an impossible task to achieve a great deal of

fairness in water distribution through public institutions. The problem is cost, you just cannot afford the administrative structure.

HELEN: Another problem is that if the farmers have to face too much uncertainty, it's very difficult for them to do planning. I keep thinking about the community irrigation system in northern New Mexico that existed for 200 years where they really did set up ways of sharing shortages and established priorities and ways of policing themselves, and they did pretty well. But part of it was that they knew from experience what the hydrologic cycle was like and what the problems they came up against were like and how often they were going to have to share shortages and how they'd go about doing that. It seems to me that unless there is some responsibility on the part of the water delivery system to behave with some sort of predictability, like at least as much predictability as nature, then you can't create human institutions to deal with it.

TOM: Okay, and I think the distinction you make is an important one. I guess now I'm drawing on Lessons Learned. I've heard it said, and I believe it, that we can really do better. So we go out and look at on-farm management practices, and we start looking around for the "better" that we can do. We start looking at rotational irrigation systems in certain parts of Asia, really wondering what better can we do? And I am not at all certain we can do any better.

HELEN: You mean they're very sophisticated?

TOM: No, I just mean that we can't manipulate the water any better given the way those systems have come about. The way the farmers get the water, they use it effectively. Now you're going to come back and say we could do better with that water. My tentative hypothesis is that if I want to get farmers to do better with water, I must change the economic incentives, making the water more valuable. If I bring in new crops which respond with higher value products, then farmers adjust to that and they do better with the water. If I want them to save water

by straightening up their distribution channels, I just make that water more valuable to them, and they do it, because it's the rational, economic thing to do.

HELEN: Providing the economics is rational, and that's the problem! Because somebody's got to set those prices, and I'm not sure that it's always going to be politicians who do it, or a rationality that drives the price up.

CLYDE: I keep getting back to the farmer. Now, the big reason we don't get across what we know is because it's almost a one man on one man situation, which we cannot afford to do. There are how many -- 50 or 100 milliion farmers or a thousand, whatever there are. We can't do it, but when we do do it, in small demonstration plots, for instance, or in an increased or extended extension service, we get results. But it's expensive, and we don't have enough people in this world that understand that. We have people like us who look at the big picture. But for the little picture, wedon't have very many people. We don't train very many in school; also, it's a physically dirty job.

TOM: What kind of practices in . . .

CLYDE: I mean actually with a shovel, following the water, finding out where it's not covering the ground, in surface irrigation. Many people think that sprinkle or drip irrigation is going to solve their problems, but like Jack said, "It doesn't." It takes people out there working with the farmers, which we've done in this country.

RAY: I think you're both saying the same thing. I mean, take the Texas High Plains in this country. You had all the extension people out there talking about efficiency of water use and production, and the efficiency was still pretty low. But you up the price of the energy to pump that water and the efficiency changes overnight. But we have people tell them to be more efficient, we have people tell them, "You should use this water better -- it's costing you, it's not free." But they didn't

have that value on it, like Tom says. It didn't have that value to them until they had to pay the cost of pumping and had control over the reliability of their pumped water.

DEAN: Even if the water is delivered to the farm on demand, and even if the demand is based on soil moisture sensing, there are many water management decisions about agricultural production and irrigation to be made for which better information is needed. I tend to regard water as an asset rather than as a production input; because, like fertilizer, it's the continuing right to have a water supply year after year that influences the farmer's investment year after year. If the farmer doesn't have that and treats it as an asset, he will not make the essential investments in development of his farm.

THE FARMER - THE CENTRAL ACTOR

CLYDE: We have to get to the farmer. He's the one who's producing. We're not producing. We're producing paper, and the world's full of paper. But to me the important thing is what happens to the water [after it gets to the farmer]. That's where things fall apart. The farmers are the ones who have to have the best handle on the thing.

DEAN: The farmer is the principal manager, and you can't manage him with top-down management like the Apollo moon project. The only things a development project can do are change his environment, his information base and his incentives so he can better manage his own resources. But if he isn't in on this discussion, you're not going to get far.

HELEN: That's right. Pay attention to the user; get him involved in the initial planning.

CLYDE: As Jack said earlier, projects consist of two phases: new and old (rehabilitation). In the old one, the farmer has to have something to say or you're dead, and on the new one, the farmer has to know what to do with it when he gets it, which is where we fall apart.

TOM: For various conditions of climate, kind of system, etc., we often have a design slippage -- no one knows what the farmer should be doing in order to meet the objectives.

JON: Also, farmers' attitudes are important. For example, farmers in Africa tend to become very passive when confronted with a big organization, and this attitude grows over time. There may be an inhibitions blanket, an attitude of "I can't do that. That's not in my area to to act; and I can't give my wife orders to work on the canal, because she doesn't get anything out of it. But I, as a man, don't work, so I'm stuck." These occur in the social, political and economic sphere.

There is an additional question of leadership and cooperation. We do not tend to see the difference between leadership which requires consensus on each occasion and that which can give orders. We have a natural tendency as technicians to work with the most authoritarian leaders -- they deliver! There is probably also an intrafamily circulation of benefits. A danger lies in seeing the family as a stable system because it is dynamic. Kids get educated, etc. Land rights and tenancy are other crucial issues. We must be clear on the stake the individuals doing the work have in the system.

HELEN: Attitudes are important. We assume so much of this sort of entrepreneurial attitude, and especially when women have a really strong role in agriculture. It is often not valid. Their reward structure is usually very different.

CLYDE: Government attitudes also vary. In Mexico, for example, certain projects are operated by groups and others by the government, in which case the government tries to be all things to all people. On private systems the directors or operators or leaders say, "If you don't clean your lateral, you're not going to get any water."

JACK: It's human activity that puts irrigation in place or doesn't put it in place. We know a fair amount about how to do the physical hydraulic part and the physical agronomic part. It's the putting it in place and holding it in place and enticing it to be there that we don't know how to do.

HELEN: Are we more negative than we should be in thinking that social change is extraordinarily difficult?

DEAN: Yes, I think so. Social scientists do seem to underestimate how capable human beings really are.

HELEN: Really, because basically what happens is inventiveness, which overcomes difficulties which analysts predict. So we end up more

negative than we should be, and I say that from my disciplinary perspective which says social change is extraordinarily difficult. What really makes projects work is human creativity. Real life people come face to face with a problem and they become creative and they don't grow tomatoes, they grow something else. They do. But analyzed ahead of time, if you could predict all those difficulties, probably the bottom line would be you wouldn't have a project.

TOM: I've got to resist Dean's idea! See, he keeps really hassling the economist, but really, the basic assumption of economics is people do just that. I mean, that's what rational choice really means to an economist. The farmer is going to find a way to make it work, a way to make it pay off, and if it doesn't pay off, he or she won't do it.

CLYDE: The farmer's got to make it work.

TOM: Exactly!

DEAN: And he'll do a lot better than you think he will. It must be really traumatic for you to be the dismal scientist and have the ultimate faith!

HELEN: I have a question. You're talking about the farmer who makes rational decisions and the farmer who's interested in his own self interest and so forth, but at least part of the time (I know in Peru, and certainly in the Dominican Republic) there was no farmer. There was instead another bureaucracy which was called land reform, which had all these people who didn't own the land, and it was behaving with some production targets, but production was only one of a whole bunch of other purposes that had to do with absorbing people, establishing more cooperatives, and other agendas. So it becomes terribly difficult in this case, it seems to me, to figure out why people behave the way they do, because it's not within the irrigation system. Irrigation is incidental to other social goals.

JON: The interaction between land reform and irrigation is a special subtopic.

TOM: We in WMS are certainly obligated to comment on how a particular policy is going to impact on the objectives which are spelled out on those irrigation projects. For example, we might throw out alternatives on how the land reform policies might affect the irrigation system.

FARMER PARTICIPATION - INSTITUTIONS AND ORGANIZATIONS

TOM: We can really deceive ourselves if we don't understand the motivations for farmers participating in projects where there are multiple benefit streams including the "bennies" he got by participating. We must look carefully at what the motivations are of the people when they're involved in the organization.

HELEN: From that a social science Lesson emerges: Organization is much easier to do when people get together and demand something. Then the getting it isn't what keeps the organization together, it's the desire to have it.

DAN: C.S.U.'s Pakistan experience verifies that.

JON: Again and again we assume organizing costs are free. Except ours -- we always know ours! The thing is, organization is expensive to do no matter how you do it.

HELEN: Participation costs are related to access to other parts of the system. We need to look not just at user groups, but also at what it is they're making claims against and how those claims are reacted to. In fact, if the whole system works, it may be that those groups are not all that necessary. Participation for participation's sake is probably costly and a waste of a farmer's effort.

RAY: Beneficiary involvement is important. If the beneficiaries are involved at the beginning, maintenance has proven to be less of a problem.

HELEN: In generating Lessons, it would be important to capture whether there would be user involvement in the initiation of the project or only later when the water splashes up against the user's headgate.

JON: Francis Cordon argues from the Philippines that if you involve the clients early, you can get a successful user tradition going, but if you try to bring them in late, it doesn't take root.

HELEN: I think it's wrong to look at it as if user groups were some entity outside the irrigation system. The formation of a user group makes sense if you have a large scale organization because large scale organizations are only responsive to organized users. So the need to have a user group is a function of what they have to access.

CLYDE: Water management at the farm level is the thing that the people who are trying to help these countries are confronted with at the end point: Engineers can build some beautiful projects, the economists can analyze them, the social scientists can say what could be done, but it still gets down to the farmer at the end. And we haven't figured out how we do it.

We have these technical guidelines, but how do we actually use them? How do we put it into practice? Do we have people who go out and have meetings and bring the farmers together? And it isn't easy, because some of these places you have to go are in the boonies.

HELEN: People behave as if water were an asset which they need to husband, to take care of, and pass on to future generations to develop. I see the opportunity to make decisions about water as part of the development of community decision-making processes.

IRRIGATION BUREAUCRACIES - FARMER RESPONSIVE AGENCIES

HELEN: In answer to the question of where are we all coming from, what is it that we know, and what is our area of ignorance, in my model of a system I look at users, agencies and projects. I really start with the user. Irrigation projects the world over are driven by farmers' desire for control of those irrigation projects, and secondly their desire to participate. Then they want security in the water supply; then some equity and then, way on down, some concern about efficiency.

Large scale irrigation implies bureaucracy. I don't think about production functions, I think of bureaucracy. You have to have a big bureaucracy to operate a big system. Users can't relate to bureaucracies individually. They have to relate to them in an organized fashion in groups. So I ask, "What about responsible bureaucracies? Is the bureaucracy responsive to demand? Is it somehow held accountable for its actions? Do users have influences over the rewards which come to bureaucracies?"

There is a learning process. Bureaucracies go through phases, first there is a construction phase, then the results of construction begin to come in. There are environmental impacts and user concerns. Bureaucracies hate being responsible, so I ask: "What are the characteristics of user groups that are able to hold bureaucracies responsible? How do they get organized?" When people are more alike they trust each other more and are more likely to work together. They have in common the same background, same social milieu, same size farm, same school, and there are certain incentives not to do your neighbor out of water, because you have to live with him for the next few generations, etc.

When examining the characteristics of agencies, I find the diversity of personnel is really important. If I know anything, I know how hard it is to move bureaucracies. For example, what the Instituto Nacional de Recursos Hidraulicos (INDRHI) wanted to do was to create their own user groups and these couldn't have anything to do with crops and they couldn't have anything to do with marketing organizations or

creditor organizations. The idea to INDRHI that they might have to be beholden to the farmers for anything, including a user fee, was just an outrageous idea, or that the ditch rider might be a farmer. And that was the model I was trying to impose -- user involvement in planning and development!

TOM: My original assumption was that there is no such thing as an enlightened bureaucracy. It acts in its own interests.

HELEN: There isn't. Bureaucracies try to insulate themselves from external pressures, to control their own bureaucratic environment; and they create their own internal reward structures -- especially special agencies. Special agencies in this country are answerable to no one.

TOM: In the Gal Oya experience, you would make the case that the tension within and for the bureaucracy, which you say they're trying to eliminate from their lives, is reduced by being responsible to the farmer, because now the decision is not the agency's if something goes wrong.

HELEN: Creating mechanisms for responsibility is difficult in large scale efforts. There is this big push toward larger amounts of production justified with outside funding, and there is a tendency, then, to build large scale engineering outlets.

Construction bureaucracies build consent by creating perceptions of likely benefits. Water is a romantic thing, everybody believes that if you just have water you have wealth.

TOM: The higher the technology you bring in, the greater the number of agencies that are going to be involved in your irrigation project is likely to be.

JON: There have been two categories of people in the bureaucracy over time: (1) people working on the irrigation authority may originally have all come from farms; and (2) with modernization and education,

before the farming system is modernized there may be an elite and no communication with peasant farmers.

HELEN: There are different types of personnel in irrigation agencies: (1) in community-built irrigation organizations, personnel have lived in the project area always, are a part of the culture, have similar backgrounds and don't rotate much; and (2) in large-scale organizations, people in the agency are usually civil engineers who don't have a lot to do with farming and who don't have any relationship with the area that the irrigation project services.

The difficulty in talking about responsive bureaucracies is that they don't stand alone, because it is all so dependent on the setting. I can give some general rules, but I can't tell you if it's going to work or not. Looking at a bunch of bureaucracies, one can say these are the things that lead to responsiveness, but whether or not you could make any bureaucracy in a particular place responsive by trying those things, I don't know.

Physical things matter, too. It's probably easier for users to control bureaucracies in arid regions where irrigation's the only source of water than it is where irrigation is supplemental. The tail-enders who are not making it have an incentive to organize, and this is a constant in an arid environment.

DEAN: We also need to determine how to create some kind of institution that will work outside of the construction bureaucracy to get improved agricultural production.

JACK: The management of the system is a human activity, and the physical structures are just there as resources for people to use. How it's managed depends on labor, skill, energy and capital factors and involves tradeoffs between hardware and software.

One spectrum ranges from simple systems which are the irrigator's own mental images to sophisticated mechanical systems where the irrigator need not even be present in the field. A second spectrum ranges from systems which change the probability of having moisture but give no control over moisture available to a full demand system where the irrigator takes water on demand.

BRYANT: Likewise, farmers range from individual entrepreneurs to industrial or parastatal systems.

JACK: Management systems which deliver water somewhere are usually industrial systems, while those which produce agriculturally are entrepreneurial.

TOM: Given that, what are the likely responses to the system by an irrigator? The system itself requires communication to function -- hydraulic communication, bureaucratic communication and human communication. The question is, how does it deal with the interface of the users and the main system where the industrial meets the entrepreneurial.

The middle management level and the farmers need to determine what decisions should be left to the farmers and what should be left to the middle management.

JON: Another management discontinuity occurs, because the canal systems are linear and long and all the political units are contiguous. Problems also occur among the low level staff who are monitoring this system and have to deal with the farmers. Since the system as designed

doesn't fit farmers' needs, there's got to be bargaining going on. In such cases, benign corruption may be very good!

Engineers have one image of their universe, and the farmers have another. The result is two systems with crucial linkages being out of control, because they're unrecognized by either side. But probably neither system wants to know, because if either system knew what the water guards were doing, they'd have to adjust their image, and they both reach a tacit consensus.

TOM: What happens when there's a rainfall down in this area, no rainfall up in that area, water's already in the canal, lifting gates, dropping gates, whoooo! The engineers can't cope, you know, really!

JACK: That's why water is delivered 24 hours a day, because it's hard to turn off.

HELEN: One thing for sure, we should start way earlier in telling the farmers this is what's in it; so it doesn't come as so much of a shock.

TOM: What would the enginers do if they were going to allocate the water? What would they do when yields started to be depressed, or even someone's crop failed because it didn't rain? Would they say, "Oh well, save the water in the reservoir; water will be higher value next season." Could they withstand the political pressure?

HELEN: Another question is does the industrial process deliver water in ways the farmers can use it?

JACK: The conjunctive use of surface and groundwater is another interesting area, because by using groundwater farmers can often bypass the bureaucratic organization and most community activities. We've said little about it, but it shouldn't be overlooked.

JON: Jack, you say you pay particular attention to the ends. Now, there's got to be a reason why this would be which would be helpful for

the rest of us. What do you see especially at the ends of the flow?

JACK: Well, the first, you know, you have to put topography into the system, and if it's a big flat floodplain, the ends are all over the place. There's no pronounced end -- each piece of it has its own end. At the ends of systems, at the ends of watercourses, you can really see the equity issues coming out. You really see that there is water down at the ends, and not only seeing it, it's nice to talk to farmers, talking about the water that they're getting and how often it's coming, and things like that. I'm not going to ask them why or how they're dealing with the institutions or how they're dealing with the hierarchy, I'm just asking them what's happening. I'm just using the farmers as some additional eyes, from the physical side, and getting some of their observations.

If I were out there all the time, I could have gotten it myself. That's the kind of information I get, so the ends really tell me how well the system's working in terms of getting water to the ends. And then with this kind of a membrane tension concept, I relate that together and put that in my head. One of the early analyses is, what is the relative water supply or the water density -- how much tension the system has. Then I'll look at the ends and find out how well that membrane's held in place. I can tell how well it's in place, and I can talk to whomever I'm with, Helen or Jon or Bryant, about the fact that it's not held in place very well, it's not working very well, something's gone wrong, and I can give you the signals on how bad it is relative to the nature of the system.

HELEN: Mmmmm, yes, and then one can sort of ask why it is that people make decisions in such a way that it's held together so badly.

JACK: Yes, and you would be chomping around on that stuff, and you might be up in the Irrigation Department and Jon may be down in a farm community finding out what they're doing and I would just try to scope out the state of affairs a bit. Another reason to look at the total end is, if it's a steep system, if you just look at the main drains out of

the system, you really get a quick look at all the reuse and really how effective the whole system is, because if it's fairly steep and you know something about the seepage and sort of the geology of the area, you get a pretty good feeling for how it's going in a real hurry -- how much of the water's actually been consumed and how much is left over.

TOM: But it's really important to understand, I think, that when you look at it is just as important as looking at it. For example, if you look at it in a period of time when water is scarce, you see one situation. If you look at it in a period of time when there's an abundance of water, you may see something else, and you could come to quite erroneous conclusions based on looking at the end. As a matter of fact, the Gal Oya was an example of where we looked at it at one time of the year, came to a conclusion, and what other people said was, but you should see it . . .

JACK: During the rainy season.

TOM: During the rainy season. And our reply was, "But that's not the right time to look at it, that water going there is not scarce water, and you have no opportunity to retain it. What you're trying to do is get rid of water then. That wasn't the time to look at it, now's the time to look at it."

CLYDE: Well, if you were trying to get rid of water, that would be the time to look at it.

TOM: If that's what you were looking for, but understand that that's what you're doing.

IRRIGATION SYSTEM EVALUATION

JON: One thing an economist should learn about an irrigation scheme is that we're pooling an immense concentration of efforts, so although it's marketing, it's marketing in a virulent and new way.

Another impact in a big, powerful irrigation bureaucracy is that we change the vested interests when we pump in a lot of water. Diseases also may be increased. Sri Lanka's under the third malaria eradication campaign in the last 15 years, and it's the result of increased intensity of irrigation.

Also, it seems to me the engineering design has quite a bit of potential for introducing continuing conflict. We must try to avoid designs that structure a continuing conflict into the local scene. It is important to ask how water systems influence the level of conflict in the system. The assumptions about who will do maintenance, and why, are critical. Generally, you can predict that maintenance won't occur, so the interesting question is, why does it occur in some places.

It is also important to look at domestic water and to realize that the requirement will fluctuate with number of animals. Go for flexible designs. In drylands, irrigation schemes are also the source of all other water in the system. This is not true if you have tubewells. If the system supplies household water, you can't draw it down, and you can't turn the water off.

The problem is, if irrigation is having immediate and linked costs, and if we just take the benefit and don't look at the cost, we get an artificial result. Could we handle it in sequence, and use some scheme for saying, "This is what we're going to look at in the immediate context." But then also, as part of WMS-II, make it a tradition to look at how this ball game fits in the larger time dimension and economic policy dimension -- whether it's a sensible strategy, what are the impacts over time, how does it fit into national policy, and so forth.

SECTION III

INDIA, A CASE STUDY

INTRODUCTION

This section is offered as an example of how Lessons Learned might be organized and presented from the disciplinary perspective of an engineer. It is developed by Dr. Dean F. Peterson from his experiences in Maharashtra State, India.

MEDIUM-SIZED PROJECTS IN DECCAN
MAHARASHTRA STATE

A. Site Characteristics

1. Physical Environment

a. Climate: Subtropical, semi-arid summer monsoon (500-1500 mm precipitation).

b. Soils: Mostly residual, mostly vertisols (black cotton soils) of varying depth, less than 1 m to 10-15 m.

c. Aquifer: Limited shallow unconfined aquifer overlying rock.

2. System

a. Size: 2,000-10,000 ha.

b. Type: Reservoir storage with distribution canal network.

c. Management: By State Irrigation Department down to unit outlets serving 40 ha. Farmer responsibility below. Some modifications down to 8 ha for construction. Operation and maintenance responsibility not yet defined.

d. Irrigation Service: Supplemental irrigation for monsoon season (kharif) crops. Irrigation for winter season (rabi) crops. Canal service not provided for dry hot season or perennial crops except in highest rainfall areas.

e. Finance: Publicly financed to unit outlet. Privately financed below.

f. Water Rights: Vested in State. Allocations made seasonally by Irrigation Department based on applications for specific crops (Shejpali). Block allocations may be made for several years for perennials. Demand distribution is

attempted, but may reduce to rotational arrangements. Law provides for wholesaling of water to user organizations, but this hasn't been done.

3. Human

   a. Income: Rural income average $79/annum.

   b. Farm Size: Average about 4 ha; about 50 percent of holdings below 2 ha.

   c. Land Tenure: 92 percent farmer owned according to census. May be misleading. Tenants are entitled to purchase land. Land ceilings range from 7.2 ha for perennially irrigated land to 14.4 ha unassured seasonal irrigation.

   d. Farmer Organization: Water user organization nil on project systems. Cooperatives have successfully financed and developed lift irrigation schemes, however.

   e. Rural Demography: Industrial sector is healthy but two-thirds of labor are employed in agriculture which has a growth rate less than rural population.

4. Social

   a. Political: Democratic -- strong local pressure on political leaders for irrigation projects leads to starting too many projects and slow down of completion.

   b. Agricultural Support: Credit banks for land development and agricultural production are in place, but suffer operational problems. A Training and Visitation Extension system has been started. Local and district level committees plan procurement and allocation of production inputs of fertilizer, seeds, pesticides, etc. State provides support for development of market facilities on a self-financing basis.

B. Diagnosis

1. Overall irrigation utilization targets are not being met. On 5 existing projects ranging from 5 to 17 years old, historical average percentages of irrigated land cropped (sum of all seasons) to area planned to be cropped were: 49.7, 60.2, 36.1, 52.3, 41.3.
2. For the winter season (rabi) utilization targets were more nearly met. Reported utilization on three projects as percentage of planned rabi area are: 95.1, 68.9, 67.9.
3. For the monsoon (kharif) season, utilization was very low: 18.9, 32.2, 8.4, 25.3 percent of planned areas for four projects reviewed.
4. Overall system water supplies were essentially as estimated; however, diversions for irrigated hectare were usually much higher. For rabi crops percentage diverted compared to planned-for average area irrigated on two projects where data were available were: 129.5, 189.8. Crop water requirement estimates seem reasonable so this means that the delivery networks were much less efficient than assumed, i.e., distribution losses were substantially higher than assumed. Measurements of seepage losses in large canals made under World Bank auspices showed these to be at least twice as high as assumed in design.
5. Technical information and procedures for estimating seepage losses and deciding at time of construction where lining is needed are not available. Because of the political pressure and policy to extend irrigation to as many farmers as possible, getting rehabilitation projects approved will be difficult if not impossible, so it is important to be able to predict losses at time of design.
6. Irrigation canals and reservoirs substantially increased local groundwater supplies over recharge by rainfall which is low due to low infiltration. Firm data on how much this is percentage-wise are not available. Doubtless it varies

depending on site. There is some evidence that this may be as high as 100 percent or even more. A study of 13 proposed projects using Government of Maharashtra procedures, which are conservative, estimated 50 percent.

7. In the aquifers overlying the hard rock Deccan, which covers about two-thirds of India, groundwater cannot be exploited using tubewells; rather, large diameter (5 to 8 meters) dug wells serving about two hectares each are used. Even with enhanced recharge, groundwater in this region can accommodate only about one-fourth to one-third of the cropped area. Because of its availability on demand and during the hot dry season, it greatly enhances the opportunity for cash crops and perennials and this has important economic and cash flow benefits.

8. Post hoc benefit-cost analysis estimate on one project indicated that rates of return over its 17 year life were almost as targeted: 9.85 percent. When groundwater is added, internal rate of return raises to 11.3 percent. However, the project chosen, which had good historical data, had favorable economic conditions. Groundwater development, which is privately financed, accelerated beginning in the year in which a sugar factory nearby opened and a credit bank was established in a project village. Where economic conditions are good, farmers are making great efforts to develop their farm lands.

9. Lining and other engineering technologies available in the area are unsuitable for use under local soil conditions.

10. Farmer human resources for communal and farm responsibilities "below the outlet" are not utilized. These probably constitute the greatest potential for improvement. Institutions are not developed, and there is no extension function on the water delivery side. Technical support is also lacking. Inadequate topographic surveys are significant factors in mislocation of mimnor canals and watercourses are inadequate topographic surveys.

11. Irrigation intensity is kept low by the system designers (and as a matter of policy) in order to provide some irrigation to as large a number of people as possible. The floor on this is limited by the requirement for a benefit-cost ratio of 1.5 at 10 percent. While the estimated return may be fictional, the procedure is sufficiently standard so that there is an operational floor vis-a-vis intensity.

C. Conclusions - Lessons Learned

Lessons Learned, if any, are largely region specific. The extent to which they can be applied globally is unknown.

1. The information base for good decision-making is quite deficient in many areas in all disciplines. Much of the needed information can be obtained by studying existing systems. Getting this information is essential to improving design and operation. This is true for both physical and human factors The same principle applies to finding ways to do things better, e.g., better small scale engineering technology and better utilization of rural human resources.
2. Institutions below the outlet and for support of agricultural production under irrigation are weak. Development project design needs to build in ways to strengthen these through training, policy changes, etc. More timely completion should be required and proliferation through budget commitments of host government be insured against.
3. Groundwater development should be built into irrigation project development in this region.
4. Over-optimism about canal efficiencies is common and is a serious factor resulting in poor performance. Realistic assessment of delivery sysem capability and improved design of delivery networks are critical factors for project success.
5. Rural human resources are seriously underutilized in the intensive distribution of water. It is essencial to learn how these can be mobilized and to work toward solving the

difficult problem of training, institutional development and bureaucratic responsibility in this area of activity.

6. Where to locate the change agents is a problem. Villages could employ them as junior water masters; credit banks could employ them as technical specialists; they could be attached to the Irrigation Department or the Agricultural Extension Service.

7. India's policy of extending irrigation to the greatest possible area at less than full irrigation cropping intensity within an economic criterion is not only politically necessary but also socially; it is uncertain, but the net aggregate economic return to the country may be higher, because everybody is pushed a little bit back on the water production curve where there are higher marginal returns for the water. This principle can probably be generalized to any situation where the water supply is sufficient to serve only a fraction of the potentially irrigable area.

8. There would seem to be little point in allocating much water for kharif irrigation in this region on these projects. What needs to be known is why farmers do not take kharif water and if the existence of kharif irrigation potential (insurance) has influenced productivity by reducing perceived risk.

9. Technology really isn't transferred until there is an institutional change that results in socialization and implementation of that technology. People can be trained, but what happens is that the people train, and they go back to their same old job unless the new technology is institutionalized through its valued practice; i.e., there is a valued requirement to implement the new technology.

10. Having the bureaucracy or the village or whomever employ new trainees in the new task which needs to be done, needs to be encouraged. The approach was to search for subproject design or loan criteria which required doing these new things. The engineers were required to run a 20-year operational study based on the evapotranspiration irrigation requirements, so

based on the evapotranspiration irrigation requirements, so some people were trained to do that. Training is the key, and a number of ways were identified to institutionalize these functions at least into the project implementation.

11. The engineers were criticized by the soil scientists and the agronomists because of lack of attention to land classification maps or soil surveys. How these might be utilized on schemes under this project is not very clear; thus, there will be an overt study to begin to identify more specifically how to utilize soil surveys in the irrigation system planning, design and operation and to institutionalize the result into specific procedures.

12. Because distributaries and outlets were located using fairly small scale maps and were often mislocated relative to farm commands, the project required that the same surveys and the same survey benchmarks be used for the layout of distributaries and minors as were used for laying out watercourses and farm channels on fields, and that maps be accurate to 15 cm vertical elevation. This was resisted at first, but after trying it out, everyone was excited about it.

SECTION IV

APPRAISAL APPROACHES

INTRODUCTION

This section contains a description of the appraisal approaches of the Workshop participants. This material arose from a discussion in the Workshop and consists of statements by the participants of how they personally approach rapid appraisal.

Each participant also contributed a set of what they consider to be the important questions for rapid appraisal within their respective disciplines. In addition, several participants listed the questions they have for team members from other disciplines.

HELEN INGRAM - POLITICAL SCIENCE

The difficulty is not so much generating pictures of the world, because I think any discipline has plenty of these, and certainly public policy theory has a lot of pictures that I could trot out. The real challenge is trying to manipulate a policy framework so that it's even useful for a physical issue such as water, and that is why I ended up in my formal paper with a long list of sequential steps in the building of a project; including authorize and start projects; fund complete projects; allocate water to different uses including domestic water, recreation, fishing and agriculture; and how is that done and by whom; design and construct projects; maintain and manage projects; and lateral management and on-farm management, because at least I have some political science wisdom about each of the steps. That isn't my preferred way of cutting up the world. If I am allowed to think of public policy in the abstract, I identify things such as interest aggregation -- I want to know what kind of structures there are to collect people's wants, wishes, desires, frustrations and support; how they operate; who leads them; to what extent are they particular to irrigation or are interest aggregating mechanisms.

It is important to identify the channels through which interests are expressed, and to determine to what extent channels of influence operate through direct telephone calls to the ministry from individuals, through administrative agencies, or through representative bodies. I also want to know to what extent is access or transmission of interests built in by who gets chosen to be in agencies, and to what extent they function through such mechanisms as formal elections. I have spent a lot of time looking at interest aggregation in the water issue in the American system.

Other factors in abstract public policy frameworks are decision-making structures. How is it that authoritative decisions get made, in what kind of an arena, with what kind of rules about who participates and who doesn't, with what kinds of rules about what's relevant or irrelevant, what limits are placed upon discussion, and when do you have

to come to closure? And when is a decision considered legitimate and final?

Another factor in considering public policy or implementation is, how do you get people to follow the decision? What sanctions are imposed for failure to act according to policy? Are they just paper sanctions? When information is transmitted, is it really received? When the extension agent goes out and transfers information to farmers, is he or she effective and do farmers change their practices? While this may give you the flavor of a policy framework, I am not sure other disciplines can be comfortable with it.

I have a democratic bias. I think the users' demands ought to be satisfied. Further, the costs of those demands ought to be made apparent to the user. I share an economist's bias against subsidies, because I think it fools people into making the wrong kind of calculation. However, my major value is in favor of self-determination.

Important Questions from Political Scientists

There is substantial overlap between the kinds of questions that are likely to come from political scientists and from sociologists and anthropologists. Many of these are fairly well set out in AID's Manual for Project Identification Documents. These questions focus on the impact of projects upon user welfare, participation and organization. There are also a number of administration-type questions indicated in the AID materials. I believe that the linkage between user participation and the presence of responsive administrative organization or bureaucracy is not as clearly set out as it might be, and my questions are aimed toward probing for the existence and conditions favorable for the creation of responsive bureaucracy.

The first set of questions relate to the assignment functions of project construction and maintenance and project management assigned:

1. If several agencies are involved, what is the nature of their interrelationships?
2. Do procedures exist whereby management perspectives are

inserted into construction design? By management perspectives, of course, I am mainly concerned with farm management and sensitivity to users' behavior and preferences.

3. If these functions are assigned to a single agency or to several, the following questions need to be adressed to each:
   a. How are user satisfaction, equity concerns and farm production related, if at all, to agency welfare? That is, to what extent are these people's related concerns and their satisfaction connected to agency successes in acquiring funds, personnel, authority, etc?
   b. Does agency success depend largely upon fulfilling construction missions involving new water projects, or is the agency operationally held accountable for successful management of projects?
4. Much can be learned about the orientation of water resource agencies by asking the following types of questions about their personnel and structure:
   a. Is the agency largely peopled by physical scientists and engineers, or do social scientists hold important positions?
   b. Is the organization centralized or decentralized? Decentralized agencies tend to be more sensitive to particular problems that arise in the field.
   c. What is the budget for construction as compared to the budget for management, operations and maintenance?
   d. What career ladders characterize the agency?
   e. Do the officials at the top come mainly from construction, or are there important officials who have had backgrounds and experience with mangement problems?

User group access to agencies is essential for bureaucratic responsibility. Access may be direct to the principal agency, or through other agencies better attuned to farmers, or through political mechanisms such as legislatures or elected politicians. In any case, it is important to ask questions such as the following:

1. To whom do farmers complain when they do not like the management?
2. What, if anything, is likely to happen as a result of farmer complaints?
3. Further, is it important to delineate the division of responsibility for water management between agencies and local user groups: Who allocates water among users along irrigation ditches, and by what rules, established how? How is water paid for?
4. To whom are ditch-riders responsible, and who appoints them and pays for them?

Questions for Economists from Political Scientists

From the perspective of a political scientist, economists spend far too much time specifying the most efficient allocation of resources, and too little time examining politically feasible actions and advising as to whether such actions are economically possible. (It is not so important that they be economically optimal.) Literature suggests that projects must be effective before they can become efficient. Therefore, it would be helpful to know the following:

1. Are markets available for products farmers want to grow?
2. Are the prices farmers are likely to get sufficient to sustain farming?
3. Is labor going to be available at the wages farmers are able to pay?
4. Since the purpose of many irrigation development projects is to improve the condition of the poor, it would be helpful if economists specified the distributional effects of proposed or operating projects and different management schemes.
5. Also, since water projects are looked to by people as a means to obtain self-determination and control over their own lives, economists ought to be able to specify the extent to which projects will make farmers vulnerable to or secure from the

risks of national or international markets and balances of payments.

6. What sort of credit will farmers require under various schemes of on farm water management, is that credit available, and can farmers afford it?
7. To what extent must farmers' marketing, borrowing, etc. be centrally coordinated, or can it be decentralized and individualized?

Questions for Engineers from Political Scientists

Political scientists are not so much interested in the best physical designs as whether politically and socially preferred designs involve serious physical flaws.

1. What will be sacrificied if control structures and measuring devices are designed and located in ways which accommodate management which is responsive to users?
2. Can structures be designed to maximize user group control?
3. What technical possibilities might be chosen in managing water at a particular location, and what does each require in terms of financial resources, knowledge and organization?
4. Are there physically feasible means whereby control over water management can be decentralized so that user groups or individuals have greater influence?

Questions for Sociologists from Political Scientists

There is a lot of overlap between the sorts of questions political scientists would ask themselves, and those that they would expect sociologists to answer. However, sociologists are more attuned to class structure, groups and roles. I would expect sociologists to be able to answer the following types of questions:

1. Will certain management schemes be socially acceptable?

2. Will peasant farmers migrate, engage in dual or triple cropping, change their eating preferences, their work preferences?
3. Can lines of accountability be shifted?
4. Is there sufficient experience with communal decision-making so that user groups can make and implement decisions, or are patterns of hierarchical authority so firmly implanted that they are terribly difficult to change?
5. What are the implications of various management alternatives to the role of different members of the family, especially women and children?
6. Whose interests are represented in different social and political groups in society?
7. What sort of conditions does culture impose on water management, and how may it be changing?
8. What are the implications of existing social structure and roles for the possibility of responsible bureaucracy?
9. Are agencies dominated by and responsive to only certain classes?
10. Is there a tradition of positive farmer participation and communal decision-making or of involving peasant farmers in decison-making?

TOM WEAVER - ECONOMICS

What do I do? I'll tell you what I do. Before I even start thinking economics, I need a context, and that context is based on the macro-physical environment that I'm going into, because I have certain classifications, or sets, that are related to those environments, and I look for dry, arid environments and I look for humid environments. Then I split the humid environments up in a kind of continuum of climatic zones which I'm familiar with from my experience, and I look within those systems.

Well it makes a difference of whether it's a project which is to be started or one which is already ongoing. But I look for the seasons of the year in which they're trying to do their irrigation, and that kind of gives me a physical system. I try to have some sense of evapotranspiration in the environment, some sense of what rainfall distribution patterns look like. I try to see it visually, to mentally picture what it would be like living in that environment, how rains come, how they go. So I have some expectations of what I'm going to see before I go out, of the cultivator's physical response, of the response of system design to that physical environment.

Then, over on the economics side, the first thing I ask is, what's the objective function? I want to know as much as is known, not always expecting that it will be known, why the irrigation system is put in here, what we're trying to do in terms of production goals, what we're trying to do in terms of distribution, and the convergence of those two, because they're often mixed. I need to know that.

I have to put the achievement of those goals in the context of an agronomy technology. So again, I'm still not in the economics, but I want to know the agronomy, I go into crops. I want to know what level of technology -- let me keep it really brief -- is in there, and that level of technology then triggers expectations about support systems that I'm looking for to support those technologies. Just to give an example, if it's a rice area and we have a new improved rice, then immediately that brings me to extension, demonstration farms and

research systems. Are they there to support the technology?

All this sets a context for me to raise the question of the production economics. I really want to know what the input-output situation is down on the farms -- the micro-economics at the farm level, across the situations that we're going to encounter. I want to get a real sense. I'm not happy with the averages. I want to get a sense of the distribution, what's the variance within the season, between seasons, which then gives me some basis of looking at income flows to farmers. I need to keep that distinct in my mind against the total social evaluation of the project itself, which is another thing which I'm looking at simultaneously -- the benefits flowing from the project in a social sense compared to, at the same time, benefits from the farm level. Knowing, I guess, to make the point for you, the project can be successful in a social sense and a failure for the farmer who can't pay his bills because of the cash flow problems.

Then, I allow myself to think about alternative economic systems to what I see. There's a farming system that's in there, that's part of the way the project's going, the way it's set up, then I start asking myself, "There are other farming systems, should these be here, might they be here?" I ask this question in the context of what I am able to learn. What I try to find out about the total agriculture economy of a particular country is, is this strictly a rice economy, or is it rice, rubber and oil; what are the crops, what are the cropping patterns here? I try to expand my knowledge of the economic system and try to get into the economic potential of the whole thing.

Now, this whole thing, all of this, is kind of a micro look, but I try to put this whole thing in the context of the total country. And how I do that varies greatly. I don't know that I want to talk about that now. I will say that I won't get into export/import policy analysis, but I want to know what policy is. I want to know what the government agricultural policy is in a broad sense, not just as it relates to that specific project, but what's their price policy, what's their credit policy, what's their stockpile policy, etc.

Now, all of this is put against a basic assumption that I carry with me, that farmers are: (1) smart; and (2) they are profit

maximizers and you can understand them in the profit maximizing sense as long as you are able to understand profit maximization, and you don't need any more framework than that if you know where the benefits are coming from. Profit maximization doesn't just mean that I'm maximizing my money income. Benefits flow from a whole host of other possible sources which may just be my relations with my neighbors, or it may be reducing conflict, which is a cost reduction, and which enters into my profit maximizing equation. So, profit maximizing is defined in the very broadest sense.

I feel like I've left something out, but that gives you some sense of what I do. Yes, that triggers something else I do, too -- I assume every situation is unique, is culturally specific, that there are things here that I know and that I don't know. It's a cultural context which I try to capture. But I don't necessarily always get it, but I am aware of it. I have other biases I bring with me, such as that the engineering's probably screwed up somewhere. Not that that's a bad thing, but that's the nature of the game. It's impossible to design perfectly, except in a very small system, any system. It's going to be screwed up somewhere along the line. I always basically assume that if improvements would pay off to the individual farmer, he would have done them, and that if they aren't done then it's because there's not a direct connection between him, between the doing and the benefits, to any extent.

Important Questions from Economists

1. Is the project profitable (net income) on a per crop basis?
2. Is water being applied by farmers in such a way to suggest that they are equating MR = MC of water, or what is their allocation strategy?
3. What is the net return from any suggested farm practice, e.g., on-farm water management, leveling, ditch maintenance, etc., and who receives this return?
4. What were the output or production objectives of the projects?

5. What were the distributional (equity) objectives of the project?
6. How have these objectives developed over the life-gestation period of the project?
7. How are farmgate prices determined?
8. Do cropping patterns appear to reflect market price?
9. What is government price policy?
10. What is government agricultural trade policy?
11. What are the market constraints? The nature of the marketing chain?
12. For rice (and other crops) how is the product differentiated at the point of milling? What are the economics of drying? Is it a problem? What is the price differential for various grades? What are the marketing margins?
13. What is the capacity of the market institution to provide a product of recognized quality at the appropriate time in the appropriate place?
14. How does the project fit into a total development strategy?
15. How well are the factor markets developed, including labor?
16. Are required inputs available in adequate quantity and quality at the right time and at what price?
17. What are the farm audit programs and credit needs?
18. What have been the growth patterns of the total irrigated areas? What factor explains the observed rate of growth?
19. What extension services are available and how effective are they?
20. Are there demonstration plots?
21. Is there an effective research program supporting the project?
22. What are the associations between research and extension?
23. What are the system economics of the total project regarding any water reuse?
24. What are government tax policies and water pricing policies, and how do they affect the economics of the project?

Questions for Agronomists from Economists

1. What are the soil types, and how are cropping alternatives affected by soil types?
2. What are the disease and insect issues?
3. How does the crop water requirement vary as a function of soil type?
4. What soil differences seem important to cultivation?
5. How do cultivators identify soil types?
6. What is the climatic situation: Length of growing, crop calendar, rainfall, temperature requirements, etc.?
7. What, if any, are the climatic (other than water) constraints on plant growth?
8. Are there saline or alkaline problems and subsequent irrigation problems?
9. What is the water table situation, especially as it relates to water drawdown and drainage?
10. What are the recommended irrigation practices and fertilizer practices? Are they followed by the cultivators?
11. Do irrigation and fertilizer practices reflect significant differences in soil type?
12. What is the soil structure?
13. How does soil structure and type limit or otherwise affect cropping possibilities and husbandry techniques (including power requirements)?

Important Questions for Engineers from Economists

1. What type of system is it? What state of repair is it in?
2. How "efficient" is water delivery? What is the consumptive use?
3. How appropriate is the technology? Is the system well designed? Are the designs well executed?
4. How reliable is system maintenance? What are the economics of

system maintenance?

5. What are the recommended on-farm water management practices? Why are they recommended? What are the economics of the recommended practices?
6. How do the hydraulics of the system work? What is the variation in the working of the system between years and between seasons? Can or should (on economic grounds) the variation be eliminated, and to whose benefit?
7. What gains (economic) can be made by changing (improving) main system distribution?
8. What is the total irrigated area including water reuse, illegal acreage?

Important Questions for Political Scientists from Economists

1. Who's in charge here? Who makes policy and who imposes the decisions? How does and did the political process influence and impact on project selection and implementation?
2. What is the administrative structure? How is the irrigation function integrated into the other development activities administrated by other agencies? How effective are these arrangements?
3. Whose goals are adopted? Whose objectives are they and how is and can policy be changed?
4. How do the cultivators communicate with the bureaucracy, what are their links to high authority, and how effectively do they use them?
5. What is the role of the AID project manager, and how has he defined it? How effective is he? What might be done to increase his effectiveness?

Important Questions for Sociologists from Economists

1. What is the cultural setting? Who are the decision-makers (male/female, young/old, etc.)?
2. What are the cultural constraints opposing the level of cooperation necessary to effectively utilize the irrigation system?
3. Is the extension system sensitive, aware, and culturally integrated with the cultivators and with the researchers?
4. How "field wise" is the research system?
5. What conflicts and tensions are created among cultivators, groups and villages by the irrigation system? How can they be eliminated, if desirable? What are the conflicts for scarce resources?

Strictly Interdisciplinary

What is the project monitoring system? How does it operate and how could it operate?

Help -- I'm out of time! I know this set isn't the all of it. These individual questions on all pages are an attempt to see the total system in its place across time (years and seasons). We hope it all operates and a lot of anything can be manipulated or controlled to achieve production and distribution goals and objectives.

RAY MEYER - AGRONOMY

I make it really simple as far as basic approach. I look at some of the same things Tom was talking about, agroclimatic conditions and crops. What crops we're going to grow. I guess I place a lot of emphasis on yields, what are the country average yields of various crops. And I always try to find what the farmer is actually producing and what a better farm would actually be producing; and this may or may not help me relate it to an experiment station yield.

The reason for the yields is it gives me, I think, at least, an indication about what the technology level is. And if there's a big disparity between say, country average yields and better farmer yields, and experiment station yields; I simply start looking for a constraint of why is there that difference. Everything comes into it, because if there are some good farmer yields -- if the better farmers are getting good yields -- then it is not primarily a matter of technology really, because it's available, somebody's getting it. When it's not getting to other farmers, we have to assume all of the other problems. A lot of these are social or whatever, but they may not be technological problems. I think this gives me an indication of separating out the technological problems that can be addressed.

I think this is essentially it, except if we start looking at constraints, we have the transportation infrastructure, input supplies, improved seed supplies, fertilizer supplies, and then we get into individual soils and specific local conditions. But if the yields are good and production for the country is still short, that brings in another set of problems, which gets back more into the other area, because again, they aren't agronomic problems.

Basically I feel that most agronomic problems can be solved.

Important Questions

I always compare answers to same or similar questions as given by:

1. Ministry of Agriculture people at central or regional headquarters;
2. Ministry of Agriculture people in the field;
3. Other national university staff, professionals and consultants and farmers; and
4. Local AID staff.

Important Questions from Agronomists

1. What are yields of major crops:
   a. Food crops;
   b. Cash crops;
   c. Experiment Station plots;
   d. Better farmers;
   e. National averages;
   f. With and without irrigation; and
   g. Within project or area of interest?
2. What are potential yields?
3. What are reasons for constraints to higher yields?
4. Was increased production the basic objective of the project?
5. If the primary reason for the project was political or social, accepting that as a given, how can increased production as a secondary benefit be achieved?
6. Are specialty crops a major factor?
7. What are farm sizes?
8. Are there labor constraints?
9. What information is available? Soils? Climate? Production? Is it being used?
10. Are agronomic inputs available? Are they being used?
11. Is the extension effort effective in improving technical levels?

Important Questions for Engineers from Agronomists

1. Is water being supplied dependably?

2. Do farmers have control over water supply or is the supply the same as increasing rainfall probability but with no control?
3. Can the farmer manage the water as to when it is received and the amount received?
4. Is the system well designed?
5. Is the supply of water sufficient for the crops being grown?
6. Is application of water to the field uniform?
7. What are the constraints to water being used more efficiently? Labor? System design? Ignorance? Lack of research? Poorly trained technicians?
8. Is the command area well related to the water supply?

Important Questions for Economists from Agronomists

1. Are crop prices free, controlled, and above or below production costs?
2. What are the marketing, pricing, credit, infrastructure problems of using inputs? Of marketing inputs?
3. Is water price important?
4. Does the farmer consider water an asset? Why does he put "his value" on it?
5. How does this project relate to the economy of the whole country?

Important Questions for Sociologists from Agronomists

1. How important were social or welfare considerations in defining, funding and implementing the project?
2. How could the project have been staged differently for more effective implementation?
3. How important is the risk factor for the farmers?
4. Do the farmers understand the value of water or is it a mystical or romantic solution to their problems?

5. Is the extension system effective with these farmers?

Important Questions for Political Scientists from Agronomists

1. How important were political considerations in defining, funding and implementing the project?
2. Are there bureaucratic constraints in implementing the project? Supplying agronomic inputs? Marketing?
3. What is the importance of the project from a national viewpoint versus the local or project viewpoint?

DAN LATTIMORE - PUBLIC RELATIONS AND COMMUNICATIONS

I don't usually talk about communication in the sense of this kind of thing, but I think I will for just a minute today. Communication is often identified as a crossroads where a lot of other disciplines come in, so perhaps in one sense we're more interdisciplinary than most. Our roots go back to political science. Actually, the first Ph.D.'s in communication were in political science with a minor in journalism. Some were in economics, or often social sciences; we tend to be social scientists, though.

The way I would see beginning would be the way I would do it if I were working for Texaco or Manville Corporation or some other corporation; I would start looking at what we call a "communication audit." That's where we look at the audiences of communication and determine the demographics and psychographics -- the lifestyle of the audiences; how they live -- to see what the audience is like so we know something about how to communicate with that audience. Then I would want to look at the methods of communication that already exist in the situation, and what can be the methods of communication. That's where I think maybe I would deal with the video. We know what the methods of communication are, but what can be, I think we'd look at that.

Then I'd go on to look at the barriers to communication. What are the barriers in the bureaucratic organizations? What are the communication barriers between users and low level irrigation officials, and higher level officials? Then we begin to plan some strategies and tactics to overcome those particular barriers to communication, looking at some persuasion techniques that could be used. Generally, when we talk about persuasion techniques, we look at maintaining favorable opinion. Maybe there is some favorable opinion that could be maintained between the irrigation department and users, perhaps creating some new opinion where there was none, that's easier than a lot of things; perhaps negating hostile opinion where there is hostile opinion, that sort of persuasion. We'd look at persuasion techniques to do those kinds of things. And so I think what we'd come out with would hopefully

be some planned effort to overcome whatever communication problems we saw.

We have many of the biases that are concerned with survey research, because much of what we're doing is asking opinions. So you have some of the built-in biases that you have with going to groups and asking for their opinion. I'm not sure what all the biases are, but the social sciences biases, I guess, would be built in to what we have.

Important Questions from Communications

1. What are the communication barriers between and among audiences?
2. What are the information patterns of each audience?
3. What is the media use of each audience?
4. What are the demographics and psychographics of relevant groups -- farmers; irrigation officials; other lower level government field workers, including agronomists, extension, etc.; project officials; government bureaucrats; higher level government officials; host country scientists and professors?
5. What are the patterns and barriers in organizational communication?

CLYDE HOUSTON - ENGINEERING

In my first approach to a project I try to gather data on the environment, the physical environment. I want to know what information is available on the climate -- whether it's arid, semi-arid, tropical, subtropical, etc. I'd want to know what kind of climate I'm going to be working in. I want information on the soils, either through work that has been done or information gathered personally or as has been mentioned while talking to the farmers. With regard to soils, texture and structure can tell quite a bit for design and later on for project operations.

For the water supply, surface or groundwater, I may not want figures yet, but I want to know that there are data available. If it's a long term project, I might say we'd better put down some test wells and see what we have in regard to groundwater. Topography, which is easily determined, is important for irrigation project design.

In regard to social environment, I'd say first we want to know about the people. Are there people there, or will they have to import people? Do they want to keep the people there? Do the people want to stay there? Do they have farming experience? Will there be enough labor? Are they interested in irrigating? Are there schools, and are medical facilities available? If not, where are they? Are there credit, storage, marketing and processing facilities? How far away are they? Are there roads, what is the transportation system?

Then what's the, I'd say, political cohesiveness? Do they have leaders, or is it sort of an unorganized group? Do they recognize and follow their leaders? What's the land tenure situation -- are there small farmers; are there groups of farms; are there some farms that are leasing land to make larger holdings; or no farms at all? Do they have any such thing as extension services, or whatever they want to call them, and how good are they? And then, how far do they have to go to get any inputs such as seed, fertilizer, equipment -- do the farmers have to go a hundred miles, or fifty miles, or are they going to have to set a transport system up as part of the project? These are a few of

the things in regard to the environment that I would want determined.

In regard to the hydraulics, I don't like the word hydraulics, but I can't think of a better one! I want to know, what is the amount of surface and groundwater? Is there storage potential, or are any dam sites available? What about diversion potential, are diversion sites available? And then does the topography show that we can use canals to get a large area under irrigation? Do we have to pump, or can we get by with gravity flow? Will field layouts be difficult to set up due to topography or due to channelization? And can we recognize the drainage needs? Because I notice in Fred Hotes' paper, 80 to 90 percent of all Bureau of Reclamation projects eventually entail a drainage need.

This may be digressing, but drainage needs are seldom given proper recognition during the planning stage. If promoters go to Congress and say it's going to take fifty million dollars to bring this water under control and provide irrigation, and it's going to take fifty million dollars to get rid of the surplus, the project will probably not be approved. For example, in the Columbia Basin, when development first started, it was a hundred and fifty feet to the water table and then 30 years later it was five feet to water, and a request was made for fifty million dollars to drain the area. If this had been known in the beginning, the project may have been turned down. Another example is the Imperial Valley of California where the cost of drainage has been about three times the cost of the original water development in the early 1900's. Had this been known, perhaps the private developers would not have invested in the area. These are both good projects; and if the planners knew the drainage problems would arise, in my opinion, they were smart enough to know if they mentioned them, they'd never get the projects approved. In the Salt River Valley, they installed wells for drainage, and fortunately the pumped water supplemented their main surface water supply.

Add water organizations under hydraulics. Under agriculture production I feel that it is most important to consider the farmers' experience, whether they are dry land or irrigation farmers. As I said once before, personally, I would rather work with farmers who have never irrigated than farmers who were irrigating improperly. Now that's a

very personal bias. Additional information is gathered on what crops can be grown, not from the standpoint of market, but what crops can be grown given the soil, the climate and the available water. I didn't mention that the quality of the water is extremely important. What about the other local production factors? Is it a soil that you would suspect is going to take a lot of fertilizer? Is it a soil that's going to take a lot of water?

I want to know about other production factors, as well. First, labor -- is labor available or did it all go to Jordan where they pay more? Do they have to develop mechanized equipment to take care of the shortage of labor, and if so, where do they get the money or where do they get the equipment? One thing I think is extremely important, both in renovation and new irrigation projects, is local demonstration or applied field research plots. We all recommend what we know, and we don't know everything about places where we haven't worked before, and the only way we can really find out is to try some things. Now, that's a little longer term program; but we've been saying for the last two or three days, we build these things and then we don't know for a few years whether they're going to work -- or before we try to find out why they're not working. Well, the same is true with production. We think we know how to produce, but the best way to be sure is to try it under local conditions.

I try to keep my biases to a minimum, but I'm sure they creep in. We all have to have a personal bias, that's why we're there. What I try to do is get the facts and then make a decision. To me, one of the big pitfalls when you're getting information, especially in developing countries, is that you just aren't sure how valuable it is, because some people tell you what they think you want to hear and others tell you what they think you should know and others have exact data, and sometimes it's hard to tell which are which. This learning of the culture we're working with is extremely important in my opinion.

Important Questions from Engineers

1. What is the water supply -- surface or groundwater?

2. How much water is available for development and use?
3. What is the quality of the water?
4. Is surface storage necessary? Are there storage sites?
5. What are the climatic conditions?
6. What are the main soils from a textural and structural standpoint?
7. What is the history of irrigation in the area?
8. How is water distributed to the farm, by canals or pumps?
9. How is water applied to the farmers' fields?
10. What are the water requirements of individual crops?
11. Are local planning organizations, private or public, available to develop plans?

Important Questions for Agronomists from Engineers

1. What is the cropping history of the area?
2. Are crops rotated?
3. What is the fertilizer experience?
4. What is the disease and insect experience?
5. Are fertilizers and pesticides locally available at affordable prices?
6. What are present and potential crop yields?

Important Questions for Economists from Engineers

1. Where are the markets?
2. Are transportation facilities available and adequate?
3. Are storage facilities available and adequate?
4. Is agricultural credit available and adequate?
5. What is the ownership or land tenure pattern?
6. Is labor available and adequate?
7. Can appropriate agricultural equipment be obtained and maintained?

8. How much can be paid for water with assumed yields and cost of water development and delivery?
9. What is the rate of irrigation development in, say, hectares/year?
10. Are construction facilities and equipment available and adequate?

Important Questions for Political Scientists from Engineers

1. Are water distribution agencies available?
2. Do local and national laws allow organization for development and use of water for agriculture?
3. Is there a national policy to which development must tie in?
4. How do local groups operate cooperatively?

Important Questions for Public Relations and Communications from Engineers

1. Is there an active Agricultural Extension Service in the area or country?
2. What telephone, radio and television communications are available? How adequate are they?
3. Are agriculture production publications available?
4. Can the local farmers read and write?
5. What is the local school situation?
6. Is electricity available?
7. What are the entertainment facilities?

Important Questions for Sociologists from Engineers

1. Do local people desire development?
2. What leadership do the local people recognize?

3. Will local people accept local organization to control development?
4. Will they accept a charge for water?
5. Will they band together as a group to develop or accept developed water?
6. What is the best type of organization they will desire?
7. What are hospital and health facilities?

Strictly Interdisciplinary

Depending upon one's definition, I would say that all production factors are interdisciplinary.

DEAN PETERSON - ENGINEERING

I'll start out with my bias. I came from that almost Renaissance school of engineering, that old school which thought that a Civil Engineer could understand anything and do anything. Maybe that's still my bias, so if you find me meddling in your disciplines, that's what you can blame it on! Another thing I suppose, by way of bias, is that I tend to be impatient with academic or peripheral kinds of answers. If I can't see an operational answer within the realities of development project design, I don't want to waste a lot of time. That's because, on a team, you're under pressure to come up with a design. Another bias, which may be a good bias, is that there are great opportunities in development projects, where there are existing projects, to learn by studying existing projects.

My most extensive experience has been in India, and the development project venue has been at the size of a state. These development projects consist of a number of medium-sized schemes. These are matrices of physical infrastructure in one dimension and technology transfer in the other. (I once worked in Dijbouti under great pressure to find some way to develop some irrigation where we could only find about 70 irrigable hectares in the country!) All of the development projects that I've been concerned with in India are based on programs already on-stream in each state. A program of building them is already in place, so the question is, what should the development agency do in this particular setting. My responsibility has been more as a general development project designer than as an engineering consultant, although I usually have had a major share of the engineering responsibility.

Normally, I first try to get some kind of a background feeling about the agro-climatology and the agro-ecological regions of the state and of the demographic and general economic situation. Usually there are planning reports for projects already constructed, or being constructed, and I examine these quite critically. I look at the basis for estimating the water supply. I'm not much interested in the major

structures like the dam, or generally even the size of the spillway. I think the Indian engineers can do them very well. I am very much interested in the reliability of the basic water supply, and how it relates to the size of the reservoirs. (All of these schemes had reservoirs.) I'm extremely interested in the canals and the distribution system, because these are weak -- not so much structurally as in what I call the hydrological engineering features; that is, how much water do they waste, how effectively can they deliver water and how they operate. So I go down through my checklist. I have kind of a functional checklist like we've been talking about of all the things that have to happen in an irrigation scheme.

As I get out of the civil engineering, I begin to look at production. I'm particularly interested in the agricultural production side under irrigation. There, a number of things have to happen. You can find many checklists there, so you go down these and try to determine, for example, what is the status of each item: Land tenure, farm size, extension; when and how the production inputs -- seeds, fertilizer, etc. -- are going to get to the farmers; generally, what does the market look like and are there roads; etc.

I guess I am well impressed with economics, and I have a hard time leaving economics out of most of the things I think about. I do get concerned about the benefit-cost ratio or internal rate of return (IRR) study; and usually, when there's an economist on the team, I want to know all of his assumptions, because I find that these are highly variable among different economists. If we're trying to estimate national economic efficiency, this is different from an analysis for the farmer's cash flow. So I like to know what the economic assumptions are. I will challenge the yield assumptions, the assumptions about transition from rainfed to irrigation and other technological transitions, all of which are built into IRR analysis.

The next thing I do is look to see where weaknesses are, where information gaps occur, and I try to negotiate with the country for programs to improve technology and to get information to fill in the gaps. From these I look at the training needs, and then try to work out with the host country ways in which training programs can feed back and

make an impact on the institutional structure. This is kind of the recipe used.

You may be interested in a partial listing of the studies we saw as needed for one development project. We were fortunate in having existing systems to use for models. There was need for canal loss studies, including seepage and operational canal losses; a set of agriculture water management studies, including involvement of water users or farmers, appropriate small structures for watercourses, how to design watercourses, how to operate them and manage them, and particularly the alternative of more water user responsibility; studies of the on-farm land development process itself, including technical standards, timing, financing and their improvement; studies on conjunctive use of groundwater, utilization of irrigation during kharif, and the development of hydrological-climatological operation studies based on irrigation requirements. That's another bias -- I think a twenty-year-old reservoir canal operations study linked to agro-production is important. Another problem, strange as it seems, is how to utilize soil surveys. We also found that socio-economic baseline surveys yielded really interesting information. Sometimes I think that I have more confidence in well designed social science survey data than I have in much of the engineering survey data. Other study items included alternative ways to allocate water.

Another big factor in benefit-cost analysis in India is shadow pricing, especially of labor. The World Bank had assumed certain opportunity costs for labor. I suspected that they were different from what they had assumed, so we provided a study to estimate these. We also wanted to find out more accurately how much labor actually did go into construction. The World Bank assumed that 65 percent of the cost of physical irrigation infrastructure is labor cost; this didn't seem to check out with project feasibility estimates. Opportunity costs and labor intensity may change over the years, as do other shadow-priced costs. If we're going to use shadow pricing in economic analysis for decision-making among projects, then it ought to be updated. The latest World Bank material available for commodities was circa 1978. These have recently been updated [DFP 10/15/83]. Thus, we build economic

evaluation, backed up with training programs, into our projects. As a general principle, project criteria required the host country to start doing the new tasks for which people are being trained with the intention that actually integrating these tasks and personnel into the process will begin to generate institutional change.

Important Questions from Engineers

1. What is the nature and reliability of the surface water supply for the project? Does historical information support design assumptions?
2. How effective is the canal system? Basis for design, capability to maintain full supply level, condition of outlets, design and actual canal water budget, equitable service?
3. What is the nature of the irrigation service objectives and how effectively have these been met? Supplemental or full supply or mixed seasonal irrigation intensities, design potential, historical realization of service in terms of area irrigated and water delivered?
4. How well do water allocation and distribution of water to farmers meet equity and crop water requirements? Legal basis, procedure for scheduling, availability when needed?
5. How well are groundwater resources utilized to improve reliability of supply and meet supplemental needs? Physical nature of aquifer, historical development of wells, energy supply, appropriate well technology, well financing, availability of credit, individual, joint-owned or community wells, congruence of well size with farm size and financing needs?
6. Is communal hydraulic infrastructure (outlet to field) in place and how effectively has it been designed and does it operate? Who designs, who operates and who maintains?
7. Are farm fields effectively developed (leveled, ditches, etc.) for efficient irrigation and drainage? Who has responsibility

for technological support, financial support and how effective is it?

8. How effective is the financial support for the various components of the system? Public or private responsibility, availability of budgets, availability of institutional credit; how effective is the program; what subsidies are there?
9. How effective is the technology used in water supply and distribution? Is it adequate, short-changed, appropriate?
10. What is the relative relationship between irrigation water demand and supply? Are farmers eager for more water or are they indifferent?
11. What is the status of crop yields relative to design assumptions? Historical, etc.?

Important Questions for Agronomists from Engineers

1. What are crop yields and how are these constrained? Water supply constraints, irrigation methods, land development, shortage of production inputs, technological knowhow?
2. Are there problems of soil management? Cropping patterns, tillage, drainage, fertility?
3. Are the cropping patterns appropriate? Best cultivars and crops, distribution of rainfed versus irrigated, market demand?
4. How effective is support for production technology? Availability of seeds, fertilizer, pesticides, etc; extension, credit, markets, roads; is the technology appropriate and how can it be improved?
5. Are there soil management and conservation problems and what are they? Tillage, surface drainage during monsoon, soil erosion, waterlogging, salinity?

Important Questions for Economists from Engineers

1. Are the assumptions on which the benefit-cost analysis is based realistic? Timely transition, yields as estimated, markets and prices as proposed; shadow pricing appropriate?
2. Are there serious economic distortions which breed disincentives? Price fixing, purchase, input subsidies, labor wage policy?
3. Is there a farmer income analysis for various sizes of farms? With and without project case, cash flow analysis?
4. What economic constraints inhibit effectiveness? Seasonal labor supply, production input prices and availabity, markets, market roads, etc.?
5. Are project objectives (maximize net return, food self-sufficiency, etc.) consistent with individual household objectives? If not, what are the implications?

Important Questions for Sociologists from Engineers

1. How effective is farmer participation in the allocation, distribution and operation and maintenance of water delivery systems? What are mechanisms, operation and maintenance, where is the interface, what organizations exist?
2. What are the principal equity problems, and how are these influenced by irrigation? Mechanisms for full supply to small holders, head end-tail end problems, effect of irrigation on land size distribution?
3. What is the nature of land tenure? Do most farmers have full tenure rights? Hidden circumvention, reliability of data?
4. What are the basic family and household objectives, and how are these enhanced or hindered by irrigation development? Does the development plan adequately support family objectives?

5. What cultural constraints (customs, etc.) are related to improvement of agricultural production and are these apt to constrain it? Are these cultural constraints that would inhibit effective water user organization? How can these be overcome or managed positively?
6. What minority or disadvantaged people programs are in force, and are these effectively mobilized? Religious or ethnic minority problems?
7. Are there technological-cultural mismatches? What are they? What is their impact and what could be done to relieve them or to reduce corruption opportunity?

Strictly Interdisciplinary

What interventions (financing, technical assistance, technology transfer, special studies, training, conditions precedent, covenants) can be realistically included in the development assistance project in order to reduce shortcomings or insure improved performance of the system under review and of other future, systems; i.e., advance the state-of-the-art in irrigation development assistance?

BRYANT SMITH - ECONOMICS AND LAW

I always want to know what land tenure is, what labor availability is, and what markets are. Sometimes I don't go about that in a very systematic way. Looking at some institutional approaches in terms of looking at water law, the first thing I want to know is, what is the law. I want to get the water law and read it. My assumption about water law generally is that laws are formed by groups according to their relative power in society, and that's what shapes the law. In a democracy the laws are shaped by the power of different groups in society. In dictatorships, we can really get crazy combinations of people who just come in and they turn it over to some technocrats who do all kinds of things that have nothing to do with the society or people within the society. They just do what they think is the right fix on how it should be done. But the laws really do reflect the power of groups out there.

The second thing I want to look at are the administrative procedures for the implementation of law, because judicial remedies are available to almost nobody in any society, including the United States. First of all, it's too costly. As a consequence, the amount of the implementation of law really depends upon the administrative system available for its implementation. So I want to look at what the administrative procedures are, because those are the true laws that really govern what happens in a legal system. And then what I want to look at, at least in the case of Peru I did, is, how is that administrative system operating on the farm level; because that's theoretically supposed to be where it's operating. And so what I want to do is go down to the farm level and see what's happening and then work my way back up the system. That was essentially how I tried to do it in Peru -- to see the system on the basis of what is down there and why, and then go up each layer and see what's motivating the people. I think much of how I approach things actually manifests more of an expression, or enumeration, of my biases than anything else.

One of my biases in looking at these systems and how they're administered is my belief that people do respond to incentives, and that we can affect very substantial changes by changing incentives. I have a bias that people can change far more radically than we think by changing incentives, that people in general want to change for the better, that very often the biggest hinderance to change is our belief that you can't change, or lack of belief that people can generally have a greater capacity to do what they think they can do than not, and that that tends to be a real controlling factor. If they don't think they can change, then they don't, and it's kind of a self-fulfilling prophecy. Very often people do not accept change, because it's not clear in their minds that it's really for the better; and they might, in fact, be right! We often make assumptions about things that we think we know, and we tell the people they ought to make these changes, and sometimes we really don't have the facts to know to what degree we're correct and how it will affect different groups.

Another assumption I have when I look at organizations is that individuals make a difference, that all people are not equal, that there are individuals who, if they happen to be there, can make a great difference in a system, that it's like Albert Hirschman looked at a series of development projects, and he came to the conclusion that all development projects, regardless of how well they were planned, went through a crisis of essentially failing, and whether they picked up and went on and really became a success depended on the particular individuals that were actually there administering the system, and that we are not just kind of products of the organization in which we are trapped. We're individuals, and different people make substantial differences in what happens.

Another thing I look at, because I think it's important, are the tangles and complexity of procedures. They have a very substantial ability to control how a system works and to restrain interest groups. In our own society we do it to a great degree. We entangle people in procedures and it limits their ability to exercise power, and I think that the law, of all things, offers more of an opportunity than we think to do that, to limit the power of people in a kind of abusive way. I

also think, in looking at organizations, that technology has a powerful effect on organizations. One of the reasons is that technology can often shift the power of people. Sometimes it's because new people are needed to manage it; so the people who used to manage the system no longer have the power, because they're not the appropriate people for the technology. Often it's because technology imparts a benefit on a new group of people, and, therefore, it can have a very big effect. I do not share the bias that small is necessarily beautiful. I believe the world is incredibly complicated, and sometimes big is much better than small and that many of the technological benefits we derive from our society have been a consequence of the largeness of the U.S. economy. Its ability to concentrate immense resources on research was a consequence of bigness, not smallness.

I think that people at the top of bureaucracies have a much greater desire to do a good job than we sometimes give them credit for and that they have a very poor information base from which to make decisions. We don't give them that information, and then we criticize them for not implementing recommendations, and they have no idea what really is the best decision. As a consequence, they tend to be heavily influenced by foreign teams. It's a psychological thing. The people who appear confident that they know the answers can have a real influence on someone who knows that he's ignorant and who is looking for some way, because he doesn't have the time to become technologically informed on the decisions. He becomes highly influenced by someone who appears to have the answers, who appears to be the technician in things.

In general, I have kind of a paradoxical view. I'm also very optimistic about people. I guess that's one of my very basic biases, I think people really do, in the end, make it work. Yet, I think power tends to corrupt, that absolute power really tends to corrupt, that there's a tremendous need in systems for balancing power, and that the United States is a perfect example. We have a relatively inefficient form of government, because we balance power so much. We disperse power so much through the system, and the President of the United States becomes so frustrated because he becomes President thinking he's going to be able to do all these things, then he finds out there's Congress,

and he finds out there's the Supreme Court, etc., etc., and that is kind of a prescription for inefficiency but not a bad one for justice in the society.

Important Questions from Economists and Law

1. What are the macro economic indicators of economic structure and performance? Land tenure, labor availability, growth of gross domestic product by subsector and especially for agriculture, imports of food items, etc.?
2. What is the nation's agricultural policy? Food price controls, self-sufficiency policies, food subsidies, etc.; alternatives to irrigation?
3. What markets exist for agricultural products? Export markets for crops; demand for products, actual and projected; organization for export; local market factors; transportation, including storage, market price, information systems, etc?
4. What are the water laws? Water rights, water distribution laws, administrative procedures versus performance of administration of water distribution laws, equity in distribution?
5. What is the administrative structure for enforcement of laws? Centralized versus local control; where local control exists, the distribution of power between large and small users; procedures (and their usability) for grievances and appeals of local decisions?
6. How are water laws and policies administered? Planning of national priorities -- how set, degree of consultation in bureaucracy of users, degree of technical input and political consideration; local administration of water laws -- enforcement mechanism, user involvement; interaction between water users and the Irrigation Department, agricultural background of water department administrators, level of donor agencies' influence over water policy; delivery of

technological information by bureaucracy to farmer; appraisal of capacity of individuals in decision-making positions?

7. What is the farm level economic performance? Reliability of water delivery, use of related inputs, output with or without irrigation, area irrigated, farm consumption of production, labor requirements of crops, market prices and market facilities in area, cropping pattern, percent marketed, alternative water delivery systems -- cost (e.g., groundwater versus surface water), etc.?

8. What is the overall project appraisal? Cost-benefit analysis, discount rate; flow of benefits -- yields, crop types, secondary benefits, hydroelectric power, social benefits; place of costs -- cost of capital, shadow price for each; labor, inputs, spare parts, etc.; sensitivity analysis, including alternative technologies?

JACK KELLER - ENGINEERING

There are several things that I go out to do along with a multi-disciplinary team for which I'm often the leader. One of them is to design new projects, another is to evaluate old projects, another is to scope out what's going on in irrigation in a country and develop a set of recommended strategies for irrigation development, and another is to hunt for new opportunities for projects. Then sometimes I'm involved with designing or critiquing on-farm irrigation works strictly at the design level as a lone engineer. So each one of these types of activities takes a different strategy, but I think what most engineers talk about is how they go about designing a new project. It's hard for me to explain how I do my, so-called, "thing," to say it in a useful way, because the way I see it is more a style of proceeding rather than an order or a recipe for proceeding.

Basically, I rely heavily, very heavily on intuition. Now, that doesn't sound very structured from an engineering standpoint! How do you end up with intuition? Well, the first thing I do when considering an existing project is to just do an awful lot of looking around and listening, with really, it seems to me, a fairly random path through it. In reality, I'm looking at the physical thing, and I like to hear what people are saying about the physical things, and I like to know from operators how they think they're operating their part of the system and what they have to say about the overall operation, and I like to hear users tell about what they think is happening with the system, and in looking just sort of almost randomly around, I want to tour the system. I like to get in an airplane and look around. I like to have a map as I look. What I want is to get a mental image of the system; I'm really striking out for a mental image. Now, I'm sure that mental image

irregularities in the tapestry, engineering irregularities. How I do this is terribly hard for me to say. I just identify, I think "I see irregularities," and irregularities seem to be where there are sort of functional restraints in the works itself.

I always want to go around the next corner to see more. I want to see the end of everything, kind of try to see all of it, and buzz around a lot. But anyhow, it's a feeling. After looking at a whole system, it's a sense of whether that system feels right. What it feels like to me. I think that any system in any one particular time and place, time in its own evolution, is reaching for or has reached some sort of a balance with itself, and I'm trying to see, trying to guess, where that balance is, whether it's sort of found its niche in itself or whether it's still in fairly fast motion in its evolution. I want to speculate on where it's going.

Then all of a sudden something pops in my mind, and I look at something and say, "Why is this going on here?" It just doesn't look right, and I might probe around in that area a little bit and find clues. And so, it's really not a very linear path, and it's not a very mechanistic direction. It's sort of a random look. That's the way I approach the system. I have this feeling that the way the system is is the way it's been attracted to be. In other words, the way it is has a definite reason for being. It's not an accident it's a certain way. So if it isn't the way I like it or the way everybody thinks it ought to be, whether I like it or not, then I ask myself, "Well, what is it that's made it go in this direction as opposed to the so-called 'better direction;'" and I will be hunting for its reasons for being as it is, and the restraints that kept it from going in this so-called better direction, or the attractions, you might say, that made it go in this so-called "bad direction."

I have a large suspicion that there's typically some bad engineering around, and so I do hunt for this bad engineering. I often see structures that really weren't done right, and begin to wonder how much influence they have on the project. I may see repair and rehabilitation that isn't done right, that isn't done well, or could be done more effectively and so on. So I'm looking for engineering

mistakes and possibilities for improvement all the time.

All along I'm hoping I'm with a team of other people in whom I have confidence, who are feeding into this synergistic approach to looking at the system. That's the way I'd look at ongoing systems and projects.

Looking at what's going on in irrigation in a whole country is very broad in scope, because we might be looking at a dozen systems in a matter of a few days. And so we're trying to look at sort of universal restraints to the way the systems are functioning. But again, it's looking for what's wrong, what seems to feel wrong about them and what feels right, and what are the common denominators in the restraints the systems face. We are hoping to find solutions to some of the common restraints.

When I say engineering mistakes, I'm really talking about those mistakes that are just making the system physically difficult to function, and how they could be relieved so that the engineering is not what's cutting down the possibility for the system. Then, assuming that the operation of the system is opportunistic, in that the farmers are operating it according to what they think is in their best interest, and the agencies are operating it according to whatever is that bureaucracy's structure, and what that bureaucracy has developed into its best interests, what we want to do is look at how to create strategies to entice the system to move in the so-called "better direction."

If I were with you people from other disciplines and we were looking at a project, I would be talking about what I see physically, and I'd be asking and wondering about what is going on and why, and I would assume that you would be asking me why are they doing this or that. I might say, "That's their best option considering the physical circumstances." I'd be asking you about the economics or institutions or sociology since I don't depend much on myself to analyze the other disciplines unless I'm left with that as the only proposition. Therefore, I hunt desperately for someone I have confidence in to join me and cover other disciplines.

Let me give an interesting example of a wrong feeling about a project. I led a team to evaluate the Water Management Project for the

Gal Oya system in Sri Lanka, and although I'm not normally involved with rehabilitation of civil engineering works -- in fact, this was the first time I'd ever seriously confronted a rehabilitation system in my life -- I saw people rehabilitating the physical system in a way that looked wrong. I looked at the rehabilitation activities for a while and what I saw didn't seem appropriate. So I decided to ask the engineer who was on the site, "Where are your plans?" He brought me the plans, and I looked at what he was doing and I said, "But, you're not following your plans." And he said, "Well, it isn't logical to follow the plans because the canal is eroded to this point (as he pointed), but -- we're trying the best we can to bring it up to the old standards." So I contemplated for a while, and I thought, "Gee, that used to have nice bushes and weeds and trees on the banks," and they had become stable in some sort of regime state. But here they were trimming these banks down, trying to get them back to design standards, and then they were putting sod on the banks and they were compacting it by hand and it was washing out, and they had spent all their time working on the first two miles of the canal since they needed to keep going back and forth, repairing the new erosion. Right, Tom?

TOM: Yeah, I remember the whole thing very well. I remember looking at the sod, knowing something about sod, and saying, "That's not going to work."

JACK: Okay, so we were just standing and looking. Then I went back to the District Office and said, "How are you doing this rehabilitation?" We found a whole crew of engineers at work, and here they were, churning out plans that were not being followed. Then they were going out and surveying what was done and redrawing the plans accordingly and they just kept going back. Now, all I can say is, for sure, it felt wrong! When I tell the story, you also wonder how it could happen this way. There was a chief civil engineer there, had been there for two years, a guy who I'm sure is every bit as smart as I am, two or three of them around in fact, lots of Sri Lankans, and some AID engineers had been in to see them. I don't know who-all had been there, but certainly I

wasn't the first engineer to stumble down the road. I can't help but believe that others must have wondered, "What are those guys doing?" But I guess they never asked. And so what it is, it's not that I had a checklist of what to look for, but it's just that there was somethng that didn't feel right about that process, and it seemed like there must be some other, probably better, way to do it. So I asked a few questions and studied the situation a little further, because I had a hunch something was wrong!

TOM: Well don't you think that's true? As you gain familiarity with resources, I can walk out on a farm, and I'll bet you can, too -- I can walk out on a farm in the Northeast and just stand there and look around, and I know, I just know when something's wrong.

JACK: Well, I'm afraid when I gave you my way of looking at it, I just blew it, because you were hunting for maybe a structure and all of that stuff from an engineer. If you really put me on a design problem, if I'm sitting down doing a design, then it's totally structured, once I'm in my niche going. Once I've decided to put in a center pivot or ditch system, then it's just all business and I don't need any more advice. I don't want anybody bugging me any more. In fact, if anyone is in my way from there on, they are just like rocks and mountains and things in my way!

Important Questions from Engineers

1. How does this physical situation compare with other places I know a lot about?
2. What are the crops of interest? Are they well suited here?
3. Is irrigation here supplementary or essential -- all the time, seasonally, or never?
4. What is the critical, limiting physical resource -- water or land -- in each season, in each irrigation, for short range (local) objectives, and for long range (national) objectives?
5. How does the system look in terms of equity and relative water

supply (water tension) on the average and in the extremes, and at the head, middle and tail of the system?

6. What is the topography? If the land has a slope of 2 or 3 percent or more, are there opportunities for gravity return flow; if not, what is the micro-topography, and what are the water logging and salinity problems looking like and what opportunities exist for shallow wells for conjunctive use with groundwater?
7. How much return flow is there and where does it occur?
8. What is happening with water reuse? In a sloping system, go to the far end and see how much, if any, water is coming out of the drains; in a flat system, look for groundwater use, wells, power and energy supply, salinity issues, depth to water table, etc?
9. What is the nature of the water supply? What is the storage and water supply hydrology; is there a river run (direct diversion) system or a reservoir system and all that implies, or a combination of both? What are the averages and the extremes in the system?
10. How adequate and well-maintained are the engineering works, including control structures for regulation, measurement structures, safety structures for floods, etc.?
11. What is the carrying capacity of the system, including in-line storage permitting regulation?
12. What is the safety, reliability and manageability of the delivery system? How reliable are main system deliveries?
13. Have earth channels reached some sort of stability that, while maybe not looking good, is quite serviceable, or are they continuing to erode?
14. Is sediment in the canals a problem in getting water to the tail-enders?
15. How well does the system fit its physical environment, and how adequately is it built and managed?

16. Have the farmers taken over operation of more of the system than planned or expected or authorized? If so, with what results?
17. Are there illegal structures? Is there sort of an underground battle between the Irrigation Department and the farmers for control of water?
18. What is the age of the system, and where is it in its evolutionary path?
19. Repeat the above questions for the on-farm distribution system. Also, is good use being made of the possibilities for extra uses, such as domestic, trees, pasture, kitchen gardens, etc.?
20. How well are the farmers operating and managing the part of the system for which they are responsible?
21. If the farm systems are small, how well were they designed and engineered?
22. How good is the field irrigation (application)? What happens to localized runoff? How are the farm structures being used?
23. In general, what is going on vis-a-vis the physical scene and the human emphasis of irrigation imposed on it?
24. What is needed or should be changed in a physical sense to make the main system and the on-farm systems more reliable, functional and manageable?
25. What are the realistic possibilities for making the changes required to improve the reliability, functioning and management of the main and on-farm systems?
26. What is the demand on management and labor created by the system for farmers and for the Irrigation Department?
27. What is the time sequence of the labor demand?
28. What degree of mechanization requirements are implied; including of power, implements, type of irrigation system, etc.?

Important Questions for Agronomists from Engineers

1. How suitable are the crops being grown, and how good is the system of production?
2. What are the opportunities for rainfed agriculture?
3. How good are the yields compared to the potential at the site under irrigation?
4. Do farmers seem knowledgeable of other inputs, and do they have access to these inputs?
5. How adequate are the farming practices, potential versus actual?
6. What seem to be the restraints to improved practices?
7. Are there better crops or cropping systems that are being overlooked?
8. Are there some new things from agronomy that will enhance the situation?
9. What has to be put in place to realize the cropping potential?
10. What are the labor needs?

Important Questions for Economists from Engineers

1. What are the possibilities for enhancing and the restraints that are thwarting the system?
2. What are the engineering economic issues?
3. What are realistic objectives?
4. What resources are available here -- money, energy, labor, management?
5. What are the factor markets and output markets that support agriculture like?
6. What's going on here economically?
7. What are the economic realities and incentives for the farmers as this system is now operating? (I always assume that the

farmers, within their viewpoint, are operating the system to their own economic advantage, in the broad sense of the term.)

8. What are the realities in terms of the financial provision for maintenance?
9. What are the economic incentives for professionals dealing with the system - vis-a-vis their incentives for working elsewhere?
10. Does the credit system function so farmers can get fertilizer, seeds and other inputs in a timely fashion?

Important Questions for Sociologists from Engineers

1. What is the demand on labor created by irrigation, for main system management, for on-farm management and for field labor? What is the time flow of this demand?
2. Does community support for irrigation exist?
3. Are training resources available and adequate?
4. Institutionally, what is workable in terms of irrigation?
5. What level of cooperation can we anticipate between farmers in groups, at turn-out levels, regionally and with the bureaucracy or canal management structure?
5. To what degree can we rely on farmers for construction and maintenance of the system?
6. What kind of physical incentives do you think would maximize farmer cooperation?

Important Questions for Political Scientists from Engineers

1. What level of support is available from the Irrigation Department?
2. What level of corruption should we expect in the bureaucracy?

Strictly Interdisciplinary

1. What do the farmers need and want?
2. What is wanted and needed to make this whole enterprise work better -- to meet the holistic objectives?
3. What are realistic objectives and possibilities?
4. What is it going to take to produce the realistic objectives and possibilities?
5. Are these requirements in existance or can they be obtained or developed?

ALLEN LEBARON - ECONOMICS

Important Questions from Economists

The following is a short list of important questions about economic development which, I think, are linked to the political decisions that have to be made when irrigation investments are under consideration. The list requires a set of presumptions that underly the questions chosen. For example, I assume that nations should try to reach any investment goals that they might have in the cheapest way possible. Where irrigation investments are concerned I think we feel that increased water supplies are justified on the grounds of greatly increased productivity of food and fiber. Therefore, the logical thing to ask is, "What quantities of food and fiber are going to be necessary in order to take care of a growing population in the future?" Then, the way to operate is to go after the required amounts in the cheapest way possible.

What is necessary, therefore, is to quickly "site" or "situate" the rural sector in order to understand where it is and where it is going or where it may possibly go. These are questions I feel will help in that process:

1. How nearly self-sufficient in food production is the nation?
2. What agriculture products are being imported, and how are they paid for? What is the official policy on a program of import substitution, and how big of a "gap" might be filled from local production from the proposed type of activity?
3. What agricultural products are now being exported, and how do markets look for the future?
4. What are the trends in rates of growth of domestic agricultural product production? Is this growth for rainfed, irrigated or what? Is the trend in the direction indicated by the "low cost" way? Is it the natural product of market forces, government subsidized or what?
5. How fast are population and personal incomes growing, and what

does this portend for growth of the domestic market? What do these trends mean in terms of probable widening or narrowing of any shortfalls in production in the future?

6. Where do existing irrigation facilities, practices or potential programs fit into this picture?

JON MORIS - SOCIOLOGY

Important Questions from Sociologists

1. What are the perceived constraints which define the opportunity space for farmers' adoption of technical innovations (as seen by farmers themselves)?
2. What stage in the household development cycle has the farm family reached, with what consequences in regard to labor availability, investment and "cushion" against adversity?
3. Which crops or other enterprises provide the bulk of farm investment capital? What are the perceived advantages of different crops as seen by the farmers in contrast to the alternatives?
4. What is the size and nature of the farmers' social network, and does it constitute a viable economic support system?
5. What appears to be the cash flow situation within the family? Is it sufficient to permit the purchased inputs required for commercial agriculture?
6. What has been the work and educational experience (or skills profile) of the various members of the farm family?
7. Of the technical innovations available within the community, how quickly have they been taken up here in contrast to other farmers elsewhere?
8. What is the annual cycle of farming activities, cash availability and major social celebrations?
9. What are the land, water and property rights held by members of the farm? How secure are these?
10. Is there any member of the family with a regular cash income separate from farming?
11. To what extent are farming activities and enterprises subject to unified management?
12. Is the legal owner or investment controller absent from the farm?

13. What proportion of on-farm production is sold versus how much consumed?
14. What is the aggregate cash flow situation in the community? Is it sufficient to permit the growth of secondary occupations?
15. What is the style, legitimacy and effectiveness of community leadership?
16. What is the inter-agency matrix of farm services whose actions are needed to grow the dominant cash crops? How well do these function at the local level?
17. How are representatives of the various government agencies and ministries regarded by farmers? Are they staffed by local people?
18. What major factions, conflicts and "out-groups" exist within this community?
19. What is the history of the government's previous development efforts in this place?
20. Are there traditional roles which control or influence water allocation, usage and conflicts in the community?

I would also list the following as things to watch for in sociologic domain:

A. Socio-Economic

1. Land tenure/tenancy arrangements.
2. How water conflicts are resolved.
3. Social infrastructure present in community, past history of same.
4. Aggregate psychographics (life style).
5. Nature of water leadership locally, "water masters," etc.
6. Inter-agency matrix required to use agronomy and irrigation.

B. Farmer

1. Farmer skills, knowledge, attitudes and perceptions:
   a. Water as free good;
   b. Passivity -- he can't act;
   c. Unreliable -- he can't trust water delivery;
   d. Perceived constraints; and
   e. Perceived roles -- who is supposed to do what?
2. Family support networks, inter-unit trust, homogeneity, resource intensities.
3. Atypical, outside, side-enterprises that affect response.
4. Calendar interfacing -- social demands, cash and labor availability.
5. Labor.
6. Household (and types) cycle -- is it dynamic?
7. Family decision-making.
8. Household impacts of irrigation.
9. Intra-community, class-social, differentiation; access and equity.
10. Role of family, including women, in irrigation.
11. Sociology of maintenance and investment in water facilities.

C. User-System Relations

1. User organizations -- how easily introduced into system?
2. User-bureaucracy interface.
3. User deviance patterns and why.
4. Externalized costs onto user.
5. What is assumed users will do?

DEAN: This whole thing is science as well as art -- the art of an elegant intuitive solution based on the solid insights of scientific discipline.

TOM: I think the idea of rapid appraisal as an art is relevant for the whole team idea. You can do better than being strictly scientific. Because I know that I got my feeling about farms from some grand old teachers who would go out there and just start reeling off what seemed to be unrelated facts about, "Look at this over there, look at this over here, and I remember when so-and-so used to be here," and on and on, and finally you start getting a feel. You go out with Jack and you stand there and start talking, "Well, look at this over there, look at this here." There's a dialogue back and forth, and that's a contribution, that's part of the art form. I think you could learn a lot from that. Toward the end you might kind of mentally go through and think, maybe go down a list, to see if you left anything undone, but you don't start out with it.

JON: You push it down. I mean, it's like a Masai watching his cows go up and they run by and he says, "Where's that one?" I mean, somewhere you've got a warning, a scanning mechanism, but how it occurs, we don't know. Just suddenly you smell something wrong and you say, "Something's wrong!" And sometimes you don't even know what it is, it's just three or four details, but all of a sudden you'll get that feeling, I've got something wrong, and then you start to probe with your questions. But I don't think we know how that red light goes on.

JACK: And really, in terms of the engineering skills, it has to be a person who kind of just sucks up information and listens.

CLYDE: Well, yes, but you didn't have this intuition on the first job you went on. You went off with somebody who had experience; you learned

from them. If you did have it, then, you're an amazing person! That's why you mentioned years of going out and looking at things.

JACK: In other words, I wonder, if you were working with new engineers, you'd like to get engineers to go out and be trained this way; then the experience comes in getting better at doing it, not at learning how to do it in the first place. In other words, it is probably important to get onto the approach early.

CLYDE: And knowing the right questions to ask is important, too.

JACK: I would say I don't feel smart enough to begin to know what questions I'm going to ask.

BRYANT: Well, I just have a hard time of saying that we have five guys out there, you know, just kinda, just sensitizing . .

JACK: No, it's not that at all. I mean, you're just open to information, is what I mean, you're not fixed, you don't have a solution in mind. You can't think you know the answer.

CLYDE: No, but as I say, you have to know the right questions and the right people. In Libya one time, we were down south of Tripoli, in a small area of about five thousand hectares to irrigate. There was one large area that was grass, one large area that was barren, and I'd just been on a project that had a lot of sodium, and we had no soil survey or anything, and it was sort of a rectangular area. We took soil samples, and we took them to the college. We didn't have the results when we went back the next day, and I had a couple of fellows from Canada with me and I said, "This is sodium." It felt like sodium, you know, it was crusted. And there was this little boy who was bringing some sheep through and our driver was Arab. We asked, just out of curiosity, I said ask this boy if he knows why this is like that. The little boy was about ten years old, and the driver asked him, and he said, "Yeah, I know why." The driver says, "Why?" And the boy

answered, "This used to be an airplane strip for the British during the war, and they put salt on here." So that's what made the salinity, see! And I was showing how smart I was, so we didn't ask the right question of the right people.

HELEN: I don't think a social scientist can ever do that on an irrigation project, quite frankly, to go out and sense what's the matter with it in that sort of physical sense. I mean if I've got any sensors, they are to the flow politically of where people want something and how they go about getting it and what their motives are. You know, I understand sort of how bureaucracy operates, but that is really only a part of an irrigation system, and it's just a small part of it. It's not sufficiently central. You have to have something closer to the flow of water to get that sense.

CLYDE: Well, I think you can.

JON: You get to be a development expert. What the feeling is, once you've seen about twenty or thirty of these projects, I think there are a number of things I look for. First, you sense when people are defensive right away. So it isn't that you have answers, but you watch for things that trigger off, "Ah, I better zero in." Now at that point your skills have to come in. You may ask the wrong questions, but what I'm saying is after a while you develop that intuitive sense that there is something here this guy is hiding. He's putting up too much noise, you know, and you start to look at what's behind it and why, and then it may turn out, you know, you're all wet, that he has some un-project-related reason.

JACK: Well, if I go back and admit to some of the structure, some of the structure comes in like this: I might ask a person in management, "When do you deliver water, or how do you decide when to deliver water?" And I'll listen to how. Then I'll go, and I'll have my hydrology and I may have enough on the evapotranspiration and climatology, so I've figured out what the crop needs, and I compare

what he tells me he does with what I think I see happening, and with what I think ought to be happening.

JON: And if there's a discrepancy anywhere . .

JACK: . . . I'm hunting for those, so when I'm saying I'm picking up, sucking up information, I'm also analyzing all the time, and then finding the things that don't look right, the intuitions come because I get a little nibble here, that says, "Hey, you know, this guy's just full of baloney!" The nibble can come because what he's saying and what I'm looking at don't jibe, or because what I'm looking at and what I think ought to be happening . .

TOM: But that happens between members of the team, too, because I know from my experience if you tell me something is so, you've got to convince me, and you've got to really lay it out and say okay. And I've found, for example, sometimes in talking with you [Jack] that some of the things you say are so, you have a hard time when I really start asking you.

JACK: That's right.

TOM: It turns out that, well, really, you don't know it's so, you suspect, or it's a suspicion, or a hypothesis, and so forth. And an example of that would be how to improve management of the main systems.

JACK: Well, the question you kept asking me was, "Why are you going to fix those headgates into the distributaries, why are you going to fix those?" And I said, "You oughta fix those." And you said, "Why?" And I said, "Hell, I'm an engineer" and . . you said, "That's not good enough for me, Keller, why the hell you gonna fix 'em? Why'd those guys break 'em out in the first place?" So it is true, in a good team approach, the team is stronger than the sum of the individuals.

TOM: That's right. That's right! Because you challenge each other's

conventional wisdom. Because if you have a tendency, and you always do, to bring something with you that you've learned, and you say, "Well, I know that," and someone says, "Yeah, oh really? Then that expands you and helps in the intuitive thing, and it gives you a new way to look at things that you didn't see before.