OPTIMUM UTILIZATION OF WATER FOR AGRICULTURE WITH EMPHASIS ON "ON-FARM WATER MANAGEMENT"

Terminal Report
Grant No. AID/csd-2459

Utah State Universit
Logan, Utah
June, 1978

TERMINAL REPORT 211(d) PROJECT

AID/csd-2459

Title: Optimum Utilization of Water for Agriculture With Emphasis on "On-Farm Water Management."

Grantee: Utah State University

Director: H. B. Peterson

AID SPONSORING OFFICE: TAB/AGR

Statistical Summary:

Period of Grant: May 23, 1969 to June 30, 1978

Amount of Grant: $945,000

Logan, Utah

June 1978

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NARRATIVE SUMMARY

Final Period

A major effort was made during this period to complete manuscripts that were in various stages of development. This has been accomplished as indicated by the abstracts. Another emphasis was placed on the response for assistance. During this reporting period, eleven staff members were supplied for long-term service to developing countries and twenty-five for short-term service.

There were thirty-nine students from developing countries who received training in irrigation at the University. Twelve of them were graduate students brought from Honduras for a special 15-month training session. Much of their instruction was in Spanish and special courses were designed to meet their needs.

Total Period

The Grant enabled Utah State University to expand its competence and become a center for worldwide training and research in the fields of water management, irrigation and drainage. New courses were added that cater to students from developing countries. Nine new staff members were added and are serving as specialists on campus, teaching and directing the research of students from developing countries. Other staff members are on long-term assignments in Peru, Honduras, Kenya, and Guatemala. One is commited to assist the government of the Cape Verde Islands for a period of three years. Graduate students trained under the program are working throughout the world.

Preparation of training materials has been an important component of the program. These have included slide series, extension type bulletins, and a text on irrigation systems evaluations.

In 1974 during a review of the Grant activities, AID/W requested a major change in the program. The emphasis was on utilization of the developed competence and less emphasis on development of competence. The work plans and annual reports have reflected the changes where the activities have been reported in terms of objective/outputs as follows:

Information Capacity, Education Training, Expanded Knowledge Base, Advisory Capacity, and Linkages Networks. The activities of the various universities having Grants in the field of water management have been correlated through the Consortium of International Development which received some financial support through the individual grants. Library improvement in the field of water management will have a lasting beneficial impact as will the cooperative efforts through CIDNET.

Details of accomplishments throughout the life of the grant have been reported in the annual technical reports.

DETAILED REPORT

General Background and Description of the Problem

There has been increasing evidence that in developing countries there is an urgent need for more food and better nutrition. Food production is closely linked to water available for transpiration by the growing crop and water availability is related to On-Farm Water Management. In most LDCs there is a lack of trained people for transfer of the water management knowledge available in developed countries. The lack of technology has been a deterrent to expanded production and has restricted the effectiveness of AID and other donors in solving critical food and nutritional problems common to many LDCs.

It was common knowledge that inferior and indifferent water management in LDCs was depriving the countries of needed production and wasting the water resources. Water logging and salinity were often related problems. Poor on-farm water management was often practiced under irrigation systems which might otherwise be considered to be technically sophisticated. Land was not being properly prepared for irrigation and drainage. The problems of on-farm water management are pervasive, affecting agricultural lands everywhere but are more crucial in the developing countries. Scheduling and applying the proper amount of water in an efficient manner was a goal which has, in general, not been reached anywhere regardless of the type of conveyance system bringing water to the farm. There was an acute problem concerning farmers with small holdings because of the complicated distribution, lack of credit, etc.

It was reasoned that by making highly qualified and experienced professionals available from centers of competence at universities, AID could develop and disseminate technologies that would be more effective than those being used in many countries. Through utilization of the technologies transferred, the LDC's could accelerate the rate of production expansion. By establishing strong linkages and networks among developed and developing country institutions and agencies, an even greater quantity and quality of capability could be directed toward improving the food supply.

At the time the grant was awarded, the Department of Agricultural Engineering and related departments such as Soils and Civil Engineering had many graduate students from foreign countries. However, the staff and course offerings were not adequate to teach and direct the research of these students.

Utah State university had considerable competence in the areas of irrigation and water management at the time the grant was approved. It was expected that the expanded full-time professional staff, courses of study, library information, and research would enable the University to respond much more adequately than previously to requests concerning agricultural related water management problems from such entities as: USAID/Washington, USAID Missions, other state and federal agencies.

The proposal for a 211(d) grant to Utah State University to utilize its competence in the general area of on-farm water management was one of three submitted by universities who were members of the Council of United States Universities for Soil and Water Development in Arid and Sub-Humid Areas. This consortium was to coordinate the AID sponsored research and institutional improvement of these universities. Other universities include the University of Arizona, and Colorado State University. Arizona emphasized "Watershed management" and Colorado State University specialized in "water delivery and removal systems and relevant institutional development." The Grant Project was expected to have built-in research, training, and advisory components. It was expected that by the creation of special capability in a particular area of knowledge, it would include relevant technology and the capacity to pass it on to others.

Purpose of the Grant

The Institutional Grant Program's purpose was the improvement of the competence and expertise of U.S. research and educational institutions to deal with critical problems of LDCs. There are certain identifiable shortages of properly trained personnel and gaps in knowledge and skills that restrict AID's efforts to carry out its programs of assistance in these countries. The Institutional Grants Program is designed to overcome these deficiencies. Individual projects are designed to serve the program needs of AID without a requirement for providing specific services. Institutional Grants are thus to be used to strengthen "centers of competence" within educational and research institutions and to build long-range resources in depth rather than to procure services for AID for specific limited purposes.

The specific purpose of this Grant was to expand the competency of Utah State University as a center for worldwide training and research in irrigation and drainage. As the competence has increased, the purpose has gradually shifted toward sustaining and utilizing this competence in research, teaching, training, and consulting. The Grant has now been extended and revised. The purpose of this revision and extension is to focus and sustain, within a utilization framework, an institutional response capability at Utah State University in on-farm water management with emphasis on small farms.

It is one of three 211(d) water grant extensions providing a cooperative approach to assisting developing countries in solving their food and nutrition problems.

Primary emphasis will be given to the on-farm water problems as a means of improving the quality of life for the farmers in the lowest income brackets. A secondary focus of the grant extension is to permit involvement of the University in all phases of the water chain as appropriate and in cooperation with CID. It is proposed that the competence will be used to identify water management problems in the LDCs and seek solutions to these problems through training, research, consulting, and preparation and dissemination of education materials.

The Consortium will cooperate in identifying new problems, establishing priorities, and deciding on a division of labor and cooperation among the five universities in order to prevent duplication of efforts and to utilize the most qualified personnel.

Objectives of the Grant

Objectives Restated.--The major objective of the initial Grant Program was to increase and expand the existing competence of Utah State University in the science and technology concerned with "on-farm management." Emphasis was on moisture environment on the farm as related to the special characteristics and problems of the less developed countries. The general approach was to integrate a quality research, teaching, training, and consultive technological program into an effective means of information transfer to developing countries.

Review of Objectives.--The objectives and areas of activities, as originally identified, were broad in scope and general in nature. There have been some gradual modifications until the review when the objectives were restated as above. In the plan for implementation of the program, it was anticipated that emphasis on activites would shift. Early emphasis was on identification of staff needs, selection of professors, and language training. This was followed by a review of course content and revision and introduction of new courses. Emphasis was also placed on library improvement and expansion. As the goals in these areas have been reached, emphasis has shifted to teaching, conducting research, responding to requests for technical assistance, and increasing accessibility of the library holdings. The results from the increase in language competence is becoming evident in the research and consulting accomplishments. There is a constant demand for the services of those on the staff who have the language competence to teach short courses or provide technical assistance in LDCs. The number of demands has exceeded our available staff.

In a proposal to extend the Grant, the purpose was to focus on the utilization of the developed competence and have more specific objectives with identified outputs, inputs, and verifications. Efforts are being made for closer coordination of the programs with other members of CID.

Review of Critical Assumptions.--In the original grant proposal, most of the critical assumptions were not specified as such but were largely assumed. One assumption was that the University could increase its competence faster than the increase in demand for the assistance. This has not been the experience. It was assumed that the LDC's, AID, and Missions would cooperate with the University and a consortium in identifying problems, establishing priorities, and utilizing the capabilities; however, they have utilized the capabilities but have only helped in a limited way towards identifying problems and establishing priorities. It is a difficult task to get the specific problems of the LDC farmer to the USU scientists for solution and then transfer the information back for utilization. We are sure AID is well aware of this but have limited opportunities to assist.

Therefore, as it has been stated, the altering by AID of their policies, objectives, and procedures have changed more than were originally announced to the Grantee.

ACCOMPLISHMENTS

Introduction

The Institutional Grants program was established to strengthen the grantee (university's own capabilities) rather than overseas services. The consortium institutions have attempted to integrate a quality research, teaching, training, and consultive technological program into an effective means of information transfer. During the early years of the grant program, considerable effort at Utah State University was directed toward increasing the number of staff, improving the library holdings, increasing the foreign language competence, revising the course offerings, and conducting needed research. During the 1975-1978 period, emphasis has been placed on utilization of the competence. In the 1975 revision of the program, five outputs were identified as follows:

Information Capacity
Education Training
Expanded Knowledge Base
Advisory Capacity
Linkages Networks.

The 1976 report and the final report are divided into sections corresponding to these identified outputs.

Information Capacity

The University has maintained a center of competence in the general field of on-farm water management. As a part of the center, a library of important documents has been maintained. The University librarian has worked with representatives of the other CID universities in a program to integrate the activities and where possible establish an information exchange system as well as a uniform and combined retrieval system. Utah State University personnel have participated in CID-sponsored workshops which were held in order to develop a coordinated information data system called CIDNET. Some of Utah State University holdings are being added to the system.

Grant funds were used to service user requests. During the reporting period, approximately 120 requests were received from individuals in about 18 countries and 15 states of the U.S. The supply of an old edition of Irrigation System Evaluation and Improvements has been exhausted and there have been many unfilled requests. These will be filled with copies of the new edition. The majority of publications were brought to the attention of individuals through publication brochures. Lately, requests have been coming as a result of publicity through the CIDNET brochure. Publications on irrigation requirements, precipitation dependability, and moisture availability in Latin American countries are most frequently requested. Attention to these has come through our annual reports and through AID/W efforts.

Education and Training

New courses developed during the previous period have been taught. It is evident from the student interest that they are worthwhile for students from LDCs. These courses will be continued.

During a period of fifteen months, special instruction has been given to twelve graduate students from Honduras.

Special supervision has been provided to graduate students from LDCs. The majority (36) of the graduate students in the Department of Agricultural and Irrigation Engineering are from developing countries. Where possible, these students are researching problems of their own countries.

Expanded Knowledge Base

During the period, emphasis has been placed on preparation of a book on farm irrigation system evaluation and on practical circulars and other instructional material suitable for training technicians in LDCs. An attempt was continued to formulate a plan for involving peasant farmers in irrigation project planning. A copy of the paper by Adams, et al., is attached (Appendix A).

Methods of Irrigation.--A committee was appointed which has been working toward the development of a report or reports. It was found that this is a very broad topic requiring more resources than were in the budget for this program. The members have prepared a proposal to AID indicating the nature of the problem and scope, a work plan for completion of the study, a budget, and an indication as to the personnel to be responsible for the various tasks. No funds have become available for this effort.

As a major portion of the activity to expand the knowledge base, a copy-ready manuscript of "Farm Irrigation System Evaluation" is ready for reproduction. The information contained in this manuscript is in great demand and requests have been received for permission to translate the manuscript into Spanish; as yet that has not been granted. An indication of the contents can be seen in the Table of Contents (Appendix B).

Food Production Technology Transfer.--There has been a continued effort to develop a strategy for transferring technology to the LDCs. We believe it necessary to collect information that is not site-specific and to mesh together the component parts (climate, soils, varieties, pests, fertility, and husbandry) of crop production technology in order to bring about an effective transfer. A series of papers are being prepared that show how to utilize the information on the various components. Reference Climate Sites for Agricultural Technology Transfer was published in 1975. Others dealing with soils, varieties, etc., have been completed.

The following three papers were completed during the year in order to help explain the program of information transfer:

Crop Indicator Lines for Agricultural Research and Production, L. N. Leininger and H. B. Peterson, Utah State University, Logan, Utah, July, 1977.

<u>Genotype Selection for Agricultural Technology Transfer and Utilization</u>, L. N. Leininger and H. B. Peterson, Utah State University, Logan, Utah, August, 1977.

<u>The Role of Soil Taxonomy and Benchmark Soils in Technology Transfer</u>, A. R. Southard and H. B. Peterson, Utah State University, Logan, Utah, November, 1977.

Papers dealing with instructions on how to conduct tests, collect data, and field demonstrations are supplemental to these. An example is the paper on "Line Source for Continuous Variable Irrigated Crop Production Studies." This is a technique for measuring the interacting crop response to water and fertilizer variables. Not only is it useful for research, but it is excellent for extension demonstration.

<u>State-of-the-Art on Irrigation Methods</u>.--A detailed proposal was presented in the Work Plan for 1977 to conduct a state-of-the-art study on irrigation methods. This was made with encouragement from AID/W and would be supported by supplemental funding. However, no reaction to this proposal was ever received.

Advisory Capacity

The Grant Director identified for CID the USU faculty members and their specialties for inclusion in a consortium talent bank to be developed. During the year, USU provided 23 staff members for short term teams who went to LDCs sponsored through contract with the University and CID. It also provided 11 staff members for long term assignments to LDCs. (An indication is given in Table 1 as to the nature of some of these responses.) Dr. Alfaro is spending his sabbatical year in France, Italy, and Spain in order to improve his competence to respond to requests from LDCs.

Linkages and Network

The principal domestic linkages have been with the CID Universities and the University of Puerto Rico for the tropical soil consortium. Much closer relations have been developed with FAO.

During the period, New Mexico State University, Oregon State University, Washington State University, and the University of Idaho have joined the Consortium.

Better working relations have been developed with the World Bank, CIAT, CIMMYT, IRRI, the East-West Center, Asian Vegetable Research Center, and the Central Luzan State University.

The activities of the CIDNET program have strengthened the ties with the cooperating universities.

Other Resources for Grant-Related Activities

It has been realized that the support from the grant program cannot be contained indefinitely; therefore, in order to maintain this competence and to protect the investment made by AID and the University, we are exploring ways in which the staff and program can be maintained. A proposal has been submitted to the Office of Exploratory Research and Problem Assessment of the National Science Foundation. In addition, negotiation is continuing with the Inter-American Development Bank. The Bank is interested in a joint venture entitled, "Strategies for Agricultural Technology Transfer in Latin America."

More requests for professional assistance are coming from CID and other agencies and companies than we can supply.

Although the competence in the area of water management has been greatly increased, there remains a great need for further expansion. There is also an urgent need to maintain the gains made and guard against loosing the "critical mass" of competence and thus negate an effective force. One result of the expansion has been an influx of students from LDCs and as it is now, we have an inadequate staff to adequately teach these large numbers.

Table 1. Request for Assistance Received During the Reporting Period

Name	Description of Request for Assistance	Whom Did You Assist?	Who Requested Assistance?	Who Funded Assistance?	Size of Effort Dollars Man/day	Results of Assistance
Alfaro	Evaluation and upgrading Agricultural Graduate School in Brazil	Fed. Rural Univ. of Rio de Janeiro, Rural Univ. of Pernambuco, Fed. Univ. of Viscosa	Fed. Univ. of Rio de Janeiro	Michigan State University/ Brazil	$5,383 (2 months)	Reports to Michigan State Univ. and the Ministry of Ed. Brazilia
	Improvement of water resources and conservation	Government of Cape Verde Islands	USAID/W	USAID/W	Three years	Continuing
Willardson	Review drainage problems in the field and prepare a drainage guide for Rep. of Honduras for primary use for Extension Service	Ag. Ext. Serv. in Honduras	Ag. Ext. Serv.	AID/Honduras	$2,000 (2 weeks)	Reports to AID and prepared a drainage guide for Ag. Ext. Service in Honduras
Hargreaves June '76 to July '76	Review problems relative to small farm irrigation in Honduras	Ministry of Natural Resources	USAID/Honduras	USAID/Honduras	14 days	Report with recommendations leading to a new program
Aug-Sept	Analysis of Climate as related to Agriculture for Central America	Institute Inter-americana de Crancias Agriculas and ROCAP (AID)	ROCAP	ROCAP	10 days	Computer analysis of climate
Nov 8-Nov 22	"	"	"	"	11 days	"
Jan 22-27	Planning beef production program	Centro Inter-americano Agricultura Tecnica (CIAT)	CIAT	CIAT	5 days	Program and contract with USA

Table 1. Continued

Name	Description of Request for Assistance	Whom Did You Assist?	Who Requested Assistance?	Who Funded Assistance?	Size of Effort Dollars Man/day	Results of Assistance
Stutler (Cont.) Oct '77 Jan 15-Mar 11, '78	Planning water resources development and utilization program and training for engineers	Water Resources Unit--Ministry of Natural Resources Honduras	USAID/Honduras	AID	3 months	Reports on water resource planning, demonstration farms and extension training. Provided 30 class hours of training to 15 Honduras participants.
	Evaluation of sites for possible irrigated vegetable production	Senegal/Gambia Africa	AID/Senegal	AID	(1 month)	Report to AID/Gambia Senegal
Griffin	Evaluation of extension irrigation programs	Ministry of Ag. Dept. of Ag. Extension, Honduras	Ministry of Ag.	USAID/Honduras	2,000 (3 weeks)	Report to AID, Ministry of Ag. Honduras
Stringham Aug-Sept.	Analysis of proposed irrigation projects and setting priorities for development (Honduras)	Ministry of Natural Resources for Govt. of Honduras	USAID/Honduras	USAID/Honduras	25 days	Recommended priorities for irrigation dev.
Feb-Mar.	Curriculum development in Agricultural Engineering, Water Resources at Egerton College	Kenya-Ministry of Education	USAID/Kenya	USAID/Kenya	30 man days	Report on revised curriculum staff needs, building needs, equipment and program phase-in.

Table 1. Continued

Name	Description of Request for Assistance	Whom Did You Assist?	Who Requested Assistance?	Who Funded Assistance?	Size of Effort Dollars Man/day	Results of Assistance
Hargreaves (cont.) Feb 6-Apr 15	Program preparation for dry land agr. and irrig. agr. Committees of Club des Amis do Sahel and AID/Washington	ROCAP & AID Mission	ROCAP	ROCAP	24 days	Contract with AID San Salvador for USU--additional climatic data and climatic analysis
Keller	Development outline for water management	Jordan	USAID	USAID	2,683.00 (2 weeks)	Water management technology for sprinkle irrigation (Jordan) training program
Daines	Consulting on drafting new water law	Ministry of Water Resources Honduras	USAID	USAID/Honduras	600.00 (2 weeks-1 wk Honduras, 1 wk USU)	New Improved water law draft
Anderson	Tech. Assistance for AID/Chile for water distribution organization	USAID/Chile	USAID/Chile	USAID/Chile	560.00 (2 weeks)	Report on water origin feasibility
Bishop	Irrigation consultant	IBRD/Burma	IBRD	IBRD	(6 weeks)	Report to IBRD
Stuttler	Water management research in El Salvador	El Salvador	USAID/TAB/ El Salvador	AID/TAB	14,000 (9 months)	Seminar and workshop on water management in El Salvador 4 publications 8 draft extension bulletins

EXPENDITURES

Details of expenditures by objectives/outputs are given in Table 2. Total expenditures according to budgeted items are in Table 3. The detailed expenditures for the report period are in Table 4.

Table 2. Distribution of 211(d) Grant Funds and Contributions from Other Sources of Funding.* Reporting Period July 1, 1976 to June 30, 1978.

Grant Objectives/Outputs	Review Period	Cumulative	Non-211(d) Review Period
Information Capacity	$ 9,324.00	$122,880.00	$ 17,500.00
Education and Training	31,504.00	189,871.00	21,200.00
Expanded Knowledge Base	31,786.00	279,753.00	25,000.00
Advisory Capacity	37,578.00	240,784.00	9,000.00
Linkages and Networks	31,080.00	111,682.00	7,250.00
Totals	$141,272.00	$944,970.00	$ 79,950.00

Table 3. Distribution of 211(d) Grant Fund Expenditures May 23, 1969 to June 30, 1978.

Categories	Total Budget Amount	Inception to June 1976	Period Review	Cumulative
Salaries, Wages and Consultants	$533,700.00	$492,282.00	$115,215.10	$607,497.10
Travel	114,200.00	71,482.00	3,372.43	74,854.43
Equipment	8,500.00	7,915.00	-0-	7,915.00
Stipends, Tuition and Fees	176,550.00	145,489.00	9,040.00	154,529.00
Supplies and Computer Use	54,000.00	56,225.00	3,105.04	59,330.04
Publications	38,050.00	20,306.00	539.30	20,845.30
CUSUSWASH-CID	20,000.00	10.000.00	10,000.00	20,000.00
GRAND TOTAL	$945,000.00	$803,699.00	$141,271,87	$944,970.87

Table 4. 211(d) Expenditure--Reporting Details Under Institutional Grant AID/csd-2459, 1976-1978

	M.M.	Salaries F.Y. 1976-77	M.M.	Salaries F.Y. 1977-78	Total Salaries 1976-78
I. A. Professionals					
Jack Keller	6.3	17,759.05	3.2	9,720.00	27,479.05
A. Alvin Bishop	0.9	3,172.78		-0-	3,172.78
Robert Hill	4.8	9,046.68	3.9	8,055.45	17,102.13
Kern Stutler	1.7	3,587.15		-0-	3,587.15
Howard Peterson	9.4	30.927.66		-0-	30,927.66
Safa N. Hamad	6.0	2,411.28		-0-	2,411.28
J. F. Alfaro	6.7	13,494.08		-0-	13,494.08
L. N. Leininger	2.0	4,844.27		-0-	4,844.27
		85,242.95		17,755.45	103,018.40
B. Clerical					
Bonnie Thompson		1,216.14		-0-	1,216.14
Amy Krambule		4,336.60		-0-	4,336.60
Linda Van Orden		5,165.09		-0-	5,165.09
C. Leadingham		686.37		-0-	686.37
Adeeb H. A. Baki		125.75		-0-	125.75
Dale Allred		666.75		-0-	666.75
		12,196.70			12,196.70
II. Student Support		Country		Amount	
Bob Hulsman		USA		4,160.00	
Nancy Adams		USA		1,200.00	
Dale Allred		USA		2,910.00	
Peter Canessa		USA		770.00	
				9,040.00	
III. Travel				3,372.43	
IV. Equipment				-0-	
V. Library Acquisitions Thesis and Dissertations, Reports, Papers, etc.				539.30	
VI. Supplies and Computer Use				3,105.04	
VII. CID Support				10,000.00	
GRAND TOTAL					$141,271.87

INVOLVEMENTS OF MINORITY PERSONNEL AND WOMEN

It has been difficult to find and obtain the services of minority personnel and women. There seems to be a shortage of qualified individuals and also a lack of interest by women in the field of irrigation engineering.

Through the assistance of the Grant, one minority professional staff member, Dr. Jose Alfaro, Associate Professor of Agricultural and Irrigation Engineering was recruited. He has taught several irrigation classes in Spanish and has undertaken numerous consulting assignments including attendance at a seminar in Costa Rica on irrigation and drainage at the farm level for Central American countries and Panama. In 1974-1975, he spent nine months consulting for the International Development Bank in Guatemala where he was coordinating a program to assist Guatemala in implementing a plan of work for irrigated agriculture. He has done research on infiltration-runoff as well as frost prevention by controlling plant growth by cooling. Dr. Alfaro has also authored and co-authored the following publications: "Medidas de Agua en Canales por Medio del Aforador 'Sin Cuello'," and Irrigation System Evaluation and Improvement. He is actively translating many of our Grant supported publications into Spanish. Presently he is studying in France, Spain, and Italy.

Nancy Adams has been employed by the grant part time as an undergraduate and graduate to conduct research dealing with information transfer. Ms. Adams was a graduate student in the Department of Agricultural and Irrigation Engineering. She is currently working for Colorado State University on a project in Egypt. Bonnie Thompson, a technician supported by the grant, has been instrumental in collecting data, assembling reports, and editing publications initiated by the staff members. She is also active in the CIDNET Program. Others supported by the Grant include Amy Krambule, clerk-steno, and Linda Van Orden, research aide.

Presently, there are three women in our irrigation engineering graduate program and one Mexican-American male.

All classified and nonclassified positions at Utah State University are recruited through established procedure, utilizing and following the statement of the Office of Affirmative Action and Equal Employment.

Abstracts

PEASANT INVOLVEMENT IN ON-FARM IRRIGATION DEVELOPMENT

by

Nancy Adams[1/] Jack Keller[2/], M. ASCE and

Bonnie M. Spillman[3/]

ABSTRACT

Peasant involvement can promote project success in several ways. First, it provides the institutional structure with better insight into peasant agricultural needs and concerns. At the same time, it allows planners to tap the knowledge peasant farmers have developed through many years' experience in the project area. Peasant involvement can also increase peasant commitment to new practices and alter community organization, thus creating sufficient understanding of the project. Peasant farmers' can then make further improvements if needed.

Social development inputs are required in addition to traditional development inputs to gain the benefits of peasant involvement. One highly effective human development technique, directed communication, is between the planning team and the peasant community. Applying this technique to on-farm irrigation development can best be achieved by organizing a structured planning procedure in which specific interaction activities are identified.

Interdisciplinary approach is the best procedure for peasant involvement in on-farm irrigation planning. For example, communication activities which are effective in peasant-planner interaction are identified in the work of Freire (5) with Brazilian peasants and Rogers and Shoemaker (10) on the communication of innovations. In addition, Freire describes a procedure for utilizing the activities. A public participation model developed by Ortolano (8) for planning water resource development provides another framework for peasant participation in project planning. Although none of these models is specifically designed for irrigation planning activities, they provide a basis for planning procedure which involves the peasant community and has the potential to increase project productivity.

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FARM IRRIGATION SYSTEM EVALUATIONS

A GUIDE FOR MANAGEMENT

by

John L. Merriam[1/] and Jack Keller[2/]

Widespread interest in Irrigation System Evaluation and Improvement, by J. L. Merriam as a guide to better irrigation practice has been encouraging. It has been used by irrigators, land managers, technicians, and students who have had varied experience in irrigation. Some found the explanations excessively detailed, but others expressed the wish to see more advanced information published. This new text, which incorporates much of the earlier material, has been written to promote wider use of the evaluation techniques and the suggestions for better practices in irrigation management.

Professor John L. Merriam of the Agricultural Engineering Department at California Polytechnic State University has been largely responsible for reorganizing and expanding the surface irrigation concepts by including basin and basin-check irrigation, simplified techniques for use with furrow and border methods, and more explanation of standard procedure and management practices.

Dr. Jack Keller, who is Professor of Irrigation Engineering at Utah State University, has had the major responsibility for the sprinkle and trickle irrigation sections. The information about sprinkle irrigation has been expanded by including descriptions and discussions of the many variations of sprinkle systems which include sprinkler-lateral, perforated pipe, orchard sprinkler, traveling sprinkler, center pivot, and gun sprinkler systems. The book has been further enhanced by additional new information about trickle (drip) systems.

The text has twelve chapters and a total of 285 pages.

1/ Professor of Agricultural Engineering, California Polytechnic Univ.

2/ Professor of Agricultural Engineering and Irrigation, Utah State University.

CROP INDICATOR LINES FOR AGRICULTURAL RESEARCH AND PRODUCTION

L. N. Leininger and H. B. Peterson[1/]

Annually many variety (cultivar) testing trials are conducted throughout the world. Most of these trials generate large amounts of information, but these data are time and site-specific, and hence not transferable.

When field trials are properly designed and the necessary detailed data collected on water, temperature, radiation, soils and crop development, physical and biological models can be used to make the information transferable to many environments.

It is proposed that a system analysis technique be used in order to develop appropriate mathematical relationships describing significant interactions among the components of crop production. These relationships are to be synthesized into computer simulation models of the various crops, tested with field data, then utilized as an aid in technology transfer.

Obviously, different genotypes will be necessary considering the diversity of the world's climates and soils, but the diversity of genotypes used can be held to a minimum if widely adapted genotypes in each crop are identified, catalogued, and made available. Two things are paramount: (a) all agricultural research must identify the crop and species used in experiments and, (b) a species must be selected whose genetic background is known. This paper discussed such selection using two major world crops, corn and soybeans, since they illustrate two major genetic systems in use for crop production, hybrids and pure lines, respectively.

The greatest void in plant growth research data existing at the present time is in plant-environment interactions. This paper presents rationales for eliminating this void with a minimum of cost and time.

[1/] Research Collaboratory and Professor, Agricultural and Irrigation Engineering Department, Utah State University, Logan, Utah 84322.

GENOTYPE SELECTION FOR AGRICULTURAL TECHNOLOGY TRANSFER AND UTILIZATION

BY

L. N. Leininger and H. B. Peterson[1/]

A means for rapidly improving world food production is through the innovative transfer of crop production technology found in temperate regions to developing nontemperate regions where major food deficits exist. This requires that current and newly developed production technologies be transferred as rapidly as possible to deficient areas, and there integrated into farming systems which are acceptable to the indigenous farmers. Most of these deficient areas are located in subtropic and tropic climatic areas where economic food production appears to be possible, at least to some degree. However, despite repeated attempts to transfer the more advanced agricultural technology from one climatic area to another, only limited success has been achieved. More transfer can become a reality when proper genotype selection is an integral and important part of the program strategy.

This paper presents the more immediate aspects in regard to genotype selection for international testing and the benefits which can be expected to result from a thoughtful and systematic selection process. The selection rationale is appropriate to all agricultural research involving plants and will have its greatest synergistic effects when all agricultural research embraces the concept.

The greatest plant-growth research-data void which exists at the present time is in the extensive area of plant environment interactions. This paper identifies part of a rationale for eliminating the void with a minimum of expenditure and in a relatively short time.

The primary deterrent to a more successful transference of agricultural technology is a failure to understand the genotype by environment (G x E) interaction. Consequently, research which will at least partially elucidate these interactions is needed to enhance agricultural technology transfer.

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THE ROLE OF SOIL TAXONOMY AND BENCHMARK SOILS IN TECHNOLOGY TRANSFER

by

A. R. Southard and H. B. Peterson[1/]

A generalized description of a soil taxonomic system is presented along with an indication as to the kind of information that can be transferred to an underdeveloped area when the soil families of the area have been identified. A proposal is made to conduct crop production studies on prominent soils (Benchmark) and make the information available through a data bank system.

This is one in a series of papers prepared on techniques for hastening technology transfer to developing countries where the prssure to increase production is great and there is a shortage of trained technicians.

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APPENDICES

Appendix A.

PEASANT INVOLVEMENT IN ON-FARM IRRIGATION DEVELPMENT

By

Nancy Adams[1/] Jack Keller[2/], M. ASCE and

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PEASANT INVOLVEMENT IN ON-FARM IRRIGATION DEVELOPMENT

BY

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ABSTRACT

Peasant involvement can promote project success in several ways. First, it provides the institutional structure with better insight into peasant agricultural needs and concerns. At the same time, it allows planners to tap the knowledge peasant farmers have developed through many years' experience in the project area. Peasant involvement can also increase peasant commitment to new practices and alter community organization, thus creating sufficient understanding of the project. Peasant farmers' can then make further improvements if needed.

Social development inputs are required in addition to traditional development inputs to gain the benefits of peasant involvement. One highly effective human development technique, directed communication, is between the planning team and the peasant community. Applying this technique to on-farm irrigation development can best be achieved by organizing a structured planning procedure in which specific interaction activities are identified.

Interdisciplinary approach is the best procedure for peasant involvement in on-farm irrigation planning. For example, communication activities which are effective in peasant-planner interaction are identified in the work of Freire (5) with Brazilian peasants and Rogers and Shoemaker (10) on the communication of innovations. In addition, Freire describes a procedure for utilizing the activities. A public participation model developed by Ortolano (8) for planning water resource development provides another framework for peasant participation in project planning. Although none of these models is specifically designed for irrigation planning activities, they provide a basis for a planning procedure which involves the peasant community and has the potential to increase project productivity.

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PEASANT INVOLVEMENT IN ON-FARM IRRIGATION DEVELOPMENT

BY

Nancy Adams[1/] Jack Keller[2/], M. ASCE and
Bonnie M. Spillman[3/]

INTRODUCTION

Recent project development demonstrates that agricultural production is not necessarily increased by simply supplying project farmers with new irrigation systems. When the farmer is unfamiliar with the system or rejects it for any reason, effort, resources, and potential for development are lost. Since farmers are the integrating factor in the on-farm agricultural system, it is vital to consider their role in the planned agricultural development.

Planners need to become acquainted with existing farming practices and gain local support for proposed changes in order to incorporate sound farmer roles into project development. This can be done with minimal contact between farmers and planning staff; however, research shows that sustained and directed contact between planning team members and local peasants is more likely to result in successful on-farm irrigation development.

Purpose

Potentials for increasing project success and processes for involving peasants in project development are introduced. Specific suggestions for interdisciplinary team activities involving peasants in project development are rather sophisticated; however, the purpose of this paper is to inspire planners to generate applications applicable to their situations. Thus, an invitiation is extended for readers to consider the potential of such an approach, to consider application and to try to be innovative.

Background

Lack of success in technology and resource transfer from developed to developing countries, according to Edgar Owens (9) is often due to an attitude of "development undertaken <u>for</u> the incompetent illiterate <u>by</u>

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the experts (9)." For example, peasant farmers are often regarded as a relative unimportant mechanism in the agricultural production process. This attitude ignores the fact that peasant farmers have created an agricultural system which allows them to survive and that this system is the only context within which agricultural innovation can occur.

The existing agricultural system is defined by a combination of physical components and farm management practices. Thus, farmer abilities and goals as well as technical design must be considered for a project to be dynamic and beneficial. Integration of these factors into the development process can be facilitated by communication between planners and peasant farmers.

Several advantages accrue from farm community participation. First, an opportunity for creating farmer acceptance of and competence with new techniques is created. Second, planners can gain information which can be used to design a project, fitting the level of local technology and meeting village farm objectives. Finally, community members can develop the ability to use their understanding to make various improvements throughout project life.

In on-farm irrigation development, the planning team which interacts with the peasant community might consist of three to five members of the project planning staff. This team should include a member with a background in the social sciences, who has an interest in agricultural development and a familiarity with local culture. The other members should be agricultural experts committed to the idea of planner/community interaction.

The team members with a strong agricultural background are responsible for deciding what new technical information and practices should be introduced. Other team members can provide input about important social factors, ways to interact with community members, and how the information transfer might best be accomplished. All members should work together, providing input and sharing ideas to devise workable patterns of peasant/planner communication. In addition, this team should communicate with the larger planning staff so pertinent information can be incorporated into the overall development plan.

Concepts relating to peasant participation in on-farm irrigation development were derived from an exploration of literature in the fields of project development, development economics, rural sociology, anthropology, communication, and water resource engineering. Models for incorporating peasant input into agricultural development (5, 10) and a public participation model for planning water resource development in the U.S.A. (8) provide a framework for a workable peasant participatio program in on-farm irrigation planning.

Three major assumptions underlie this program:

1. To be viable, a project must be designed so its users ca operate and maintain it.

2. Involving peasant farmers in project development will hel planners understand farmer capacities and limitations i operating a given irrigation system and will increase farme awareness of the benefits plus the work involved in irrigatio practices.

3. Involving peasant opinion leaders in project planning wil increase both the development process and the use of the irrigation system within the community.

In this paper community involvement is emphasized in opposition tc the predominant attention which in the past has been given to physical aspects of project development. Hence, the focus throughout is on people, both peasants and professionals, involved in irrigation development. In addition, consideration is given to some factors which are critical in irrigation development. Finally, a procedure is suggested for assessing peasant attitudes and abilities and for involving the peasant community in an information exchange process.

OVERVIEW OF ON-FARM IRRIGATION DEVELOPMENT: SOME CRITICAL FACTORS

Irrigation involves people using natural resources to alter their environment. In the simplest systems, irrigation results from diversion of water onto land where crops are grown. A person, with some tool, perhaps a stick, hoe, or shovel, arranges the earth so water will flow from a stream or pond onto the land. In highly developed, technological societies, irrigation system design is based on engineering analysis to promote efficient use of water for a given combination of physical and economic constraints. In such systems, the human element in the actual application of water becomes almost invisible--system operation may be entirely mechanical. Although people design and install the system, only one manager is required to maintain the system's operation; however, in developing countries where agriculture is labor intensive (when planning an on-farm irrigation project), it is critical to remember that irrigation is a human activity.

There are numerous variations between the two extremes previously described. The designers' challenge is to select from these a suitable system for the project area. The suitability of a given system depends on the physical environment, the level of technology which can be supported by the existing agricultural infrastructure, and the extent to which project farmers will adopt new techniques or to which techniques can be adapted to local conditions.

Physical Environment

Irrigation system design is based on crop requirements relating to local weather and the amount of water the soil can store. Given information about these components, an engineer can design a system to optimize the use of available water, energy consumption, or a combination of critical resources. Topography may be the determining factor in deciding whether a field should be leveled to improve a surface system or whether a sprinkle system should be installed. Finally, if drainage is required, this must be incorporated into the project development plan.

Project development based on sound but complex engineering and agricultural principles is a generally accepted procedure. Nevertheless, after these projects are instituted, they often fail in developing countries because vital factors related to the agricultural infrastructure or local custom have been disregarded.

Agricultural Infrastructure

The existing agricultural infrastructure is the framework in which the newly developed system must function; hence, its consideration is vitally important. One element of infrastructure is the marketing system through which agricultural goods and services are exchanged. The commercial structure governs the movement of goods to and from the project area and the availability of credit to the farmer. If the capacity of the commercial structure is overestimated, the irrigation development will not function as planned.

Another important element is the information development and exchange process through which farmers are advised of new, improved agricultural practices. This system may include government sponsored and private institutions. At the government level the system is composed of educational and research facilities where new practices are conceived and tested. Some institutional arrangement whereby information is made available to the farmers is also required. A private institution may perform much the same service except information is provided for a fee or is conveyed with the sale of some item such as seed, fertilizer, or a pump.

The agricultural infrastructure will not alter immediately to support new irrigation practices. That is not to say the weaknesses of the infrastructure should be ignored, but if the focus is on farm level improvements, initially the project will have to operate within the bounds of the infrastructure. Then as the project becomes a functioning part of that system, the infrastructure will adapt to support further innovation and development.

On-Farm Management Practices

Local agricultural practices and institutions directly affect the selection of a suitable on-farm irrigation system. The prevalent cultivation and planting procedures, the degree and type of pest control and fertilization, and the extent and methods of irrigation and drainage used locally must all be taken into account.

The degree of mechanization and the use of energy resources (farm animals, tractors, etc.) stipulate design constraints, as do the timing of various practices and the cropping programme. Finally, the farmers' management skills indicate the degree of sophistication to which they can adapt.

The success of an irrigation development depends largely on proper selection and introduction of on-farm irrigation systems. If the selected system harmonizes with existing agricultural practices and community mores, local farmers will use it. Furthermore, inputs necessary for system operation and maintenance will be available within the agricultural infrastructure. With such a project, traditional farming customs will be supported while new agricultural practices are incorporated.

The practice of hiring an engineering firm to design a system which works elsewhere and presenting the system to a peasant farmer in a developing country has its weaknesses. A more workable approach is to survey the human, institutional, physical, and environmental resources, and then select a system.

Aaron Weiner (11) has described a set of inputs which he sees as crucial to agricultural development. His structure parallels the approach being developed in this paper in that he incorporates non-material inputs as well as material inputs. In Weiner's analysis, non-material inputs include: improving techniques and know-how, restructuring the socio-psychological space, and restructuring the organizational-institutional space, including alteration of the political decision-making process at the village level.

Improved techniqes and know-how is the nonmaterial input which has most often been incorporated into agricultural development. It is, however, seldom included in irrigation projects. Somehow, it is assumed that if the farmers are provided with more water, they will use it efficiently. However, it is becoming more and more evident that this simply is not true.

Restructuring the socio-psychological space involves changing how local individuals think, and therefore, how they react. In the case of a peasant farmer, one of the most beneficial changes which can occur is the realization that he can control at least some aspects of his agricultural system. This awareness provides him with the capacity to analyze his operation and to function as a change agent when relevant information is provided.

The organizational-institutional space is defined by the institutions which form the agricultural infrastructure, from the village to the national level. In a village, restructuring this space might be achieved by establishing a water users' organization. At the national level, it involves structuring institutions to make them responsive to farmer needs and supportive of their efforts.

Nonmaterial inputs are critical in project development. They need to be identified and integrated into the on-farm irrigation development process. Procedures for the inclusion of these inputs in the design process, however, are seldom described in agricultural development literature.

MEANS AND POTENTIALS OF PEASANT INVOLVEMENT

The means and potentials of involving peasants in project development depend on the cultural dynamics of the peasant community. The specific condition of the community can be ascertained by the planning team through interaction with community members. Some general aspects have been thoroughly documented by anthropologists. Many of these characteristics clearly point to the need for changing the peasants' socio-psychological space in order to achieve successful development.

Perhaps the most characteristics feature of present culture, aside from poverty, is their fatalistic attitude.

> Occupying as they do a very low socio-economic level in the states of which they are a part, they find that the basic decisions which affect their lives are made from outside their communities, and have always been so made. Peasants are not only poor, as has often been pointed out, but they are relatively powerless. The apathetic and quiescent state . . . normally characterizes their outlook on life (4).

The combined effect of poverty and powerlessness has caused peasant communities to retreat into their culture to the point where they frequently lose the ability to critically question traditional ways.

Since peasants subsist on a very narrow margin, this strong community orientation toward tradition functions as a survival tactic. Even though new practices may be beneficial, peasants may be unwilling to try them knowing that even small failures may prove disastrous. Along the same line, they probably do not have implements necessary for improvement.

These conditions are magnified by a prevailing belief that there is a finite amount of goods available within the community. Foster's study (4) suggests peasants feel that when one attains a more prosperous state, others are deprived. This often generates negative community response to individual achievement and innovation. Furthermore, few plans are made for the future because peasants believe God controls the environment and that their activity will not significantly alter it (4).

Local attitudes and concerns must be confronted before long-range progress will follow. As planners become aware of this, they can determine realistic project objectives and viable means to attain them. Communication with peasants has proved to be an effecive way to assist them in realizing their effect on the environment and can result in a transformation of peasant attitudes.

Educing Peasant Transformation

The type of communication which brings about peasant transformation also supports successful project development. It has been described by investigators in several areas of human interaction. Perhaps the most exciting, however, is the work of Paulo Freire (5) with Brazilian peasants.

Freire and his colleagues developed a literacy program specifically directed to the Brazilian peasantry. The program was based on the assumption that as peasants became aware of their impact on their environment, they would want to gain more control. It proved true. The peasants were excited and astonished to find themselves active participants in their world, and the program was a success.

Later Freire considered the problem of agricultural development in light of the effective principles of the literacy program. His analysis started with a consideration of some basic assumptions and practices (described below) inherent in the agricultural extension process.

Agricultural extension. Freire's analysis shows that there are two main problems with the typical agricultural extension approach. It does not provide peasants a way to communicate their agricultural needs and concerns, i.e. there is no feedback mechanism. It does not provide farmers with an adequate understanding of the new practices.

Foster, reporting on an extension program in Sri Lanka (Ceylon), indicates that the one-way flow of information which characterizes agricultural extension is not only restricting to peasants but also to the extension program.

> Straus has described a . . . situation in Ceylon where the well-developed national agricultural extension service has fallen short of expectations . . . Extension operates from the top down. The department works primarily through drives to get farmers to grow various crops, and little attempt is made to find out what the farmer feels he wants (4).

With this approach there is no adequate way for the farmer to communicate his needs to those who are planning and developing new practices, and such programs almost always fall short of expectations.

When farmers are merely told when to apply various recurrent inputs such as water and fertilizer or how to use improved agricultural practices, they do not understand why the desired effect occurs. Consequently, misuse or short-run improvement results instead of permanent progress. Rogers reports one such example from a case study in India:

> . . . an agricultural change agent . . . persuaded his clients to adopt nitrogen fertilizer as a result of an energetic communication campaign but did not in the process teach them anything about the way fertilizers stimulate plant growth. When superphosphate fertilizer became available the next year, the change agent had to repeat his campaign approach, because his clients still had not gained the ability to evaluate innovations by themselves (10).

Both the ability to evaluate new practices and a two-way flow of information must be incorporated into agricultural development if full project potential is to be realized. Freire's method provides the first step in meeting these requirements. He calls this process dialogical interaction.

Dialogical interaction. Dialogical interaction consists of involved communication in which peasants are encouraged to discuss their agricultural situation and respond to development proposals.

For this to work, the planners must respect the peasants' knowledge and culture. The planners' knowledge consists of experience with modern agriculture, whereas, peasants have experience at local farming and are intimately acquainted with the local culture.

The procedure then is for planners and peasants to engage in dialogue,exchanging knowledge. Freire and his co-workers developed "culture circles" to facilitate such interaction. Peasants involved in the culture circle were presented with a series of repetitive everyday situations. Coordinators, instead of describing the situations, encouraged dialogue. Freire explains the culture circle as follows:

> Instead of a teacher, we had a coordinator; instead of lectures, dialogue; instead of pupils, group participants; instead of alienating syllabi, compact programs that were "broken down" and "codified" into learning units (5).

Topic selection for these learning units was based on impressions and data collected during informal encounters with the peasant community. These topics represent . . .

> Typical [everyday] situations of the group with which one is working. These representations function as challenges, as coded situation-problems containing elements to be decided by the groups with the collaboration of the coordinator . . . The codifications represent familiar local situations . . . (5).

During on-farm irrigation development, an "agricultural circle" can be formed. In this context, planners can structure interaction which will promote successful development. Discussions can be based on situations which illustrate local agricultural circumstances and common peasant experiences. In addition, the discussions can be directed to develop a spirit of critical analysis in local participants. Visual aids depicting relevant situations can be used to evoke discussions of the ideas presented. For further development of these ideas and possible applications, Freire's book, (5) Education for Critical Consciousness is recommended.

Results of this method often seem slow and uncertain; Freire, however, contends that although it may take longer to realize results from a given project, eventually time will be saved. Peasants will understand the basic reasons behind the proposed innovations, and situations similar to the one in Sri Lanka will occur less frequently. In addition, a means for determining peasant agricultural concerns will have been developed. Another benefit is that there will be increased self-confidence among community members and increased confidence in outside change agents. Ultimately, the value lies in altering the peasants' consciousness so they can function as their own change advocates.

Generating Innovation

Support for peasant involvement in project development also comes from research about the diffusion of innovations. Agricultural innovation results from a decision to adopt some new agricultural practice. Rural sociologists, Rogers and Shoemaker (10), have surveyed the processes by which these ideas and practices are diffused or communicated. Their findings indicate that success in generating innovation is positively related to the following activities, attitudes, and attributes of the planner in relation to the farmer.

1. "Extent of the change effort."--When there is more interaction between the planners and the peasant community, greater success in generating innovation results.

2. "Client orientation rather than change-agency orientation."--Although the change agent is "often expected to engage in certain behaviors by the change system, and at the same time . . . is expected by . . . clients to carry on quite different actions (10)," it is important to give the needs and concerns of the clients the higher priority. This may require some diplomacy on the part of the change agent, but otherwise his effectiveness will be greatly reduced.

3. "Degree to which the program is compatible with client needs."-Once again the emphasis is on meeting the clients' needs not those of the change agency.

4. "Change agent's empathy with client."--Empathy is the ability to view a situation as though you were the other person. Empathy is a significant quality because project development will alter the cultural organization of the local people. If this alteration is pursued while the clients' cultural pattern is ignored, the results may be disastrous.

5. "Change agent's homophily with the client."--Homophily is the degree to which planner attributes are perceived by the peasants to be similar to theirs. As planners exhibit an open mind, an empathic attitude, and a basic respect for the peasant culture, even the problem of perceived differences may be overcome as the perception of a shared humanity is developed. This is especially true in the case of agricultural development. While peasants and planners have differing backgrounds, all agricultural systems are the result of human organization of land, water, and plants, the common purpose of which is the provision of a better way of life. It is at this point that understanding and respect for each other can be developed.

6. "Extent to which agent works through opinion leaders."-Innovation is facilitated by communication between planners and local opinion leaders. An opinion leader is a person who can "influence informally other individuals' attitudes or overt behavior in a desired way with relative frequency (10)." For example, an irrigation farmer in Jordan (interviewed by Keller (6)) demonstrated the validity of this theory when after trying a new trickle irrigation system which proved successful, several of his neighbors planned to follow his lead.

Note, however, that an opinion leader is not always an innovator. An innovator often has a reputation for being a deviant within the community, and therefore, is not in a position to influence other community members. On the other hand, adoption of innovation by opinion leaders sets a pattern for change within the community. Therefore, it is important to differentiate between these two types of people. Some characteristics are a person's status in the community, influence on friends, and willingness to consider and accept new ideas. Identification of community opinion leaders is an important step in project development.

7. "Agent credibility in the eyes of the client."--This means that the agent is perceived as trustworthy and competent by the peasant community.

Since "credibility is a perception of, and not a trait possessed by a communicator (7)," as the planning team develops a program in accord with the above prescriptions, the team will gain credibility in the peasant community and suggestions will be more readily accepted. In addition, researchers (7) have found that credibility is increased when planners incorporate the following factors into their interaction with community members:

a. Demonstrating rather than reporting information and techniques (a hands-on approach);

b. Emphasizing similarities between themselves and the peasants rather than the differences.

c. Taking "risks" in order to build trust among themselves and the peasants (Go ahead--try that soup!);

d. Demonstrating the rewards of the relationship they are trying to build (I will help you if you will help me); and,

e. Developing a comradeship between themselves and the peasants.

8. "Agent's efforts in increasing the client's ability to evaluate innovations."--As the change agent is successful in developing this trait in the peasants, the generation of innovations will occur as a natural process needing only slight prompting from outside the community.

INTERACTION PROCEDURES FOR PROJECT DEVELOPMENT

One possible flow of interaction between the peasant community and project planners is described in the remainder of this paper. This defines a strategy for involving peasants in project development, describes specific procedures for interaction, and suggests some activities. During the first stages of project development, interaction occurs through informal encounters such as those described below.

Informal Encounters

The initial contact between the planning team and the local community occurs when investigation of the local agricultural system has begun. Community support and involvement can be gained at this time by informally communicating with people in the peasant community. The peasants should be encouraged to talk about what they do and why they do it. In addition, planning team members should communicate what they are doing to the peasants. These initial encounters are very important because they set the tone for interaction throughout the project development. The strategy for planner activities during this interaction are represented in Fig. 1.

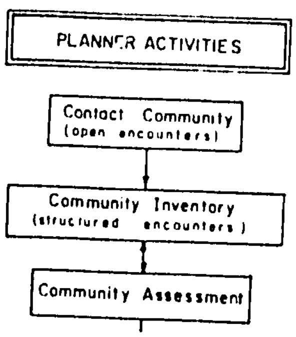

Fig. 1.--Strategy for Communication Activities During Preliminary Investigation.

This informal interaction can occur simultaneously when physical data concerning soil, water, climate, plants, and weeds are being gathered to determine development feasibility. If development is not practical, the investigation can be concluded. Otherwise a more detailed investigation, involving both physical and human elements, follows. Fig. 2 depicts the major events in this first stage of project development.

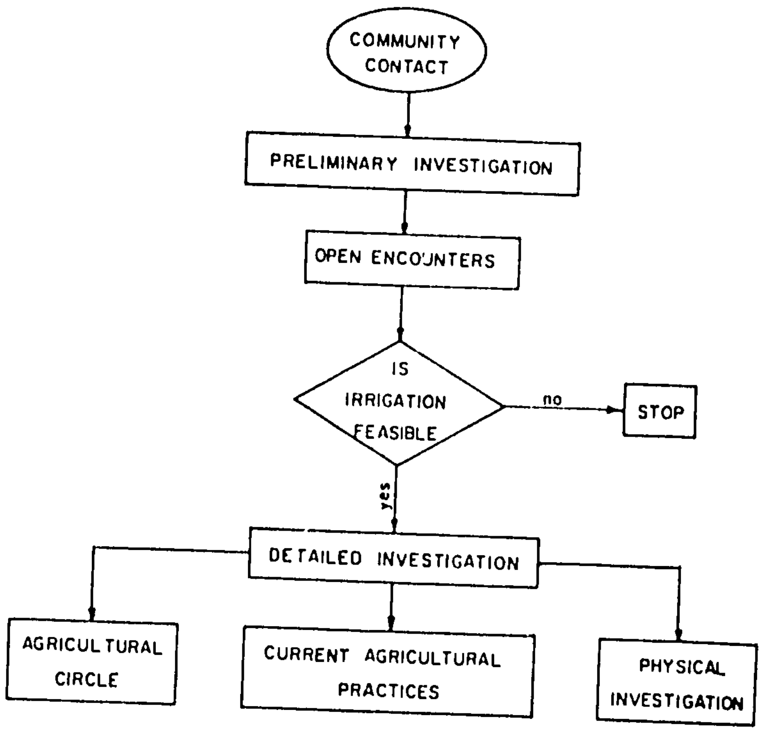

Fig. 2.--Flow Chart of Agricultural Development Events

During physical investigation, analysis of current on-farm practices as well as other activities typically carried out in project planning is required. A method of investigating and evaluating current on-farm practices has been presented by an interdisciplinary group at Colorado State University in a paper by Clyma, Lowdermilk, and Corey, entitled, "A Research-Development Process for Improvement of On-Farm water management (2)." The traditional activities have been set forth in great detail throughout the literature on project development. No further description of either is given here.

On the human level, the investigation may occur during informal encounters or a more formal interviewing procedure may be followed. Planners can also observe the peasants' work habits, patterns of relating to each other, their physical condition, and use of time. These investigations involve planners in both inventory and assessment of the peasant community.

<u>Community inventory</u>. During the initial contacts, a planner may talk with people in the village or go to the fields to talk with the farmers. To direct the conversation to obtain specific information, the planners should carefully organize their approach to obtain the desired information. The following questions, categorized in terms of system preferences, system operation and maintenance, and community impact, are provided to suggest an orientation for productive planner interaction with the peasant community.

1. System preferences questions:

   Do farmers believe water can be made available when they need it? What can be done to deserve this trust?

   Do farmers prefer to work together or separately in various phases of farming--including the purchase of recurrent inputs, farm equipment, cultivation and harvest of crops, and crop marketing?

   Do farmers understand the operational requirements well enough to indicate their actual preferences?

   Do farmers prefer a system where water is delivered periodically or where some water is delivered daily?

   If using surface irrigation, would they prefer gates, siphons, or other means to get the water onto the fields? Are they willing to use a system which requires fields planted in a specific direction?

   If using sprinkle, would they prefer pipes or hoses?

   Which types of systems do they prefer to work with?

   Would farmers accept having field boundaries changed if it would mean something good for them?

2. System operation and maintenance questions:

What is considered to be a reasonable amount of work per day, per season? Are farmers willing to work at night? Are they physically able to adapt to the work?

Are there relevant seasonal alterations in work schedules? When are traditional celebrations held and would community members work then?

What skills are necessary for implementing and maintaining the project? Are they available locally? Can the project be developed in such a way that it requires only the available skills? Are local people interested in working on project construction?

Can a system be developed which farmers can operate and learn new skills? Will local farmers adapt to the use of fertilizers, pesticides, and new conservation practices?

How difficult is it for the community to obtain parts for repair, fuel, etc.?

Are advisors available to local farmers if they encounter problems with the new practices or want to innovate further?

What kind of training programs are needed? How should they be set up?

3. Impact on community questions:

Can farmers help pay for the project or can they only meet their current fund requirements? If they are capable of paying, will they?

How do farmers pay for their goods and services? Is credit available to farmers for recurrent inputs and other small investments?

What would farmers do with a larger income? Would they prefer more free time to more goods, etc.?

Which local institutions would support or subvert innovative irrigation? On what basis is the local power structure developed? How can it be used to promote project acceptance?

Where do farmers go for advice about farming? Can the planners work through these sources? Would farmers listen to new sources?

Would growing an alternative crop disrupt other aspects of community life, such as the secondary use of crop materials for animal fodder, housing materials, fuel, clothing, etc.?

Community assessment. As planners interpret information obtained through the communication process, they will be able to determine what further interaction is needed. For instance, planners may find it helpful to know more about community use of time and patterns of activities since excessive variation from the existing norm will be resisted. Also, by evaluating interaction between community members, planners will be able to decide who can provide certain types of reliable information as well as who should participate in the agricultural circle. These patterns indicate whose agreement is required before various activities will be modified, or in essence, who community opinion leaders are.

The planners must also analyze peasants' evaluating skills in order to determine whether further development is needed before peasants can be involved in project planning. Moreover, the planners will need to use insight gained to evaluate the farmers' expressed intentions. This is significant because the people may be so enthralled with the idea of project development that they overestimate what they can do.

Local attitudes about irrigation must also be assessed. If farmers have a general awareness that irrigation can be advantageous for them, well and good. For example, Keller found that Jordanian farmers were familiar with progressive irrigation and were eager to adopt, and even improve such practices (6). If, however, farmers do not understand the improved irrigation practice nor believe it to be beneficial, the planners will have to engage them in an education process--probably with the use of a local demonstration farm.

If a demonstration farm is necessary, it should be set up as soon as project feasibility is ascertained. The facility can be used to show the benefits of various new practices. There may also be plots where farmers can use the new methods and get a feel for the required work. If at all possible, the demonstration should be done on the farm of a cooperative, respected peasant farmer.

Through their encounters with the peasant community, planning team members can gain credibility with at least some (hopefully influential) community members. Also, the peasants should be motivated to participate in the agricultural circle. If all goes as planned, this motivation will result from trust in planning team members and from some glimmer of awareness that this activity will benefit them. They should clearly perceive that the agricultural circle activities will open new horizons and enable them to be more productive farmers.

The Agricultural Circle

Within the structured context of the agricultural circle, peasant-planner interaction can be directed to specific topics and activities. Agricultural circle activities can be designed to expedite community transformation and provide planners with information required for appropriate design decisions. The planners are responsible for planning and carrying out agricultural circle activities. Concurrently, the planners can be performing the technical analysis which is necessary to plan on-farm irrigation development.

Organizational activities. At this point planner activities will include determining who will participate in the agricultural circle, when and where meetings will be held, and how community members will be encouraged to attend. These activities have been added to the planning strategy and are shown in Fig. 3.

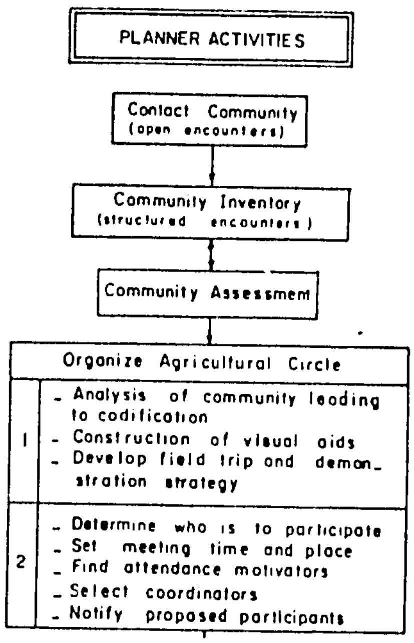

Fig. 3.--Strategy for Communication Activities Through Agricultural Circle Organization

In order to organize the agricultural circle, the team will have to decide on its objectives for the circle. Then an agriculture circle coordinator can be selected. Finally, organizational tasks can be determined and assigned to members of the planning team.

The planning team may decide that only one or two of their members are needed to coordinate the agricultural circle. These coordinators might include one member who is familiar with technical aspects of on-farm irrigation design and management and another who has good communication skills and a rapport with community participants. In addition, the circle may include the entire farm community or consist of representative members. This will depend on the ratio of planners to peasants and the time available for project planning. The planners may find it advisable to have two or three groups if great diversity exists within the community. Members of each group would represent various community factions.

Participation activities. As developed in this paper, participation activities occur in two phases. Phase I emphasizes development of peasant understanding about irrigation. In addition, if necessary, planners should incorporate activities which will encourage the peasants to evaluate their situation and express their concerns in this phase. In Phase II, the agricultural circle activities move into a consideration of the actual project development. This involves consideration of the local situation with direct relation to possibilities for improving it.

Phase I: Peasant development. At this point a separation of planner activities occurs. Some activities are carried out exclusively by the planning staff, while others happen with both planners and members of the peasant community. During the encounter period, there was no such separation because informal interaction can occur rather spontaneously throughout the initial stages of project investigation.

Part of the planners' responsibilities during Phase I is to provide peasant participants with activities which will enable them to critically evaluate their agricultural situation and to understand irrigation. These activities have been added to the interaction strategy as represented in Fig. 4.

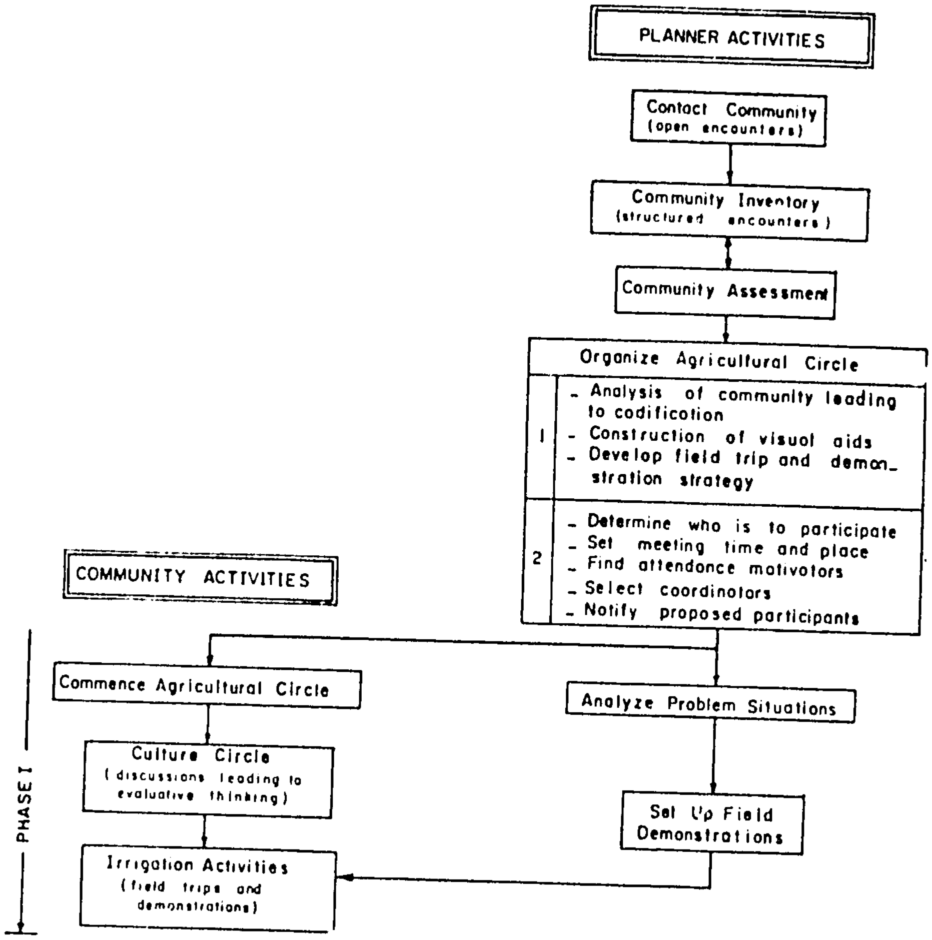

Figure 4. Strategy for Communication Activities through Agricultural circle: Phase I.

Activities which promote this Phase I objective include discussion about everyday agricultural or community situations, hands-on training, question-and-answer group discussions and analysis, role-playing, and formal and informal persuasive communication. The following list indicates specific content and ordering of activities and topics which might occur in Phase I:

1. Discuss everyday agricultural situations and problems; explore their origin and possible solutions.

2. Take field trip to demonstration farm. Show the benefits of irrigation, fertilizer plus irrigation, and of various tillage practices, etc.

3. Discuss irrigation of local farms. Use pictures of local farms, irrigation systems, and systems in typical locations.

4. Discuss local farming practices including irrigation. What is done now, why it is done, and how the farmers think the practices might be improved on the basis of what they have learned in the agricultural circle.

5. Discuss secondary aspects of irrigation or water delivery, monoculture, and fertilization.

6. Discuss and try on-farm water management procedures or when to irrigate, how much to irrigate, and how to irrigate, etc.

Pictures of typical local farm conditions, systems which the farmers have handled, as well as sketches of different systems in appropriate locations can be used to generate the discussion. These discussions should not be highly technical. The purpose of the discussion is to involve the farmer in considering possible alternatives and to produce commitment to the development, not to develop an irrigation expert.

Secondary requirements for developing a more modern agricultural system might also be presented and discussed. Topics may include "new crops, block farming, cooperative farming, the use of new equipment and methods, ... irrigation (scheduling), and other procedures (1)." Agricultural development researchers in Honduras state that when irrigation water is made available for the first time in an area,

> . . . this resource makes the beneficiaries very receptive . . . and other procedures can frequently be initiated at the time that irrigation is introduced. However, once farming and operating procedures have been established, changes are apt to be very difficult to make unless some substantive new factor requiring an overall change is introduced at the same time (1).

The planners may want to postpone these discussions until the project is operational; however, the opportunity to encourage new practices along with irrigation should not be overlooked.

The coordinators must evaluate the activities as they are carried out. (The dynamics of this process are indicated in Fig. 5.) As the coordinators sense that the agricultural circle participants understand the basic ideas and are willing to evaluate them as a group, the circle can move on to Phase II activities.

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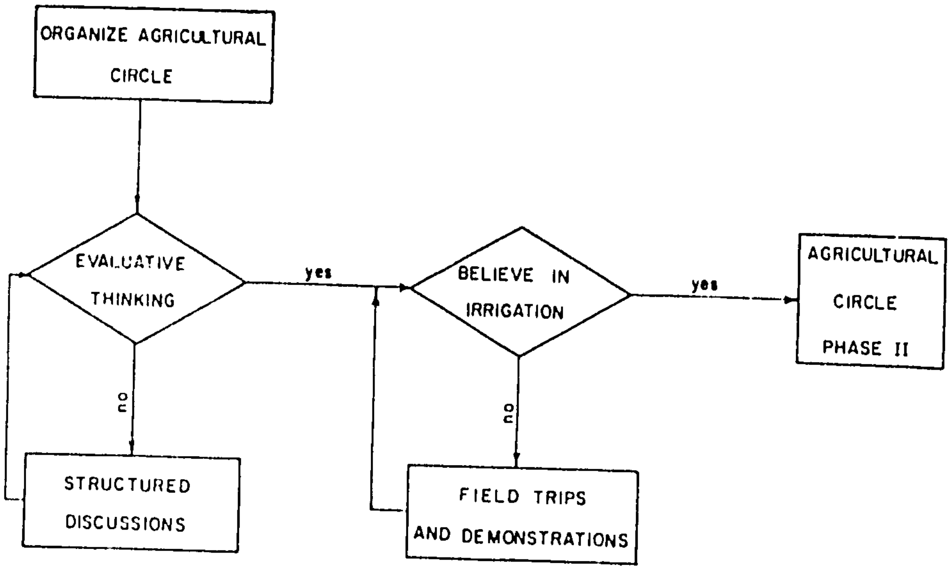

Figure 5. Evaluation Process for Agricultural Circle Coordination

<u>Phase II: Project planning</u> The basic interaction strategy is completed with Phase II of the agricultural circle. (The complete strategy is shown in Fig. 6.) Separation of activities into those which are performed exclusively by the planners and activities which are performed with peasant participants is more pronounced in this phase. It is important, therefore, to note the large information flow between planner activities and community activities. This flow is what promotes the benefits discussed earlier in the paper.

Ideas for the planning strategy presented in this section were derived from a model developed by Ortolano (8) for use in water resource planning. The model is applicable at the regional or community level and focuses on public participation in the planning process.

Ortolano's model consists of a process through which planning a development appropriate for the affected community can be facilitated. The planning process itself consists of four planning activities:

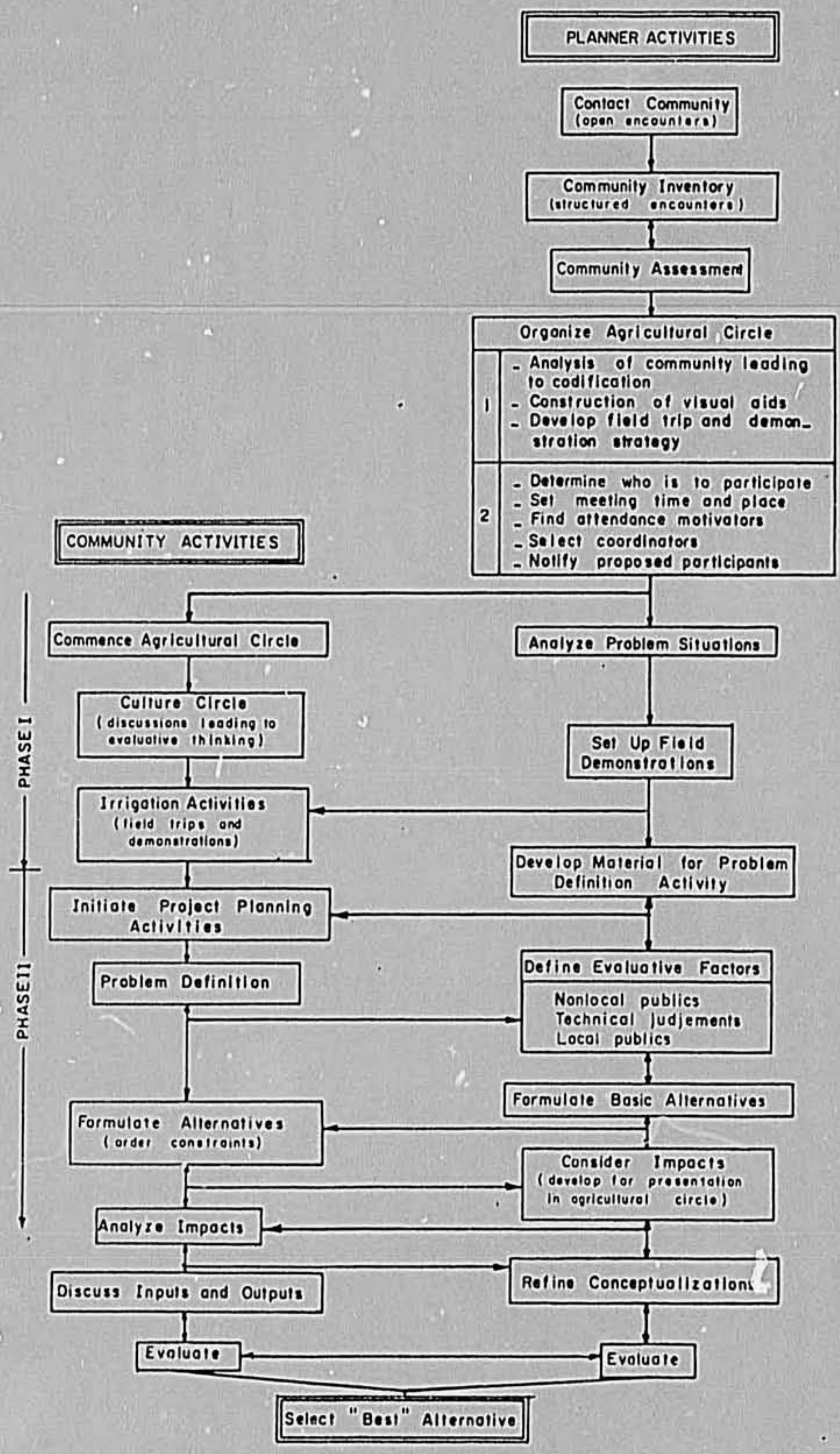

Figure 6. Strategy for Communication Activities During Project Planning.

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problem definition, formulation of alternative plans, impact analysis, and evaluation with considerable information flow between them. While any one activity might be emphasized at a particular phase of the planning process, each activitiy should always be open for reconsideration. As the process continues, the concepts should focus toward a particular plan which will finally be adopted.

PROBLEM DEFINITION

Problem definition consisting of identifying goals, concerns, and constraints which affect project development, must be actively worked on from the inception of the project. These evaluative factors depend on the preferences of nonlocal publics (people indirectly affected by project development) and local publics (those the project will affect directly) as well as on technical and scientific judgments.

It is the planners' responsibility to determine constraints relating to nonlocal publics and to technical judgments. The nonlocal publics' interests can be determined by communicating with relevant government officials or agencies, by communicating with representatives of related interest groups, and by investigating existing laws and regulations. Technical judgments can be made on the basis of planner training and experience.

The planners should determine and analyze the nonlocal and technical factors by the time the agricultural circle is ready to move into Phase II. Also, by this time planners will have encountered many of the goals and constraints present within the local community through prior interaction with the peasants.

Using this information, planners can develop a presentation for the agricultural circle providing local participants with an understanding of the planners' analysis. This presentation will provide a take-off point for discussion.

On the basis of the understanding pertaining to irrigation gained during Phase I, diverse opinions about the local situation and its solution should emerge. Excitement will likely occur as new possibilities become apparent. <u>If the process assumes the form of the coordinators presenting an idea and the peasant participants simply going along with it, there is something wrong</u>. This is a place for peasant expression of concerns and needs, not for planner proclamation of what is going to happen.

FORMULATION OF ALTERNATIVES

On the basis of goals and constraints encountered throughout problem definition activity, the planners will be able to start conceptualizing technical alternatives for improving local agricultural production. To do this, planners must "translate concerns, needs, etc. of the affected publics into technical concepts and parameters that are operational (8)."

Once these alternatives are delineated, the planners can go back to the agricultural circle and explore the response to their ideas. Here the planners should be open to the peasant's opinions. The agricultural circle members may even suggest alternatives or pieces of an alternative the planners had missed.

IMPACT ANALYSIS

As alternatives are generated, planners can use technical judgment and models to forecast and describe probable impacts. In the agricultural circle, the consideration of impacts should focus more on the changes which will be required in local agricultural practices and agricultural consumption patterns than on the system's physical requirements. The analysis of physical impacts is the responsibility of technical experts on the team.

Like all other activities in this process, impact analysis occurs repeatedly. Early in the planning when goals are roughly defined, limiting alternatives and impacts are considered. This information allows the "publics and other decision makers to: think through their own perceptions of the problem (i.e., refine some of the evaluative factors), make their own judgments concerning preferences for different alternatives, and suggest new alternative actions (31)." As the process evolves, the issues become clearer and available alternatives are fewer and more completely defined.

Topical considerations may include how a system can be modified to better suit farmer operations or how farmer activities will have to change to fit the system. No matter what the topic, however, the peasants should be offering opinions about how the new practices will affect their way of life.

Consideration of alternatives and impact analysis will probably create controversy and conflict. Coalitions may even form to support various alternatives. Meanwhile, the planners can begin evaluating the available development alternatives by categorizing the concerns and ideas arising from the discussions.

EVALUATION

Evaluation occurs whenever preferences are expressed. When the evaluation activity is emphasized, previously expressed values and the corresponding alternatives and impacts can be organized and ranked in terms of participant preferences.

One possibility for preference ordering is in terms of known priorities and constraints. For on-farm irrigation development, the order might be in terms of: physical resources and constraints, motivations for and resistances against changing agricultural practices and institutions, and motivations for and resistances against changing agricultural consumption patterns. Tables 1 to 3, which are suggestive rather than exhaustive, indicate such an ordering of a hypothetical set of resource-constraint, motivation-resistance considerations.

Evaluation activities in the agricultural circle require the peasants to analyze development alternatives on the basis of impacts they have discussed. Having the peasants express their opinions about irrigation and other relevant farm practices also allows them to clarify their preferences. Furthermore, it is during this kind of interaction that conflicting interests can be resolved.

Fisher states that group interaction during problem resolution

> . . . is a curious blend of persuasion, compromise, negotiation, argumentation, flexibility, and firmness of opinions. Issues are thrown into the hopper of group interaction and compromise the raw materials for the group's final consensus decision (3).

He further delineates four distinct phases describing this interaction. In the orientation phase, participants spend time getting acquainted. Attempts are made to clarify issues, opinions are tentatively expressed, and decision alternatives are generated. Next a conflict phase ensues in which dissent, controversy, social conflict, and innovative deviance predominate. Participants discuss many alternatives and form coalitions to support various points of view. The next

TABLE 1.--Ordering of Physical Resources and Constraints

SYSTEM (1)	RESOURCES (2)	CONSTRAINTS (3)
All Systems	(1) Good water supply available (2) Crops respond to irrigation (3) Crops can be grown in rainy and dry seasons (4) Water can be pumped or diverted from river (5) Aggregates are available for concrete (6) Immediate drainage problems do not exist (7) Soil is fertile and has good texture (8) Chemicals are available for fertilizers and pesticides	(1) Little electric energy is available (2) Petroleum must be imported (3) Limited climate data is available (4) Good dam sites are far from project area (5) Cement has to be imported
Surface (all)	(1) Land can be leveled (2) Material is available to line ditches (3) Concrete can be constructed locally	(1) Canals and ditches have to be lined (2) Small farms require many ditches (3) Fields are irregular
Furrow	(1) Crops are grown in short rows	
Sprinkle (all)	(1) Concrete pipe can be constructed locally	(1) Pipe must withstand adequate pressure (2) Energy for pumping is scarce (3) Sprinklers must be imported
Aluminum Pipe		(1) Metal pipe must be imported (2) Rigid pipe is not adaptable to irregular size and shape
Plastic Hose	(1) Local materials can be used to construct plastic hose in country (2) System is adaptable to small farms and irregular fields	

TABLE 2.--Ordering of Motivations for and Resistances Against Changing Agricultural Practices and Institutions

SYSTEM (1)	MOTIVATIONS (2)	RESISTANCES (3)
All Systems	(1) Local economy will improve (2) Farmers can remain in community (3) Community leaders support development (4) Villagers will own their farms (5) Work is generated in other sectors (6) Farmers trust planners (7) Production variation will be reduced (8) Production will increase (9) Control of pests and disease will improve (10) Government is going to assist	(1) New works habits are needed (2) New tools must be used (3) Use of system will cost more (4) Use of time will be changed (5) New materials must be used (6) Water delivery may be unreliable (7) New cropping programme is needed (8) More inputs and risks are required (9) Farmers are not sure systems will work (10) Extra labor may be needed
Surface		
Furrow	(1) Irrigation required only once a week (2) System is easy to maintain	(1) Day of irrigation requires hard work (2) Land must be leveled (3) Cooperation in scheduling is required (4) Physical maintenance is required
Sprinkle (all)	(1) Some irrigation is done each day (2) No night attention required (3) Method seems easy to learn	(1) Irrigation should be continuous for economy (2) Access to parts is difficult (3) Water must be pumped so costs more (4) Mechanical maintenance is required
Aluminum Pipe		(1) All sprinklers on line must be watched (2) Farmers do not like moving pipes (3) Nozzles probably won't be repaired
Plastic Hose	(1) Hoses can be constructed locally (2) System works under low pressure (3) Practice seems easy (4) Only one nozzle per hose so may repair	(1) Farmers think hoses may not last

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TABLE 3.--Ordering of Motivations for and Resistances Against Changing Agricultural Consumption Patterns

SYSTEM (1)	MOTIVATIONS (2)	RESISTANCES (3)
All Systems	(1) Diet will not have to change (2) Traditional crops can be grown (3) Large market is available (4) New local industries can be established (5) More food will be available (6) More goods available for consumption (7) New systems will be subsidized	(1) Crops must be marketed outside village (2) New storage facilities will be needed (3) Crop must be transported to market (4) Seeds must be bought (5) Transportation system is not good
Surface		
Furrow		(1) Cement must be purchased
Sprinkle (all)		(1) Energy is needed for pumping (2) Pumps must be purchased and maintained (3) Sprinklers must be purchased
Aluminum Pipe		(1) Metal pipes must be purchased (2) Conveyance pipe for high pressure system must be purchased
Plastic Hose	(1) Hose can be produced locally (2) Low pressure concrete pipe for conveyance can be produced locally	

phase, emergence, is characterized by the dissipation of social conflict and dissent. Ambiguity toward various decision proposals recurs, thereby allowing those who dissented from a particular alternative to change their position. During this phase the decision emerges. Finally, in the reinforcement phase, consensus is achieved. There is no further testing of ideas and the opinions expressed are predominantly favorable toward the proposal and toward the opinions expressed by other participants. This phase is pervaded by a spirit of unity and results in commitment to the proposals which were previously the subject of conflict and from which the decision emerged.

Through compromise and elimination, the participants can settle on a satisfactory plan of irrigation development. Then planning team engineers can design a system which will fit the expressed preferences given the existing constraints, i.e., SELECT "BEST" ALTERNATIVE.

Although researchers point out that the group decision making process seems to take an excessive amount of time, they conclude that this is only true during the beginning stages (3). When the background has been laid, the process speeds up and the resulting decision is often of higher quality than an unilateral solution would have been. An added benefit is that group members are committed to effecting the emergent decision. When this group includes opinion leaders of the farm community, this commitment can hasten adoption of the proposed innovation throughout the community. Moreover, this interaction allows for personal growth and increased understanding of the proposed development.

SUMMARY AND RECOMMENDATIONS

An approach to irrigation project planning involving more social input has been developed. This plan follows much of the traditional planning approach, however, a strong human component has been incorporated. The approach is as follows.

An interdisciplinary planning staff can be organized to investigate the proposed project area. If project development proves physically feasible, this staff can pursue investigation of current on-farm practices and a more detailed physical investigation. In addition, a team can be formed from members of the staff to interact with the local people. The initial focus of this team will be to determine human constraints on project development.

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This process of constraint determination is based on both informal and structured interaction between the planners and peasants. In order to achieve maximum benefit from this interaction, the planning team should determine who the local opinion leaders are. The team also needs to decide how to involve the leaders in the planning and development process. Hopefully, such information can be obtained during informal interaction with local farmers and other community members. The planners should also interact with people knowledgeable about local farm practices and constraints.

Once the planners have decided which local people to involve, an agricultural circle can be organized. The purpose of this circle is to provide a setting where peasants can learn about irrigation practices and discuss project development potentials. In addition, it can function as a feedback channel through which planners can obtain some insight into community members' feelings, what their reaction to development might be, and how this response might be altered.

Having local people participate in the circle increases the likelihood that a core of individuals committed to development will be formed. Their increased technical know-how and their understanding of how development can improve local conditions will enable them to encourage adoption of the new practices. They will also be able to show their neighbors "how to do it." If some participants are local opinion leaders, their support will be even more beneficial.

Through this process, the socio-psychological space of the participants may also be altered. Such alteration will reflect out into the community and, in doing so, change other individuals. Thus, through this development process, there is greater possibility that community transformation will be initiated. This can lead to quicker acceptance and, consequently, more timely social benefits and economic operation of the project.

Appendix B.

FARM IRRIGATION SYSTEM EVALUATION:

A GUIDE FOR MANAGEMENT

by

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PREFACE

Widespread interest in <u>Irrigation System Evaluation and Improvement</u>, by J. L. Merriam as a guide to better irrigation practice has been encouraging. It has been used by irrigators, land managers, technicians, and students who have had varied experience in irrigation. Some found the explanations excessively detailed, but others expressed the wish to see more advanced information published. This new text, which incorporates much of the earlier material, has been written to promote wider use of the evaluation techniques and the suggestions for better practices in irrigation management.

Professor John L. Merriam of the Agricultural Engineering Department at California Polytechnic State University has been largely responsible for reorganizing and expanding the surface irrigation concepts by including basin and basin-check irrigation, simplified techniques for use with furrow and border methods, and more explanation of standard procedure and management practices.

Dr. Jack Keller, who is Professor of Irrigation Engineering at Utah State University, has had the major responsibility for the sprinkle and trickle irrigation sections. The information about sprinkle irrigation has been expanded by including descriptions and discussions of the many variations of sprinkle systems which include sprinkler-lateral, perforated pipe, orchard sprinkler, traveling sprinkler, center pivot, and gun sprinkler systems. The book has been further enhanced by additional new information about trickle (drip) systems.

Together the authors have almost 75 years of combined design, field and teaching experience in irrigation engineering. During their many years of practical field irrigation engineering experiences, they have had direct field involvement with all of the evaluation techniques and management practices discussed.

To avoid confusion with certain similar but more general terms, three important terms used frequently in the earlier text have been renamed. Irrigation System Efficiency is now called *Potential Application Efficiency of the Low Quarter;* Actual Application Efficiency is now called *Application Efficiency of the Low Quarter;* and Distribution Efficiency has been changed to *Distribution Uniformity*.

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