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**PART III**

**OPTIMUM UTILIZATION OF WATER RESOURCES:  
WITH SPECIAL EMPHASIS ON WATER DELIVERY AND  
REMOVAL SYSTEMS AND RELEVANT INSTITUTIONAL  
DEVELOPMENT**

**23 May 1969 - 23 May 1970**

**by**

**Colorado State University**

**Colorado State University**

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## SUMMARY

A grant was awarded Colorado State University (CSU) on May 23, 1969 by the Agency for International Development (AID) pursuant to the authority contained in Section 211 (d) of the Foreign Assistance Act of 1961, as amended. The purpose of the grant is to implement the project "Optimum Utilization of Water Resources, With Special Emphasis on Water Delivery and Removal Systems and Relevant Institutional Development." The grant funds are \$750,000 and are to be utilized over a five year period. This report covers the first year of the grant.

There have been several additions of individuals having experience in water resources to the CSU professional staff since the grant began in May 1969. Mr. Wynn R. Walker joined the Agricultural Engineering Department staff in July 1969. Dr. A. Klute and Dr. Bashir Malik from the Atomic Energy Agricultural Research Center in West Pakistan joined the staff of the Agronomy Department. Dr. Malik will be a visiting professor for one year. Mr. H. P. Caulfield joined the staff of the Political Science Department in September 1969, and Dr. Garth N. Jones and Dr. Norman Wengert joined the Political Science Department staff during the Summer of 1970. Mr. L. Scott Tucker joined the Civil Engineering Department and will assist Dr. Maurice L. Albertson in administering the grant funds.

During 1969-70, ten graduate students were supported to various extents by grant funds. This number will be expanded to thirteen graduate students fully supported by grant funds in 1970-71.

Grant funds directly supported research on "Combination Check-Drop-Energy Dissipators," in the Agricultural Engineering Department during 1969-70. This research will be continued in 1970-71. A proposal was submitted to AID by Utah State University (USU) for "Irrigation Distribution and Measurement Structures for South and Central American Countries," jointly written by L. H. Austin of USU and G. V. Skogerboe of the CSU Agricultural Engineering Department. The research will be conducted on a cooperative basis. The Agricultural Engineering Department will begin research on cut-throat flow measuring flumes and on small water management structures for irrigation distribution systems.

Research will begin in the Fall of 1970 in the Agronomy Department on soil moisture. Research was started in the Civil Engineering

Department on "Optimal Timing of Irrigation Water," by Professor G. L. Smith, Professor M. L. Albertson, and graduate students. Research funded by the grant was conducted by the Political Science Department on comparative successes of American Indians and Caucasian farmers as related to irrigation agriculture. A graduate student in the Political Science Department will examine political aspects of watershed management in Uruguay in 1970-71.

The grant was responsible, either directly or indirectly, for the expansion of course offerings related to the less-developed countries in several departments. Agricultural Engineering added AE455, Irrigation Structures, as a direct result of grant support. The course will be offered for the first time Winter Quarter 1971. Another new course, AE752, Farm Irrigation Systems, has also been added. Professor G. L. Smith of the Civil Engineering Department taught CE795, a special studies graduate course on water resource systems, during the Winter Quarter 1970. The course was initially developed by grant funds. A new course, EC464, Institutions and Economic Development, will be developed with grant funds by the Economics Department in 1970-71. A concentration of courses will be developed during 1970-71 in Public Administration by Professor G. N. Jones of the Political Science Department. Funds allocated from the grant enabled the Sociology Department to expand its curriculum offerings in the area of developmental change in two courses, S740, Comparative Family Institutions, and S460, Social and Cultural Factors in Technological Change. A new Seminar, S747, Industrialization and Urbanization in the Third World, supported by grant funds, will be offered during Fall Quarter 1970 by the Sociology Department.

An International Interdisciplinary Seminar in water resources management was held weekly for two hours during the 1969-70 academic year under the chairmanship of Professor Henry P. Caulfield of the Political Science Department. Faculty members from the following departments assisted in developing the seminar: 1) Agricultural Engineering, 2) Civil Engineering, 3) Agronomy, 4) Economics, 5) Fishery and Wildlife Biology, 6) History, 7) Political Science, 8) Range Science, 9) Recreation and Watershed Resources, and 10) Sociology. During the 1969 Fall Quarter the seminar was limited to faculty members in these departments, but the seminar was later opened to all interested graduate students in addition to the faculty.

A brochure was developed and distributed to approximately 90,000 persons to recruit highly qualified students interested in pursuing graduate study in disciplines associated with water resource management in developing countries. The brochure described the multidisciplinary international education and research program in water management resources at CSU. The brochure not only assisted in locating students for grant supported activities, but also located other students interested in water and the developing countries.

Approximately 750 publications were added to the water management program library during 1969-70. Most of these publications were purchased with grant funds, but many were donated by faculty returning from projects overseas. Approximately two people per week (faculty and students) check out material, and approximately 20 per cent of the publications are in use at one time.

Six international trips were partially or completely funded by the grant. These include a trip to Pakistan by Professor D. M. Freeman; Iran and Pakistan by Professor W. R. Schmehl; Philippines, Thailand, India, and Pakistan by Professor V. Yevjevich; Pakistan by Professor D. B. Simons; Pakistan by Professor E. V. Richardson; and Japan, Pakistan, Thailand, and Iran by Professor M. L. Albertson. A trip to the Lower Balsas River Basin in Mexico by Professors H. H. Biggs and J. O. Reuss and eight graduate students was partially supported by grant funds. The grant also supported travel costs for several faculty members to attend conferences and meetings in the U. S. Much of the travel, both abroad and in the U. S., was directed at establishing lines of communication and interaction with other persons interested in water resources in developing countries.



## INTRODUCTION

### Program Objectives

The objective of this program, supported by a grant from the U. S. Agency for International Development (AID), is to strengthen the already existing competence of Colorado State University (CSU) in water delivery and removal systems and in development of institutions which are relevant to the various aspects of optimum utilization of water resources. The project is coordinated with similar projects at the University of Arizona and Utah State University through the Council of U. S. Universities for Soil and Water Development in Arid and Sub-Humid areas (CUSUSWASH or Council).

The competence of CSU in water removal and delivery systems and in development of institutions relevant to various aspects of optimum utilization of water resources exists in several departments whose staff members constitute the basic capability and interest. The grant has been used and will continue to be used to expand both the depth and breadth of this capability in its application to the less developed countries (LDC's). Specifically, the grant has been used and will continue to be used to support the salary of staff members and graduate students, and their travel and other expenses related to these activities.

### Land Grant Background

Shortly after the Land Grant Act was signed by President Lincoln, the Land Grant College for Colorado was created in Fort Collins to work with the people in the rural areas through its extension service programs, and to provide higher education for the common man. The Colorado Agricultural Experiment Station was also created at Fort Collins as an integral part of the college to conduct research and experiments on problems confronting the farmer. Colorado State University thus has a long-standing interest in and commitment to the problems of

development -- particularly in arid agricultural areas where water resources are in short supply or not yet fully developed.

This very practical beginning for what is now Colorado State University has continued to be the central theme, a strong program in research, education, and service. The primary aspect of this program is in water resources development, including agriculture, engineering, watershed management, geology, and various aspects of biological and social sciences. There is now well over 100 faculty and more than 300 graduate students from both the United States and abroad that are involved in various water resource programs of research and education in the various departments of Colorado State University.

With the funds from the grant, CSU has been improving its level of excellence with respect to planning, development, management, and utilization of water resources. This has been accomplished through the following steps:

1. Expansion of number and competence of professional staff in the various departments of the University which are involved in water resources activities related to the needs of the LDC's.
2. Expansion of the number of graduate students in these departments from, or interested in, the LDC's.
3. Expansion of departmental research programs and activities related to the needs of the LDC's.
4. Expansion of course offerings in these departments -- including interdisciplinary courses -- which are related to the LDC's.
5. Expansion of special activities in the United States and abroad which are related to research, teaching, and service -- e. g., seminars, exchange programs, institutes, conferences, and publications which are concerned with the LDC's.
6. Help to alleviate the critical shortage of qualified professional personnel with international interests,

experience, and expertise, and with cross-cultural insights.

7. Expansion of the capability to serve in advisory and consulting capacity to various individuals, government agencies, industries, business, and other organizations who have an interest in activities abroad.
8. Improvement of the understanding of the nature of the less developed societies, and determination of ways and means of assisting them to resolve crucial problems relating to water resources development and management.
9. Development of an exchange of personnel and publications, and other programs of interaction, which will help to establish steady and effective lines of communication between Colorado State University and the LDC's.

Subject areas of specialization that have been enhanced as related to the needs of the developing countries include the following:

1. Development of water supplies from various sources.
2. Conveyance, delivery, and drainage of water in open and closed conduits, including rivers, canals, irrigation ditches, tunnels, and pipelines.
3. Storage and use of water in reservoirs, both above and below ground.
4. Control and measurement of water in storage, and water being conveyed either for delivery or for drainage.
5. Control of erosion and sedimentation with respect to storage.
6. Use of wells as a source of water or for storage of water underground.
7. Use of systems engineering for development of optimum solutions to problems of water resources utilization.
8. Understanding social, economic, political, and cultural factors in technological change, and the processes of developmental change.

9. Analysis of prevailing social systems, their structural-functional characteristics within specific LDC's to determine:
  - a. The kinds of structural changes necessary for maximizing water resource development and management, including the use of necessary new inputs.
  - b. The sources of resistance to these necessary changes, and
  - c. Effective ways of dealing with social resistance.
10. To analyze specific organizational and administrative structures for agricultural development in specific LDC's to determine needed changes for better water utilization in maximizing agricultural production.
11. To conduct economic analyses, including input response studies, and including the analysis of delivery and removal systems, to achieve efficient and economic allocation of water for agricultural purposes in selected areas of the LDC's.
12. By use of systems analysis, develop case studies analyzing and documenting the above relationships in selected areas of the LDC's for instructional research, and training purposes in a multidisciplinary setting.

An operational plan was developed to use as a guide in managing the grant funds. The broad aspects of the plan are as follows:

1. Assemble and analyze existing information on water delivery and removal systems related to the LDC's.
2. Assemble and analyze existing information on development of institutions relevant to optimum utilization of water resources in the LDC's.
3. Prepare plans for additional research programs which will increase the knowledge of methods, techniques, and procedures for optimizing the utilization of water

resources in the LDC's.

4. Increase the breadth and depth of teaching and educational materials for the subjects of this program and for the situations in various LDC's.
5. Solicit especially well qualified graduate research assistants, from both the United States and the LDC's, who expect to work in some aspect of international development upon completion of their training.
6. Expand the library collection, especially with respect to the problems of the LDC's.
7. Develop a program of student and faculty exchange with certain LDC's.
8. Plan, initiate, and expand an interdisciplinary seminar on development and the interrelationship of the many factors involved in development -- especially in the LDC's.
9. Conduct short courses, institutes, seminars, and other activities to stimulate other personnel to become more deeply and actively involved, and to help in continuing education for those already involved in various aspects of international development.

The first year of the program was devoted to "tooling up" and getting the program underway. Some of the activities included the following: an interdisciplinary seminar on water resources was organized and conducted on a weekly basis; a brochure was prepared and distributed to locate qualified graduate students; students were supported through graduate research assistantships; faculty members were supported to direct students, develop research proposals and projects, and develop new course work; faculty members visited LDC's to increase their awareness and understanding; faculty members attended professional meetings and conferences in the U. S. ; and significant additions were made to the library. The direction of these activities was guided by the general objective of the grant, namely to increase the competence of CSU in water delivery and removal systems and in the

various aspects of optimum utilization of water resources.

The above activities are discussed in detail in the remainder of this report. Sections are included on the following:

Departmental Activities, Accomplishments, and Plans; International Interdisciplinary Seminar in Water Resources Management; Publications and the WATREMAN Brochure and Response; Complementary Activities Supported by Other Funds; Travel Report; Expenditures; and People Available for Consulting.

Appendix B, Volume 2 includes the following sections:

Section I, Final Proposal; Section II, Some Biodata Indicating CSU Consulting Competence; and Section III, Publications Added to Library During 1969-1970 Fiscal Year.

## DEPARTMENTAL ACTIVITIES, ACCOMPLISHMENTS, AND PLANS

The objectives of the grant (to increase the competence of CSU with regard to teaching, research, and consulting in the area of water resources related to LDC's) are accomplished through the following six departments:

1. Agricultural Engineering
2. Agronomy
3. Civil Engineering
4. Economics
5. Political Science
6. Sociology

Each department developed a program and requested funds to pursue their program. The accomplishments of each department during 1969 and 1970, the relationship of accomplishments to grant objectives, and planned work for 1970 and 1971 are discussed in this section. Funds are administered and allocated through the Program Director, Professor M. L. Albertson, to insure coordination and compliance with grant objectives.

### Agricultural Engineering

Accomplishments to Date, FY 1969-70: To date, the primary research emphasis as a part of delivery of water at Colorado State University in the Agricultural Engineering Department has been with respect to "Combination Check-Drop-Energy Dissipators. The work on these types of structures is being pursued by Miss Venus T. Somoray, a M.S. student in Agricultural Engineering under the supervision of Professor G. V. Skogerboe. Miss Somoray has completed two interim reports regarding problems involved in the design of check-drop-energy dissipators. Miss Somoray, who is from the Philippines, has a Graduate Research Assistantship (GRA) funded by the grant which will continue until October 1970. A paper will be presented at the annual winter meeting of the American Society of Agricultural Engineers in

Chicago in December 1970.

A proposal, "Irrigation Distribution and Measurement Structures for South and Central American Countries," was submitted to AID by Utah State University (USU). The proposal was written by Messrs. Lloyd H. Austin of USU and G. V. Skogerboe of CSU. The proposal would have Mr. Austin located in South America during fiscal years 1971 and 1972. Part of his assignment would be the field evaluation of various irrigation structures. A cooperative effort between CSU and USU would be developed which would consist of laboratory research at CSU with field performance evaluations being conducted by USU in South America. The field evaluations could be easily extended to other LDC's such as Pakistan.

Two other graduate students, Mr. Tsu-Yang Wu and Mr. Va-Son Boonkird will undertake M. S. theses on topics in irrigation structures for water delivery and removal. Both students are AID participants programmed through the U. S. Department of Agriculture, and are not supported by grant funds. In each case, the student will be generating data which are needed to fill present gaps in design information with specific application to the LDC's. The results of the laboratory data will provide the necessary background information for conducting field evaluations.

Relationship of Accomplishments to Project Objectives: The research project, "Irrigation Distribution System Structures," initiated by the Department with support of grant funds, has allowed the Principal Investigator, Professor G. V. Skogerboe, who had little previous experience with irrigation in the LDC's, to develop a knowledge of irrigation practices in Pakistan, South-east Asia, South America, and Central America.

As a direct result of grant support, a new course, AE455, Irrigation Structures, has been approved and will be offered for the first time during Winter Quarter, 1971. The course will be taught by Professor Skogerboe and will have both a foreign and U. S. emphasis. Another new course, AE752, Farm Irrigation,

Systems, will also be initiated due to the increase in staff with expertise in irrigation and drainage. Professor D. L. Miles will teach AE752.

A number of personnel in the Agricultural Engineering Department attended the weekly International Interdisciplinary Seminar. The department will initiate a Graduate Seminar next school year which will allow graduate students participating in the grant and other AID programs to present and disseminate the results of their research efforts. The interest of faculty in the water problems of the LDC's has noticeably increased due to seminars and projects funded by the grant.

The Agricultural Engineering Department conducted an "Irrigation Practices Training Course" for the first time during the period 8 June through August 1970. This course was funded by other AID funds and was attended by 14 foreign engineers from Turkey, India, and Thailand. The course will probably be continued next summer.

Planned Work for FY 1970-71: Miss Somoray's GRA will be continued under AID 211 (d) support until October 1970. A GRA has been offered to a student, Mr. Ray S. Bennett, presently at Utah State University. This student began his graduate work July 1, 1970. His thesis is concerned with cutthroat flow measuring flumes which have special application to the LDC's where convenient, simple, and low cost water management devices are urgently needed to develop better water management. The results will be published in both British and metric units and will be printed in both the English and Spanish languages. He will be supported by grant funds.

Another M. S. student, Mr. James H. Barrett from Australia, will begin graduate work in September 1970. He will be supported by grant funds and will undertake one of the research topics listed in the report, "Analysis of Small Water Management Structures in Irrigation Distribution Systems," by G. V. Skogerboe and W. R. Walker.

Professor Skogerboe contemplates two trips during fiscal year 1971. One trip would be made to South and Central America, at which time some of the field evaluation work cited in the Utah State University proposal would be initiated. The other trip would cover Pakistan and possibly portions of Southeast Asia to determine the types of irrigation structures, along with available design information, used in this portion of the world. The trip to South and Central America would also entail the development of this same type of information.

Mr. Wynn R. Walker joined the staff of the Agricultural Engineering Department in July 1970. Mr. Walker is one of the co-authors, along with Professor Skogerboe, of the report, "Analysis of Small Water Management Structures and Irrigation Distribution Systems." Thus, Mr. Walker will be able to effectively participate in the project, "Irrigation Distribution System Structures."

#### Agronomy

Accomplishments to Date, FY 1969-70: Dr. John Reuss represented the Department of Agronomy on the committee that developed and planned the International Interdisciplinary Seminar directed by Professor Henry P. Caulfield. He participated in program planning and in the seminar from September 1969 through May 1970.

Dr. Bashir Malik visited the CSU campus in March 1970 and participated in seminars of international scope. He was also available for individual consultation on water management and related problems in West Pakistan. Dr. Malik is on leave as a soil scientist at the Atomic Energy Agricultural Research Center in Tandojam, West Pakistan. Dr. Malik's visit was supported by funds other than the grant funds.

Dr. W. R. Schmehl traveled to Iran and Pakistan in September 1969. His trip was supported by grant funds and the purpose of the travel is discussed in more detail in the "Travel Report."

Relationship of Accomplishments to Project Objectives: The seminar and the visit by Dr. Malik have provided a better understanding of the technical as well as social and political problems of developing countries. This has increased the interest and capability of the staff to serve in advisory or consulting capacities on foreign programs. These activities have also increased the capability of the teaching staff to present and discuss problems of food production in LDC's with both undergraduate and graduate students.

Planned Work for FY 1970-71: Dr. John Reuss will continue to serve on the International Interdisciplinary Seminar Committee.

Increased emphasis will be made to provide new training and education experiences for the Agronomy Staff in International Development. Dr. Malik, from West Pakistan, will be at CSU for post doctoral study and will be assigned to participate in the International Interdisciplinary Seminar. He will also assist in developing seminars of international scope for both undergraduate and graduate students in the Agronomy Department, and will be available for committee work on CSU International Program planning, for individual consultation, and for lectures on selected topics. Dr. Malik will not be supported by grant funds.

A Ph. D. cooperative training program with the Ministry of Agriculture of Iran is being planned. A student from Iran, Mr. M. Monadjemi, will complete his training in academic courses and in research techniques at CSU during April 1971. After completing his preliminary examination he will return to his position in the Ministry of Agriculture to conduct research of mutual interest to Iran and CSU (research will probably be related to sugar beet production in southern Iran). Progress during the research will be reviewed from time to time by CSU Staff in route to the AID-CSU Water Management Research Project in West Pakistan. A dissertation will be written from the research and following a successful exam in Iran, the Ph. D. degree will be granted by CSU. Mr. Monadjemi is not supported by grant funds.

A GRA will also be awarded to a student yet to be selected. He will study under Professor A. Klute and will be involved in soil moisture research.

### Civil Engineering

Accomplishments to Date, FY 1969-70: During the 1969-70 fiscal year, the Department of Civil Engineering made accomplishments in the following areas:

1. Active participation in the interdisciplinary seminar
2. Development of additional courses and a new program in the Civil Engineering Department
3. Planning for future special institutes
4. Preparation, planning, and undertaking of international travel
5. Active participation in preparing WATREMAN brochure
6. Support of graduate students

Professor G. L. Smith developed, with Professor M. L. Albertson, an outline for an improved Water Resource Systems Engineering Program in the Department of Civil Engineering. This program involves, to a very large extent, the problem of water development in arid and sub-humid regions and stresses the international dimension. Professor Smith attended a two-week intensive course on water resource systems at UCLA from August 18 through September 1, 1969 to provide him additional background for developing the program.

In addition, Professor Smith developed and taught CE795, a special studies graduate course on water resource systems, during the 1970 Winter Quarter. Twelve students were officially registered for the course, and up to 18 were usually in attendance. The CE795 course was refined by Professor Smith and submitted to the Civil Engineering Department for acceptance as a scheduled course. The course was accepted and will be taught as CE545. This course was not supported by grant funds, but was a direct outgrowth of previous efforts by Professor Smith, which were

supported by grant funds.

As an additional outgrowth of grant seed money, Professor Smith is developing a special studies course in Water Resources Engineering for Colorado SURGE, a CSU program providing graduate-level education through video tape. This course is very similar to CE545, and is designed to acquaint students with the fundamental concepts and definitions involved in water resource systems engineering.

Professor Smith was also partially supported by grant funds to develop research dealing with optimal application and timing of irrigation water. He wrote an unpublished report on "Optimal Timing of Irrigation Water," using work by Warren Hall of the University of California, Riverside. He used corn as a crop example, but it is intended that this concept will eventually be applied to research in Pakistan. Mr. Yasumi Yamaguchi's M. S. thesis was on this topic, and Professor Smith contributed to the development of the thesis.

Professor Smith was also involved with Professors Albertson and Caulfield on development of a brochure on a Multidisciplinary International Educational and Research Program in Water Resources Management (WATREMAN). His efforts with the WATREMAN brochure were supported by grant funds.

Another Civil Engineering course, CE745, Water Resource Systems Engineering, taught by Professor Albertson, was also improved and refined due to grant support. Assistance was provided through grant funds for help from G. L. Smith, Warren Hall, Richard Males, and others.

Professor Hubert J. Morel-Seytoux devoted some time making preparations, contacts, and arrangements for an information tour of North Africa and the Middle East. The trip was taken in July 1970 and was supported in part by 1970-71 grant funds.

Professor Morel-Seytoux devoted additional time supported by grant funds to planning a five to six week Mobile Institute on Water Resources Management. The institute is being designed

to provide American and foreign students already in the U. S. an opportunity to visit water resource projects in the arid sectors of the U. S. It is planned that the field trips would alternate with course instruction which could be given at university or college campuses at various points on the circuit. The institute will be taught for the first time in the summer of 1971. A letter of interest was mailed to prospective interested groups asking them to indicate their interest in attending such an institute. A very favorable response to the letter was received.

Professor E. F. Schulz was involved in the planning stages of the International Interdisciplinary Seminar directed by Professor Caulfield. He was also responsible for the planning of two sessions of the seminar. The seminar is discussed in detail in the section, "International Interdisciplinary Seminar in Water Resources Management."

Professor V. Yevjevich made a world tour in August and September 1969; Professor E. V. Richardson visited West Pakistan in September 1969; Professor D. B. Simons visited Japan and West Pakistan in September 1969; and Professor Albertson visited Japan, Thailand, Pakistan, and Iran during September and October 1969. All these trips were in some degree supported by grant funds and are summarized in greater detail in the section on "Travel Report."

During Fiscal Year 1969-70, eight graduate students were funded in various degrees by grant funds. The students were: Luciano Cepeda, Mohammad Talib Chaudrhy, Emilio Rios, Donald Taylor, Fang Hong Wu, Jaime Millan, Philip Hosterman, and Suresh Doddiah.

Luciano Cepeda, who was supported for only one month by grant funds, searched and reviewed literature for Professors Albertson's and Smith's classes. Mr. Chaudrhy is involved in a systems analysis of irrigation for conjunctive use of surface water and groundwater resources for West Pakistan. Emilio Rios is studying optimal timing of irrigation water, considering other

factors such as fertilizer application and stochastic inputs. Mr. Taylor studied rural-urban aspects of water resources development. Mr. Wu has been conducting research on minimizing the cost of a canal network water distribution system while also considering the sediment transport effect. Jaime Millan, who was supported for only one month by grant funds, collected data for a research proposal on "Application of Systems Analysis to Water Resources Development in Developing Nations," for Professor Smith. Philip Hosterman is involved in developing a new interdisciplinary perspective on LDC's. His thesis will be on determining some of the social effects caused by technical change in West Pakistan. Mr. Doddiah worked on a report on Reclamation of Water-Logged Lands Under Irrigation for M. L. Albertson.

Relationship of Accomplishments to Project Objectives: The support provided Professor Smith allowed him to develop a competence in water resource systems engineering. His teaching competence related to water development was improved as evidenced by his teaching CE795 on water resource systems engineering which has now been approved as a regular course. He now has the capability to conduct research and provide consulting services on water resource systems engineering problems related to arid or sub-humid regions.

The traveling (mobile) institute being planned by Professor Morel-Seytoux will be a positive teaching instrument for instructing U. S. and foreign students studying water resources. His trip to North Africa and the Middle East will give him an opportunity to gather information for the development of a course on water resources in the developing world and will serve to stimulate and develop his existing interest in research concerning water resources and the developing world.

Professor Albertson was able to improve and refine CE745, Water Resources Systems Engineering, and to lay plans for new courses on water management.

Research was initiated on optimal application and timing of

irrigation water by Professors Albertson and Smith. Hopefully, this research will eventually be extended to field studies in Pakistan.

Professor Schulz's effort with regard to the International Interdisciplinary Seminar resulted in learning experiences being acquired by those in attendance. Professor Schulz, however, has had much experience with resource problems in developing nations and his involvement in the seminar did keep him active in this area. This involvement will carry over to his classroom teaching and research.

Professor D. B. Simons and others in the Civil Engineering Department are currently involved in consulting activities for the World Bank, Acres International, and the Government of Pakistan. They are studying river mechanics, flood control, erosion and sedimentation problems in the delta of the Ganges and Brahmaputra Rivers near their confluence.

Planned Work for FY 1970-71: The support of graduate students will continue in 1970-71 at about its present level.

Professors Albertson and Smith will continue to develop the Water Resource Systems Engineering Program in the Civil Engineering Department, with an international dimension, and to developing new programs. Professor Smith will continue to improve his new course, CE545, and Professor Albertson will continue to refine CE745 and plan and develop new courses concerned with optimum utilization of water resources.

Professor Morel-Seytoux toured North Africa and the Middle East in July 1970. The results of his trip will be discussed in the 1970-71 annual report. He will also continue to develop the Mobile Institute on Water Resources Management, and direct a GRA in assembling information and doing research appropriate to grant objectives.

#### Economics

Accomplishments to Date, FY 1969-70: During the 1969-70

academic year, the Department of Economics has made accomplishments under the grant primarily in three areas:

1. Active participation in the International Interdisciplinary Seminar.
2. Offering of additional courses.
3. Planning for future institutional development and departmental participation.

During the past year the following faculty members actively participated in the Interdisciplinary Seminar: H. H. Biggs and L. M. Hartman. Other members of the department who attended many of the sessions but were not funded under the grant included Professors R. G. Walsh and G. D. Wilken (Geography). In cooperation with Ivan Wymore, graduate student in Watershed Management, Professor Hartman delivered a seminar on 18 February 1970 on "Economic Evaluations and Projections as a Part of Comprehensive River Basin Planning." Professor Biggs also served on the seminar planning committee.

Due to increasing interest among students in the economic problems of the LDC's, a second section of EC460, Economic Development, was taught by Professor Biggs during the Spring Quarter. Non-economic majors were encouraged to attend, particularly graduate students, both U. S. nationals and foreign students, who were involved in field research in the LDC's. Specific economic problems were approached with special attention to interdisciplinary implications (e. g., the technical, social, and political implications of agrarian reform). There is still the need for a course which examines the relationship between institutions and economic development. Such a course will be developed under the grant for the coming year entitled, EC464, Institutions and Economic Development.

A number of discussions were held among persons within this department and with members of other departments concerning prospects for further development of expertise at CSU in dealing with the problems faced by the LDC's. In particular,

emphasis has been placed on the potential benefits of an on-going interdisciplinary social sciences seminar, the need for funding graduate students with an interest in LDC's, and the expansion of course offerings of particular interest to both economic and non-economic majors.

Relationship of Accomplishments to Project Objectives:

Professor L. M. Hartman was the only person from the Economics Department who was supported directly by grant funds. Professor Hartman's active participation in the seminar increased his interest in water problems related to developing nations and upgraded his competence to teach, perform research, and engage in consulting activities regarding this subject area.

The participation of other Economics Department staff in the International Interdisciplinary Seminar substantially increased the staff interest in water development problems related to developing countries.

Plans for FY 1970-71: The Economics Department has been budgeted funds to support six man-months of faculty salary. Two man-months are for continued participation in the International Interdisciplinary Seminar.

Two man-months are to develop two courses in geography. One course, GR340, Economic Geography of Underdeveloped Areas, will examine geographic aspects of underdeveloped areas; their natural resources, population characteristics, patterns of indigenous and introduced agricultural systems, trade, and industry. The other course, GR422, Geography of Indigenous Agricultural Systems, will examine various agricultural systems found in undeveloped regions. The course, GR340, will be offered during the 1970 Fall Quarter, and GR422 will be introduced during the 1971 Winter Quarter.

The remaining two man-months will be devoted to expansion of course offerings related to LDC's, particularly those with an interdisciplinary orientation. The course to be developed will

focus on the evolution of institutions and the role which they have played and are currently playing in economic development of Latin America. The course has been designated EC464, Institutions and Economic Development: Latin America. The course will be taught during the 1970 Fall Quarter in order to precede EC466, Economic Development of Latin America, which is available during the 1970 Winter Quarter.

The support of graduate students will be increased from none in 1969-70 to two in 1970-71. One of the students is Mr. Larry Caswell, M. A. candidate in economics, for a 12 month period beginning Summer 1970. Funds from the grant will support this master's thesis on the impact of irrigated agriculture on export earnings in Mexico and provide him teaching experience. Professor Biggs will direct Mr. Caswell's research efforts. The second graduate student, Mr. Phouangphang Sananikone from Laos, will start in September 1970 and will study natural resource economics and agricultural economics in resources. Mr. Phouangphang will also study under Professor Biggs.

#### Political Science

Accomplishments to Date, FY 1969-70: During the academic year 1969-70, Professor Henry P. Caulfield, Jr., served as Chairman of the International Interdisciplinary Seminar in Water Resources Management. The activities of the seminar during the first year are summarized in the following section, "International Interdisciplinary Seminar in Water Resources Management." Professor Caulfield also assisted Professor Albertson, Director, in the administration of the grant.

One graduate student, Mr. T. J. Manninen, was funded by grant funds to conduct research on comparative successes of American Indians and Caucasian farmers as related to irrigated agriculture. Professor Caulfield was Mr. Manninen's faculty advisor. One NSF trainee, Robert Dildine, conducted research on the personnel problems of water management agencies in West

Pakistan with Professor Phillip Foss as faculty advisor. Mr. Dildine began work on a master's thesis and expects to complete it during the academic year 1970-71. Under the supervision of Assistant Professor Straayer, two graduate students, Robert F. Schmidt and Arlene Dwyer, participated in the Pakistan Water Management Resources Research Project. The work of Mr. Schmidt resulted in a master's thesis, "Water Management in West Pakistan," which was completed in June 1970. Possibilities for publishing the thesis are being investigated with the Rural Development Academy at Peshawar, and one part of the thesis is being abstracted and reworked for submission to Pakistan Development Review, Karachi.

Relationship of Accomplishments to Project Objectives: The grant enabled, in part, the bringing to CSU of Professor Caulfield, who was formerly Executive Director of the Federal Water Resources Council, Washington, D. C., and oriented his activities to a very significant extent, to the water needs of the LDC's. The grant, during the first year, extended existing interest in the Department in domestic water development research problems (as indicated by the work of Professors Foss, Hill, Meek, and Straayer) to the developing countries. While Professors Foss, Hill, Meek and Straayer were not funded at all by the grant (Professor Hill was on leave of absence on a water research project at the Georgia Institute of Technology for much of the year), they actively participated in consideration of problems related to water and developing countries.

Planned Work for Fiscal Year 1970-71: Professor Caulfield will continue to provide the leadership in the International Interdisciplinary Seminar during the 1970-71 academic year. Part of the cost of his effort regarding the seminar will be provided by grant funds. In addition to his teaching responsibilities and research on domestic problems relating to water and environment generally, Professor Caulfield will continue his participation on the United Nations Expert Panel on Water Resources Development

Policies. The Panel met in Buenos Aires in June 1970, and will meet again in Delft in December 1970. The United Nations has contracted with Professor Caulfield to draft a paper reflecting the Panel's thoughts on this subject.

Dr. Garth Jones, an internationally known authority on development administration, joined the staff of Political Science Department in late July 1970. Professor Jones will develop a concentration of courses in public administration including: (a) courses in public personnel administration, public finance administration and organizational (administrative) theory and behavior; and (b) courses on political modernization or nation building, development administration and change, and development planning administration (organization of central planning agencies, program budgeting, modern accounting and revenue systems, etc.). He will teach a current course, PS449, Politics of Development and Nation Building, which could not otherwise be given in the Fall or Winter of 1970-71, and work on completing publications initiated during his period at the East-West Center at the University of Hawaii: (a) "Planning, Development, and Change, A Bibliography on Development Administration," co-authored with Dr. Shankat Ali and ten graduate assistants; (b) "Monastery Model of Development: Towards a Strategy of Large Scale Planned Change," (c) supplement to bibliography by Garth N. Jones and Shankat Ali, Pakistan Government and Administration: A Comprehensive Bibliography, (Rawalpindi: Research Centre on Public Administration: 1970); (d) Bibliography on Indonesian Government and Administration, and (e) a book on "Pakistan Government and Development Administration," edited with the assistance of Dr. B. A. Abbas and Dr. M. Rashiduzman. In addition, Dr. Jones will be principal investigator with respect to the political science element of CSU's Pakistan Water Management Project that is separately funded by AID.

Professor Norman Wengert, an internationally known expert on natural resources policy and administration, who will also

join the staff in the Political Science Department in September, is not funded by the AID grant. Nevertheless, he will substantially strengthen the Department's competence in the natural and environmental resources field, including water and related land resources, both with regard to the United States and the LDC's. Dr. Wengert in 1959 was consultant to the Government of India, provided by the Ford Foundation, to advise on problems of food and agriculture. This experience resulted in a book on "India's Food Crisis and the Steps to Meet It," (Ministries of Food, Agriculture and Commodity Development, Government of India: 1959).

Equivalent funds to support 1-1/2 graduate research assistants will be provided the Political Science Department under grant funds. One GRA will be with Dr. Jones and will assist in preparing the following:

1. Information Sources for Water Management in West Pakistan for Food Production: Institutional and Human Factors,
2. Water Management for Food Production in West Pakistan: International and Human Factors (an edited work),
3. Comparative Institutions for Water Development.

The other graduate student will be with Professor Caulfield and he will examine political aspects of watershed management in Uruguay.

### Sociology

Accomplishments to Date, FY 1969-70: Funds allocated from the grant have enabled the Department of Sociology and Anthropology to expand its curriculum offerings in the area of developmental change. In the case of two courses, (S740, Comparative Family Institutions, and S460, Social and Cultural Factors in Technological Change) the offerings were broadened from once an academic year to twice, in the case of S740, and three times in the case of S460. As a result of grant seed money, the department was also able to develop and offer new courses and seminars related to

LDC's, largely at the graduate level. These new course offerings included the following:

S560 - Literature of Development, 5 credits

S571 - Education and the Development of Nations, 4 credits

S692 - Methods of Evaluation Research, 4 credits

S770 - Institutional Order and Developmental Change, 3 credits

Professor Freeman traveled to West Pakistan in August and September 1969. The trip was supported by grant funds and is summarized in the section on "Travel Report."

Relationships of Accomplishments to Project Objectives: The accomplishments enumerated above indicate that the Sociology Department has been able to expand its course offerings related to the LDC's. In addition, the department has increased the professional involvement of the faculty in dealing with the substantial questions of the LDC's. The expansion of courses on developmental change also increased the opportunities for students (e. g., student enrollment in S460 was 35 in the Fall Quarter of 1969; 22 for the Winter Quarter, and an enrollment of 25 for the Spring Quarter) to acquire sociological perspectives and knowledge related to LDC's. More specifically, grant funds have permitted the department to provide students with a greater understanding of the social and cultural factors of technological change and the social progress (e. g., urbanization, industrialization, differentiation, etc.) related to developmental change and some of the technical skills necessary for evaluating such changes (e. g., S692, Methods of Evaluational Research).

Planned Work for FY 1970-71: The Department of Sociology has proposed to develop a "center" within the department. The center is viewed as an initial step towards a systematic undertaking of the following activities:

1. Designing and establishing a set of data banks related to demography and modernization.
2. Broadening the knowledge and skills for the retrieval of international and national data from a multitude of public

and private resources.

3. Obtaining more appropriate sample designs of ecological units, such as natural river systems, irrigation systems, strip cities, etc., for undertaking research on problems of developmental change.
4. Increasing the training opportunities of graduate students in conceptualizing problems relating to developmental change, data retrieval, computer and analytical skills, etc.

The "center" will contribute towards increasing CSU's understanding of the social and cultural factors related to the developmental change. Specifically, it will expand the opportunity for a broad spectrum of research on aspects of development, including that related to the second order of consequences from the introduction of technological innovations, e. g., water management, agricultural, etc., in ecological units at home and abroad. The primary responsibility for the development of the "center" initially will be shared by Professors Kenneth Berry and Evan Vlachos. Funds are allocated to partially support Professor Vlachos and Professor Berry for this purpose. Also, one GRA will be funded from grant funds to assist in the development of the center.

In addition to the initiation of the center, Professor Thomas Harblin will offer a new seminar, S727, "Industrialization and Urbanization in the Third World," for four credits during the Fall Quarter. An allocation of grant funds will be used to develop the seminar as well as offer it. Some of Professor Harblin's time for this purpose will be supported by grant funds.

The department will also continue to contribute a faculty member to the International Interdisciplinary Seminars throughout the academic year 1970-71. The departmental representative at the seminar will be Professor Hodgdon.

INTERNATIONAL INTERDISCIPLINARY SEMINAR  
IN WATER RESOURCES MANAGEMENT

Accomplishments to Date, FY 1969-70

In implementation of item eight of the operational plan for use of the AID grant, which called for the planning, initiation, and expansion of an "interdisciplinary seminar on development and the interrelationship of the many factors involved in development -- especially in LDC's," an international interdisciplinary seminar in water resources management was planned in the late summer of 1969, initiated with the beginning of the academic year 1969-1970, and met for two hours each week throughout the academic year.

During the Fall Term 1969, faculty members from ten academic departments -- Agricultural Engineering, Agronomy, Civil Engineering, Economics, Fishery and Wildlife Biology, History, Political Science, Range Science, Recreation and Watershed Resources, and Sociology -- constituted the seminar under the chairmanship of Professor Henry P. Caulfield, Jr. of the Department of Political Science and, up to August 1969, Executive Director of the Federal Water Resources Council, Washington, D. C. Initial guidelines for the conduct of the seminar were adopted. They provided that the purposes of the interdisciplinary seminar (with respect to water resources management generally, but especially in LDC's) are to:

1. Identify the factors involved in such management and their interrelationships;
2. Relate these factors and their interrelationships to optimum water resource utilization;
3. Develop models reflecting alternate strategies for achieving of one or more conceptions of optimum utilization of water resources;
4. Test these models in relation to the experience of practitioners and observers of water resources management;

5. Recommend research to test these models explicitly and in greater depth;
6. Enable through the seminar, in successive terms and years, the cumulative development of multidisciplinary and interdisciplinary knowledge of water resource management and the diffusion of such knowledge among members from all participating academic departments; and thus
7. Contribute to the achievement of increased levels of competence in water resources management among faculty at Colorado State University (CSU) in accord with the objectives of the Congress providing for institutional development programs through enactment of Section 211 (d) in the Foreign Assistance Act of 1966 (P. L. 89-583) and of AID in making its grant to CSU of May 23, 1969.

For the Fall Term 1969, the seminar program included:

1. Identification of those disciplines that now have a role in water resources management, how they are institutionalized in management, how they interrelate, and of existing and planned seminars and courses relating to water resources management with Colorado State University.
2. Presentation by experts from inside or outside Colorado State University on:
  - a. General cultural development of one or more countries in the Near East, South or East Asia; and
  - b. Development of water resources management in one or more of the same countries.
3. Further consideration of tentative statement of the mission and program of the seminar within a five year frame of reference, and agreement upon a seminar program for the balance of the year.

A total of eleven two-hour sessions were held. Four sessions focused primarily upon 1 above. Mutual understanding was developed as to: the nature of academic "disciplines" as analytical systems; "professions" as relating to the application of disciplines in society; the distinction between interdisciplinary and multidisciplinary activities; the role performed by interdisciplinary and multidisciplinary activities; the role performed by interdisciplinary models in bringing together the relevant parameters and variables of each discipline and certain of the problems in trying to develop such models; the analytical content of the several disciplines involved in water resources management; and some of the interdisciplinary relationships that are involved. Four presentations carrying out 2 above, followed by discussion were as follows:

1. "Water Management Problems in the Near East and Southeast Regions," Rolland F. Kaser, Vice President, Harza Engineering Company, Chicago, Illinois.
2. "American Indians and the Development of Their Natural Resources," Dr. Roderick H. Riley, Economic Advisor to the Commissioner, Bureau of Indian Affairs, Department of the Interior, Washington, D. C.
3. "Development of Water Resources Management in Pakistan," Khalid Mahmood, Graduate Student in Civil Engineering from Pakistan.
4. "India as a Cultural Region," Professor Linwood Hodgdon, Department of Sociology, Colorado State University.

And three sessions were devoted to 3 above.

Beginning with the Winter Term 1970, the seminar was opened to all interested graduate students in addition to faculty in the several concerned academic departments. The program for the Winter and Spring terms aimed at development of broad understanding of water resources management, both in the United States and the LDC's, at the several levels of focus and activity:

national, regional, provincial or state, and local. As carried out in weekly two-hour sessions, the program was as follows:

National Water and Related Land Resource Management Systems

- (1) "The Federalist System of the United States," Reuben Johnson, Acting Executive Director, Federal Water Resources Council, Washington, D. C.
- (2) "Tanzania," Harold Nelson, Regional Director, U. S. Bureau of Reclamation, Boise, Idaho.\*
- (3) "Pakistan," Rev. Robert Schmidt, Graduate Student in Political Science, Colorado State University.

Comprehensive River Basin Planning

- (4) "Missouri River Basin, with Special Reference to the South Platte River," Charles Cox and Gus Karabotsus, Planning Division, Corps of Engineers, Omaha, Nebraska.
- (5) "Rio La Plata Basin, an International Basin in South America," Charles Alvarez, Senior Economist, Inter American Development Bank, Washington, D. C.
- (6) "Mekong River Basin," J. Carl Lee, Water Resources Advisor, Office of Regional Affairs, Embassy of the United States, Bangkok, Thailand.

Special Problems in Comprehensive River Basin Planning

- (7) "Economic Evaluation, Economic Projections and Their Use," Professor L. M. Hartman, Department of Economics, and Ivan Wymore, Graduate Student in Water Management, CSU.
- (8) "Land Classification for Agricultural Use," John T. Maletic, Chief, Land Resources Branch, Office of the Chief Engineer, Bureau of Reclamation, Denver, Colorado.

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\*Author of "Rufigi River Basin - Reconnaissance Appraisal of Land and Water Resources Development Plans and Potentials," an AID report of March 1969.

State Organizational Patterns and Activities in Comprehensive Planning of Water Resources Development

- (9) "State Organizational Patterns in General, " Dr. Daniel H. Hoggan, Associate Professor of Civil Engineering, Utah State University
- (10) "Comprehensive Planning Activities in Nebraska, " Warren Fairchild, Executive Secretary, Soil and Water Conservation Commission of Nebraska, Lincoln, Nebraska.

The Poudre River System of Northeastern Colorado

- (11-a) "Organizational Study of Irrigation Water Companies, " Dr. Roy Meek, Department of Political Science, Colorado State University.
- (11-b) "Water Management: Resources, Legal Controls and Development Potentials, " James H. Duke, Graduate Student in Civil Engineering, Colorado State University.
- (12-a) "Gaining Water User Acceptance of Changes, " Dr. Donald L. Miles, Extension Irrigation Engineer and Assistant Professor of Agricultural Engineering, Colorado State University.
- (12-b) "The Economics of the Water Rights System of Northeastern Colorado, " Dr. Raymond Anderson, Research Economist, Economic Research Service, U. S. Department of Agriculture, Fort Collins, Colorado.
- (13-a) "Municipal Water Supply in Northeastern Colorado, " Dr. Norman Evans, Director, Environmental Resources Center, Colorado State University, and Chairman of the Water Board, City of Fort Collins; Dr. Morton Bittinger, Water Resources Engineer, Fort Collins, Colorado.
- (13-b) "Reclamation's View on Further Federal Development in Northeastern Colorado, " Larry Nelson, Field

Investigation Engineer, Regional Division of Project Development, Region 7, Bureau of Reclamation, Denver, Colorado.

A Local Focus Abroad

- (14) "Water Resources Management in Scarp No. 1, Pakistan," Don Smith, Tipton and Kalmbach, Denver; Dr. Kenneth C. Nobe, Department of Economics, Colorado State University; and Mohammad Chaudhry, Graduate Research Assistant, Department of Civil Engineering, Colorado State University.

Additional Seminar Sessions by Special Arrangement

- (15) "Radio-Active Material in Water Resources Management," Dr. Muhammad Malik, Senior Scientific Officer, Pakistan Atomic Energy Commission, Tandojam, West Pakistan.
- (16) "Social and Political Aspect of Water Development in India," Dr. Richard Gable, Professor of Political Science, University of California, Davis, California.
- (17) "Kenya's National Program for Development of Rural Domestic Water Supplies," S. K. Ichungwa, Superintendent of Rural Water Supplies, Department of Agriculture, Government of Kenya.
- (18) "Domestic Water Use and Decisions -- Reflections on Field Work in East Africa," Dr. Gilbert White, Professor of Geography and Director, Behavioral Sciences Institute, University of Colorado, Boulder, Colorado.
- (19) "Canadian-American Water Relations -- The Work of the International Joint Commission," Eugene Weber, Member, U. S. Section, International Joint Commission.
- (20) "Future Water Resource Development in Pakistan," Sarfraz Khan Malik, Chief, Water Resources Section,

National Planning Commission, Government of  
Pakistan, Rawalpindi, West Pakistan.

In addition to the foregoing seminar program during the Winter and Spring Terms, a Seminar Program Committee, a multidisciplinary faculty group, was established and planned the program for the International Interdisciplinary Seminar in Water Resources Management for 1970-1971.

The Seminar Program Committee also reviewed a proposal for a Faculty-Student Field Trip to the Lower Balsas River Basin Project, Mexico, and concluded that the proposed trip from June 7-15, 1970 would be a useful educational experiment. The Program Director, upon recommendation of the Seminar Program Committee, agreed to finance the travel costs of participation of two faculty members.

Ten professional participants took part in the trip. Dr. Huntley Biggs, Assistant Professor of Economics, and Dr. John O. Reuss, Associate Professor of Agronomy, took the trip. Eight graduate students -- four in Agricultural Engineering, and one each from Civil Engineering, Industrial Construction Management, Ecology, and Political Science -- were able to participate through use of student-body and personal funds.

The field trip proved to be an excellent opportunity, at no great distance from Fort Collins and at moderate expense, for faculty and graduate students to observe first hand water resource projects and their effects on social and economic development within the context of an LDC.

It has been recommended that the field trip be repeated in the future and that CSU explore the possibilities of developing a special cooperative and student-faculty exchange relationship with the University of San Nicolas, one of the oldest universities in this hemisphere and located near the Balsas Basin. The Seminar Program Committee will consider these recommendations early in the new academic year and advise the Program Director of its views.

### Relationship of Accomplishments to Project Objectives

In implementing item eight of the Operational Plan for carrying out the AID Grant Agreement, the International Interdisciplinary Seminar in Water Resources Management (an entirely new approach to education in water resources management at Colorado State University) is clearly contributing to the grant's overall objectives of increasing the competence and expertise of CSU among U. S. research and educational institutions and "to improve its level of excellence with respect to planning, development, management, and utilization of water resources." More specifically, in terms of specific grant objectives, the Seminar has expanded the interest of professional staff and graduate students in several departments in water resource management generally, and in less developed countries. Its wide multidisciplinary composition has furthered the interdisciplinary approach to understanding and solution of management problems. It has improved understanding of the nature of developing societies and of effectiveness in assisting them through comparative treatment of national experiences in developed and LDC's in water resources management. Plans for conducting the Seminar in 1970-71 emphasizes these latter specific objectives even more.

### Planned Work for Fiscal Year 1970-71

The general plan for conduct of the International Interdisciplinary Seminar on Water Resources Management in 1970-71 calls for three types of seminar presentations with approximately ten of each type:

1. Interdisciplinary seminar papers prepared by faculty-student teams on major interdisciplinary problems in water resources management. The ten topics and the team leaders for preparation of each paper have been tentatively designated.
2. Country by country presentations on cultural and institutional factors pertinent to water resources management

with particular focus on change from traditional to modern agriculture. A tentative list of countries and possible contributors of papers has been developed.

3. Outstanding speakers on topics particularly pertinent to the concerns of the Seminar. A tentative list of such speakers has been developed.

As in 1969-70, no academic credit will be given for participation by graduate students in the seminar itself. Nevertheless, it is expected that academic credit will be given by the departments concerned for participation in the preparation of the interdisciplinary papers that will be presented to the Seminar.

## PUBLICATIONS AND THE WATREMAN BROCHURE AND RESPONSE

### Publications

During the fiscal year of July 1969 to June 1970, slightly over half of the entire collection of approximately 750 publications were collected for the Water Management Program Library. Approximately 80 per cent of the library is composed of published works and the remainder is reports and various unpublished papers and theses. The library now has subscriptions for a total of nine periodicals. Most publications are requested by faculty members, and in some cases faculty members have donated articles to the library. The Water Management Program Library is located in the Program Office, Room C105 of the Social Sciences Building.

The publications are divided into 16 general subject categories, the largest of which are: Agriculture, Economics, Engineering, Sociology, and Water Resources. Faculty members have ordered the books they want, and a large number of the publications have been brought back from Pakistan by Project participants. Approximately two people per week check out materials from the library and approximately 20 per cent of all of the publications are checked out at one time.

Publications added during 1969-70 and the 16 general subject categories and their code designations are listed in Appendix B, Sec. III, "Publications Added to Library During 1969-70 Fiscal Year."

### WATREMAN Brochure and Response

A brochure was prepared describing the multidisciplinary international educational and research program in water resources management at CSU. The team that developed the brochure included Professor M. L. Albertson, Civil Engineering; Professor Henry P. Caulfield, Political Science; Mrs. B. L. Frantz, Administrative Assistant; Mrs. A. Nelson, Secretary; Mr. P. G. Smith, Printing and Publications; and Professor G. L. Smith,

**Civil Engineering.** Text material for the brochure was submitted by the department project leaders for the AID supported Water Management Research project.

The purpose of preparing and distributing the brochure was to recruit well qualified graduate students, both foreign and U. S., interested in pursuing graduate study in disciplines associated with water resources management in developing countries. Students were not only being sought for the Institutional Development Grant Program, but also for other opportunities that existed in the various departments.

More than 90,000 brochures were sent to individuals in the United States and abroad. The mailing list included the American Society of Civil Engineers, American Economic Association, American Geophysical Union, Peace Corps, Universities Council on Water Resources, CSU Engineering Research Laboratory, CSU Campus Newsletter, Hispanic Foundation, American Society of Agronomy, CSU Office of International Programs, United Nations, World of Learning, Society of International Development, Rural Sociological Society, Agricultural Engineers, Soil Conservation Society, and Range Management Society.

The brochure was distributed during 1969 and by June 30, 1970 more than 400 responses were received. Each individual responding was sent a letter and appropriate application forms for entrance into CSU and for GRA support. Copies of correspondence were sent to Department Heads of the discipline in which the individual expressed an interest. Sixty-five application forms were completed and returned to CSU, and each was forwarded to the department or college of the individual's interest. Thirteen forms were forwarded to Agricultural Engineering, 16 to Civil Engineering, 7 to Forestry, and 14 to the Social Sciences. Fifteen applications specified interest in two or more colleges. Ten graduate students were supported by grant funding during the 1969-70 fiscal year, and this number will be increased to thirteen in 1970-71.

### COMPLEMENTARY ACTIVITIES SUPPORTED BY OTHER FUNDS

Several activities at CSU related to the grant were completely or partially supported by other funds. These activities are discussed in greater detail elsewhere in this report, but are summarized in this section for easy review.

Publications are added to the Water Management Program Library on a regular basis as indicated in the preceding section. About 20 per cent of the cost of new publications was supported by grant funds, and about 70 per cent by CSU-AID Water Management Research project. Other sources of funding for the library were individual contributions and the AID-CSU Asian Institute of Technology project.

Two graduate students in Agricultural Engineering, Messrs. Tsu Yang Wu and Va-Son Boonkird, are undertaking research on irrigation structures. This research is designed to complement grant activities directed by Professor G. V. Skogerboe. They are AID participants programmed through the U. S. Department of Agriculture, and are not supported by grant funds.

The Agricultural Engineering Department conducted an "Irrigation Practices Training Course," during June, July, and August of 1970, which was supported by AID funds (other than grant funds) for foreign engineers and agronomists working in irrigation and drainage.

Dr. Bashir Malik, a visiting Professor in the Agronomy Department from West Pakistan, will be available during 1970-71 to conduct seminars and advise graduate students on matters related to grant activities. Dr. Malik is being supported entirely by CSU-AID Water Management Research Project funds.

A Ph. D. training program with the Ministry of Agriculture of Iran is being planned with a student from Iran, Mr. M. Monadjemi. The program is being supported under the CSU-AID Water Management Research project.

Professor G. L. Smith of the Civil Engineering Department submitted a course on water resource systems engineering for acceptance as a scheduled course to the Civil Engineering Department. It was accepted and will be taught as CE545. The development of the course was supported by CSU funds, but it was an outgrowth of work supported by grant seed money. Also under CSU funding, Professor Smith developed a course on special studies in water resources engineering for Colorado SURGE, a program providing graduate-level education through video tape. Again, the seed money for this course can be traced to grant funding.

A student in Political Science, Mr. Robert Dildine, was supported by the National Science Foundation to conduct research on personnel problems of water management agencies in West Pakistan. Also, Mr. Robert F. Schmidt completed a master's thesis in May 1970 on "Water Management in West Pakistan." Mr. Schmidt was supported by the CSU-AID Water Management Research project. Professors Foss, Hill, Meek, and Straayer participated in consideration of problems related to water and developing countries under CSU funding.

A faculty-student field trip to the Lower Balsas River Basin Project in Mexico was taken in June 1970 by two CSU professors and eight graduate students. About 20 per cent of the financial support for the trip was obtained from the grant and the remainder was financed through student-body and personal funds.

Text material for the WATREMAN brochure was submitted by project leaders of the AID supported Water Management Research project. Funds for printing and mailing the brochure, and putting the material together for the brochure were provided by the grant. About 20 per cent of the cost of the brochure was provided by funds other than the grant.

## TRAVEL REPORT

### International Travel

The amount charged to the grant for foreign travel in FY 1969-70 was \$1,290.19. This amount does not include \$6,530.25 for air fare and excess baggage which was paid directly by the AID Mission and will eventually be billed to CSU by AID Washington. A summary of the foreign travel follows:

1. David Freeman, Sociology Department  
West Pakistan  
22 August to 21 September 1969  
\$455.65 (Does not include air fare and excess baggage)

The purpose of Dr. Freeman's trip was to determine research capabilities and interests in selected universities in Pakistan pertaining to social factors relevant for maximizing the effectiveness of water and agricultural projects designed to increase agricultural production.

Discussions were held with university social science personnel in the following universities:

- a. West Pakistan Agricultural College, Lyallpur,  
West Pakistan
- b. University of the Punjab, Lahore, West Pakistan
- c. University of Peshawar, Peshawar, West  
Pakistan
- d. University of East Pakistan, Dacca, East  
Pakistan

In addition to university personnel, discussions were also held with personnel of other agencies concerned with water resources and agricultural production.

It was tentatively concluded that the staff of the sociology department of West Pakistan Agricultural College in Lyallpur, West Pakistan, was most capable of, and interested in the prospects of a collaborative project with the staff at CSU. Appropriate materials

were collected regarding the West Pakistan Agricultural College staff interests and publications, together with published materials pertaining to the proposed research.

2. W. R. Schmehl, Agronomy Department  
West Pakistan and Iran  
9 September to 4 October 1969  
\$114.05 (Does not include air fare and excess baggage)

#### Iran

Dr. Schmehl reviewed sugar beet production in a developing area comparable to West Pakistan. Sugar beets are being considered as an alternative winter crop in West Pakistan since higher wheat yields will release land for additional crops. Dr. Iraj Poostchi, Agronomist, Pahlavi University, was his guide to show the sugar beet production in Iran. Dr. Poostchi was on sabbatical leave at Colorado State University in 1968-69 to study sugar beet production in the United States. Preliminary arrangements were made with the Ministry of Agriculture for a cooperative Ph. D. training program.

#### Pakistan

Dr. Schmehl made initial contacts for the establishment of adaptive water-management research projects with cooperative Pakistani Institutions. The research will be conducted under the AID Water Management Research Project, Grant AID/csd 2162. Among the people in West Pakistan visited were:

Dr. Leon Hesser, Agricultural Officer, USAID, Rawalpindi

Dr. Stefan Krashevski, Soil Salinity Advisor, USAID, Lahore

Mr. Curry Brookshier, Food and Agricultural Officer, USAID, Lahore

Dr. Albert Shaw, Washington State University Advisor, WPAU

Dr. Inam-Ul-Haque, Head, Soils Department, WPAU

Mr. Aliah Bakhsh, Chief Engineer, Reclamation, WAPDA

Mr. S. M. Suid, Chief Engineer, Administration,  
WAPDA

Mr. Nur-Ud-Din, Soils Research, Land Reclama-  
tion Directorate

Dr. Nanwar Hussain, Director Ayub Research (now  
Minister of Agriculture for Punjab Province)

3. V. Yevjevich, Civil Engineering  
Philippines, Thailand, India, Pakistan  
8 August to 9 September 1969  
\$274.85

Dr. Yevjevich of the Civil Engineering Department made a world trip in August and September 1969. The portion of the trip supported by grant funds covered the period 11 September to 24 September for visits to Manila, Bangkok, New Delhi, Lahore, Rawalpindi, and Peshawar. The purpose of Dr. Yevjevich's visit to the above locations was to establish contacts in the Philippines, Thailand, India, and Pakistan regarding problems related to scarce hydrologic data and large continental droughts. The contacts will establish a base for studies and teachings oriented to develop competence in selecting methodologies for solving the above important problems.

4. D. B. Simons  
West Pakistan  
29 August to 23 September 1969  
\$173.96 (Does not include air fare or excess baggage)

The portion of Dr. Simons trip to Tokyo and return was paid for by CSU. The portion of his trip from Tokyo to Pakistan was supported by grant funds.

The purpose of Dr. Simons visit to Pakistan was to gather information for ideas and promotion of grant objectives.

5. E. V. Richardson  
West Pakistan  
1 September to 29 September 1969  
\$69.00

The main purpose of Dr. Richardson's trip to Pakistan was in connection with other projects. While

there he assisted in gathering information for ideas and promotion of the grant program. While in Pakistan he made field trips concerning water management projects for irrigated land, with special emphasis on delivery and removal structures and systems, and erosion and sedimentation problems associated with water supply and irrigation and removal of drainage water of irrigated land.

The information obtained, in addition to being of benefit to other projects Dr. Richardson is involved with, was used to improve education and research programs on water management in the developing countries.

6. M. L. Albertson  
Japan, Thailand, Pakistan, Iran  
30 August to 7 October 1969  
\$202.68

The cost of Dr. Albertson's trip was only partially supported by grant funds. Other support was derived from the CSU-AID Water Management Research Project and the CSU-AID Asian Institute of Technology Project. The portion of the trip supported by grant funds is as follows:

- a. Dr. Albertson visited Tokyo, Japan to attend a conference for the International Association for Hydraulic Research where discussions and research reports were given on water management problems, water delivery, and water removal problems.
- b. In Pakistan he made contacts and developed agreements with various institutions in Pakistan for joint and cooperative research programs on problems of water management. These arrangements were for research in Agronomy, Agricultural Soils, Irrigation Engineering, Hydraulic Engineering, Rural Sociology,

**Agricultural Economics, and Political Science.**

- c. In Tunis, Tunisia he met with Mr. Samuel Litzenberger, Head, Food and Agriculture Division, USAID, and Mr. William McNeil, General Engineering Officer, Public Works Division, among others, to discuss and review USAID projects on watershed planning and management, water resources development for drilling fifty wells, and the Medjerda Valley development.
- d. In Teheran, Iran, Dr. Albertson visited with U. S. Embassy personnel and AID training personnel regarding Mr. M. Monadjemi, a Ph. D. graduate student in Agronomy, and CSU's plans for him to do his dissertation in Iran. The preliminary plans were developed at that time, and later firmed up by Dr. Schmehl, Professor of Agronomy at CSU, in June 1970.

#### U. S. Travel

The amount expended for travel in the United States during FY 1969-70 was \$3,061.15. This included the attendance at the following conferences and meetings: Council on Water Resources, International Seminar for Hydrology Professors, 5th Annual American Water Resource Conference, National Meeting of the Operations Resource Society. American Assembly Conference, CUSUSWASH meeting, American Association on World Hunger, National Water Commission Conference, Council on International Engineering, and local trips in Colorado to obtain data, pick up speakers, and meet with people regarding information for course development or research.

Persons involved in U. S. travel were: M. L. Albertson, Professor of Civil Engineering and Program Director of AID Institutional Development Grant Program; D. C. Taylor, Research Assistant in Civil Engineering; E. C. Vlachos, Associate

Professor of Sociology; L. L. Hodgon, Professor of Sociology; D. Freeman, Assistant Professor of Sociology; H. Caulfield, Professor of Political Science; R. Whedbee, Director of Office of International Programs; E. V. Richardson, Professor of Civil Engineering; G. L. Smith, Associate Professor of Civil Engineering; L. S. Tucker, Research Associate in Civil Engineering; Daniel Hoggan, W. Fairchild, and Eugene Weber, who were guest lecturers for the International Interdisciplinary Seminar; M. Malik, Soil Scientist from Pakistan; and Tom Mannenin, Research Assistant in Political Science.

## EXPENDITURES

The actual and estimated expenditures for fiscal year 1969-1970 in the line item categories are stated in Table 1. These expenditures are through 30 June 1970 and are in balance with the Monthly Status Reports received from the CSU Accounting Office.

Due to the requests made by the various departments, more funds were expended for faculty salaries than originally budgeted. A lesser amount than budgeted was spent for graduate research assistants stipends in order to cover the faculty salary costs. This is reflected in the line item expenditures and in this report by the number of new courses which were initiated this fiscal year ("Departmental Activities, Accomplishments, and Plans," section) and the number of faculty who assisted in organizing and participating in the International Interdisciplinary Seminar (section on "International Interdisciplinary Seminar on Water Resources Management.")

The use of funds for equipment was small due to the large amount of funds which were used for the cost of the WATREMAN brochure, described in the section on "Publications and the WATREMAN Brochure and Response."

The funds budgeted for office expense and computer time were used to cover the cost of clerical help and miscellaneous office expense. No computer time was used this fiscal year, but it is anticipated that this computer time will be utilized next year with the additional number of graduate students assigned to the grant.

The proposed budget allocations for fiscal year 1970-71 will continue as proposed in the original budget plan as outlined in Table 2.

TABLE 1  
TOTAL EXPENDITURES FOR 1969-1970  
ON AID 211 (d) GRANT

<u>Item</u>	Actual and estimated expenditures	Total
<b>I. FACULTY SALARIES</b>		
Administration		
M. L. Albertson		
L. S. Tucker		
	<u>\$6,295.17</u>	\$6,295.17
Agricultural Engineering		
G. Skogerboe	1,283.31	
Agronomy		
J. Reuss	1,200.00	
Civil Engineering		
A. Mercer		
E. Schulz		
H. Morel-Seytoux		
M. Skinner		
G. Smith	10,075.00	
Economics		
H. Biggs		
L. Hartman		
K. Nobe	7,061.12	
Political Science		
H. Caulfield	8,770.00	
Sociology and Anthropology		
B. Ellenbogen		
D. Freeman		
T. Harblin		
L. Hodgdon		
E. Sharp		
E. Vlachos		
	<u>16,804.94</u>	45,194.37

(continued)

(Table 1 continued)

<u>Item</u>	<u>Actual and estimated expenditures</u>	<u>Total</u>
<b>II. GRADUATE RESEARCH STIPENDS</b>		
Agricultural Engineering		
V. Somcray	2,957.50	
Agronomy		
Civil Engineering		
L. Cepeda		
M. Chaudhry		
S. Doddiah		
P. Hosterman		
J. Millan		
E. Rios		
D. Taylor		
F. Wu	12,960.00	
Economics		
Political Science		
T. Manninen	2,115.00	
Sociology and Anthropology		
J. Ford		
Labor - Harley Bryant	1,494.80	
Consultant or Honorarium		
Consultants	<u>2,450.00</u>	<u>21,977.30</u>
PERA	<u>3,970.11</u>	<u>3,970.11</u>
<b>III. TRAVEL</b>		
International Travel		
Dave Freeman		
W. R. Schmehl		
V. Yevjevich		
E. Richardson		
D. B. Simons		
M. L. Albertson	1,290.19	
	<u>3,061.15</u>	4,351.34
<b>IV. EQUIPMENT</b>		
Interdepart. storage cabinets	<u>212.80</u>	212.80

(continued)

(Table 1 continued)

<u>Item</u>		<u>Actual and estimated expenditures</u>	<u>Total</u>
<b>V. OFFICE EXPENSE</b>			
Clerical		-----	
Labor		-----	
Misc. expense		-----	
Tele., Xerox, etc.			
Computer time	<u>-0-</u>	<u>13,132.16</u>	<u>13,132.16</u>
<b>VI. LIBRARY AND PUBLICATIONS</b>			
Brochure			
Printing		-----	
Mailing		-----	
Labor		-----	
Library		<u>6,076.74</u>	<u>6,076.74</u>
<b>GRAND TOTAL</b>			<u><u>\$101,209.99</u></u>

\*Outstanding incumbrance on travel issued on GTR's to be billed by AID Washington - \$6,530.25

TABLE 2  
 DETAILED BUDGET (in \$1,000's)

	Year					
	1	2	3	4	5	Total
<u>Salaries</u>						
Professors: 80 months at \$2,000	24	28	32	36	40	
Ass't. and Assoc. Professors: 80 months at \$1500	18	21	24	27	30	
Total						280
<u>Stipends</u>						
M. S. candidates: 40 years at \$3,000	18	21	24	27	30	
Ph. D. candidates: 40 years at \$4,000	24	28	32	36	40	
Total						280
<u>Travel</u>						
24 trips to South and S. E. Asia at \$1,500	6	7.5	7.5	7.5	7.5	
11 trips to So. Am. and Africa at \$1,000	1	2	2	3	3	
40 trips in U. S. at \$150	1	1	1	1	2	
1500 days per diem at \$18	4	5	6	6	6	
Total						80
<u>Equipment</u>	10	9	8	7	6	40
<u>Office expense and computer time</u>	9	10	10	10	11	50
<u>Library and publications</u>	3	4	4	4	5	20
<b>TOTALS</b>	<b>118</b>	<b>136.5</b>	<b>150.5</b>	<b>164.5</b>	<b>180.5</b>	<b>750</b>

## PERSONS AVAILABLE FOR CONSULTING

There are many individuals at CSU available for consulting activities regarding water problems in developing countries. A few persons are listed in this section from each department to illustrate this competence. The resumes of all individuals noted in this section are included in Appendix B, Sec. II, "Some Biodata Indicating CSU Consulting Competence." These individuals are not the only persons available for consulting. For special consulting needs, the Program Director should be contacted and he in turn will refer the request to the Department involved.

In the Agricultural Engineering Department, Professors A. T. Corey and G. V. Skogerboe are cited to illustrate consulting competence. Professor Corey has served as a consultant for the Petroleum Research Corporation of Denver, and has been a physicist with the Gulf Research and Development Company conducting research on multi-phase flow in porous rock, in addition to his 14 years on the CSU faculty. Professor Skogerboe has worked with the Utah Water and Power Board and the Utah Water Research Laboratory in addition to his two years at CSU. He has had considerable experience testing and developing small irrigation and hydraulic structures.

Professors W. R. Schmehl and J. O. Reuss are cited from the Agronomy Department. Professor Schmehl's major areas of interest are in soil fertility, clay mineralogy, and soil management. He has been a professor at CSU since 1948. Professor Reuss has been involved in areas of restoring productivity of subsoil exposed by land leveling, iron responses in field crops, reclamation of saline and sodic soils, chemical nitrogen transformations in soils, as well as general soil fertility. He has been with CSU since 1961.

In the Department of Civil Engineering, Professors M. L. Albertson, E. V. Richardson, and D. B. Simons are listed to illustrate consulting competence. Professor Albertson has had

over 25 years experience in fluid mechanics, hydraulic engineering, water resources research, and international development engineering. He joined the CSU staff in 1947. Professor Richardson's major fields of interest are experimental fluid mechanics, open channel flow, fluvial hydraulics, and stream morphology. The principal fields of interest of Professor Simons are hydraulics, river mechanics, hydraulics and river modeling, channel design, and stabilization, hydrology, and water resources development. He has been with CSU since 1963.

Professor H. H. Biggs from the Department of Economics has had experience in economic development, agricultural economics, economic theory (macro and micro), Latin American studies, and statistics. Also from the Department of Economics, Professor M. D. Skold has specialized in agricultural economics, regional economics, and resource economics.

Professors H. P. Caulfield and G. N. Jones are noted from the Political Science Department. Professor Caulfield's major areas of interest are economics and administration of natural resources, and water resources in particular. He was Executive Director of the Water Resources Council from 1966 to 1969, before he joined the CSU staff. Professor Jones just joined the CSU staff in June 1970. His major research interests are planned organizational change, comparative study of Pakistan and Indonesian bureaucracy, and modernization of financial management. He has had over 10 years foreign experience in Pakistan and Indonesia.

In the Department of Sociology, Professor C. W. Birky has had considerable experience in evaluating projects in developing countries. He joined CSU in 1946. Professor B. L. Ellenbogen, Professor and Head of the Department of Sociology, served as a consultant in several overseas projects. Included in his overseas consulting experiences are 12 months in Venezuela, 6 weeks in Brazil, and 18 months in Brazil.