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IMPROVING CAPACITY OF CUSUSWASH UNIVERSITIES  
FOR WATER MANAGEMENT FOR AGRICULTURE

REPORT NUMBER II

VOLUME I

Submitted by  
COUNCIL OF U. S. UNIVERSITIES FOR SOIL AND WATER  
DEVELOPMENT IN ARID AND SUB-HUMID AREAS

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## FOREWARD

This constitutes the second annual report of the three 211(d) grant recipient member universities of the Council of U. S. Universities for Soil and Water Development in Arid and Sub-Humid Areas (CUSUSWASH). The grantee universities are:

The University of Arizona	Contract AID/csd 2457
Colorado State University	Contract AID/csd 2460
Utah State University	Contract AID/csd 2459

The purpose of the grants is to enhance the competence of these universities in the field of water management for agriculture. The programs were initiated July 1, 1969.

CUSUSWASH was designed to provide for the expeditious exchange of views and information, the joint undertaking of projects or programs that might tax the capacity of any member university standing alone, for joint planning and review of accomplishments under assigned programs, and for coordinated leadership for the inter-university aspects of these programs.

Besides the three grant recipient universities, CUSUSWASH also includes the University of California.

This report is presented in four sections. In the first composite view of the integrated operations of the three grant-recipient members of CUSUSWASH is presented. The three remaining parts are made up of the reports of the individual members.

This report reflects the cumulative progress of the universities in CUSUSWASH so that much of the material included in the first report remains relevant and is included. New statistics are presented and new sections have been added to make the report fit the needs of a dynamic program.

## SUMMARY

The activities of the Council of United States Universities for Soil and Water Development in Arid and Sub-Humid Areas (CUSUSWASH) and its four member universities in the broad area of "water management for agriculture" are reported in this second annual report of CUSUSWASH. The University of Arizona, Colorado State University and Utah State University are recipients of grants under Section 211(d) of the Foreign Assistance Act. The fourth member university, the University of California, has no 211(d) grant in the field of water management but is active in that field under other auspice and is a highly important member of the consortium.

The four CUSUSWASH universities share nearly a century of leadership in water for agriculture and all have been active in technical assistance programs both on their campuses and throughout the developing world. The impact of grant funds has already operated to improve and enhance this attained level of excellence at the grantee universities and has operated significantly to increase their capability for overseas service in their technical areas under a program of federal and university coordination. The University of California continues to add to its tremendous stature in international assistance through contracts with the Ford Foundation.

All four universities benefit through the establishment of CUSUSWASH through which a continuing dialogue among the partners on all matters pertaining to the special assignments of each is continued.

Increased teaching competence is shared by 17 departments in the three grantee universities. During the last year (FY 1971) the teaching programs have been strengthened; eight new courses have been added; and eight new staff members of high distinction and competence have been added in part

with 211(d) funding. Material progress has been made in increasing both the depth and utility of library collections partially with grant funds. Three technical reports have been issued and the preparation of many additional reports, textbooks, circulars, manuals and monographs are now underway. Thirty-two graduate students were supported with grant funds.

The competence of member universities in language fields has also advanced, and consideration is being given to offering several basic water development and management courses in at least two languages at Utah State. All member universities are prepared to counsel students from the developing countries in many of their own tongues, as the need arises.

The decision was taken during the year to activate an Executive Secretary's office and by year's end an Executive Secretary had been selected to be officed at Utah State University. A \$25,000 budget drawn from 211(d) grant funds available to the member universities had been approved to cover the first year's operation of the office of the Executive Secretary.

New staff members are heavily engaged in research. Research programs in which 211(d) staff and students are participating include: water use optimization, drainage, irrigation structures, hydrological systems analysis, sociology, political science and public administration.

The consulting capability has been increased largely through direct consulting assignments and trips undertaken for other purposes.

Inter-university programs on publications, seminars, and student faculty interchange are being actively developed by the Council.

## PART I

### DEVELOPMENT OF A COORDINATED CUSUSWASH PROGRAM

Increasing agricultural productivity throughout the world to a major degree is dependent upon making proper use of water and effectively and efficiently coordinating water use with other agricultural inputs. This is especially true in the case of the developing countries. The importance of water in the mix of agricultural inputs necessary to increase agricultural productivity has been well stated in a variety of reports and publications. It has been recognized by every major governmental institution in this country from the White House and the Congress through the Bureaus of Agriculture and Interior and the Agency for International Development that are most directly concerned with the subject. Attaining efficient water use, of course, occupies a position of high priority in the program of the Food and Agricultural Organization of the United Nations. Recognition of these facts provided the incentive for the establishment of the Council of United States Universities for Soil and Water Development in Arid and Sub-Humid Areas (CUSUSWASH) by four land grant universities. Subsequent to the establishment of CUSUSWASH, the University of Arizona, Colorado State University and Utah State University received grants under Title II of Section 211(d) of the Foreign Assistance Act. The University of California participates in the activities of the Council as a regular member. It also is active in international programs funded under the Ford Foundation and other grants.

The establishment of CUSUSWASH and the initiation of programs under Section 211(d) is a logical extension of the U. S. Land Grant University system to the problems of international assistance. The expertise of the

American land grant universities is widely recognized as a major source of strength in meeting man's ever-growing needs for food and other agricultural products throughout the world. Historically, these universities have participated in the international assistance programs since these programs formally began following World War II. Prior to formal entry of this country into the field of organized foreign assistance, the land grant universities were extremely active in training thousands of foreign nationals on their U. S. campuses in the subjects now grouped under the heading of Water Management for Agriculture. Since adopting foreign assistance as a major instrument of international policy, the land grant universities have continued to serve in marshalling U. S. technical know-how and providing the major source of trained professionals to carry out agricultural assistance programs. The land grant university has also been the model for university creation and development in many of the developing countries.

The CUSUSWASH universities' activities in water management for agricultural production began nearly a century ago and much that is known and has been placed into practice in this broad field has been developed at their research stations. These institutions also have shared in the increasing task of international development, but, like other U. S. universities, have not been able to develop their full capacities for international service because of limited state support for international activities and irregular and uncertain support from other sources. This deficiency has been well recognized by the universities, the Congress and the Agency for International Development, who have been concerned about improving the effectiveness of technical assistance.

Section 211(d) of the Foreign Assistance Act, as revised in 1966 was passed as a result of these concerns. This Section provides that the Agency

for International Development (AID) can support "research and educational institutions for the purpose of strengthening their capacity to carry out programs concerned with economic and social development of the less developed countries."

In accordance with the spirit of the legislative history of the Act CUSUSWASH and AID have adopted a joint university-federal government approach to strengthening the capacity of the nation for research and education in the area of water management for agriculture. Considering technical assistance efforts determined to be of national interest, the program has evolved a broad scope in its planning and initiation by the universities in consultation with AID within the agreed-upon goals.

#### Delineation of Responsibility

Water management for agriculture is a complex art embracing or impinging upon many individual arts and sciences. It involves protecting or reclaiming land from excess precipitation or flooding, husbanding and managing soil moisture, optimizing cropping practices to the moisture regime, impoundment, distribution and application of irrigation water supplies, coordinated management of watershed areas, and the development and maintenance of institutional capability necessary for support of water related aspects of agricultural operations. The art of transferring technology and of assisting in the related institutional building in the developing countries is also a difficult and complex one which must be merged with the technical arts of water management.

Discussions of how the CUSUSWASH universities might increase their joint capacities to provide resources for agricultural water management began January 31, 1967, at Davis, California. In the interim, prior to

initiation of the 211(d) grants, on July 1, 1969, three formal meetings of the Council and one informal meeting of representatives in Washington, D. C. formalized the Council's Charter and Agreement and its organization.

Other accomplishments during this period included:

- 1) development of the objectives and philosophy of the consortium
- 2) developing an operational procedure for the consortium
- 3) conceptualizing the program and assignment of responsibility
- 4) assistance in preparing specific university proposals
- 5) interchange of ideas at the University operating level, and
- 6) development of plans to implement some specific inter-university activities.

The universities recognized from the beginning that joint cooperation and planning with the federal government was essential in order that programs would be meaningful to technical assistance. Planning and implementation has proceeded with representatives of AID in a spirit of mutual cooperation.

All the CUSUSWASH universities have considerable existing capability and teach some courses in most water management fields. Their students desire and need broad backgrounds that include some exposure to most of them. Extending capacity for international service in all relevant subjects at each university, however, would be inefficient and wasteful. Rather, leadership responsibility should be identified in each case so that the results may be shared by all. Research is a necessary and important element of all graduate education. In the context of technical assistance, like teaching, it has two dimensions also: the technical one and the one of extending it overseas. While separately administered and

reported, complementary research programs based in developing countries are essential adjuncts to the 211(d) program.

Implementation of programs for all of the topics which are included in the art of water management for agricultural production is not immediately possible. Priorities have been considered and choices have been made. Time is not adequate to go through the decades of agricultural evolution that have led to the present level of technology in the more developed countries. Based on these concepts and considering existing capability and interest of the several universities, assignments were made as follows:

University of Arizona

Watershed management with special emphasis on the science and methodology of applying systems analysis techniques to problems of less developed countries.

Colorado State University

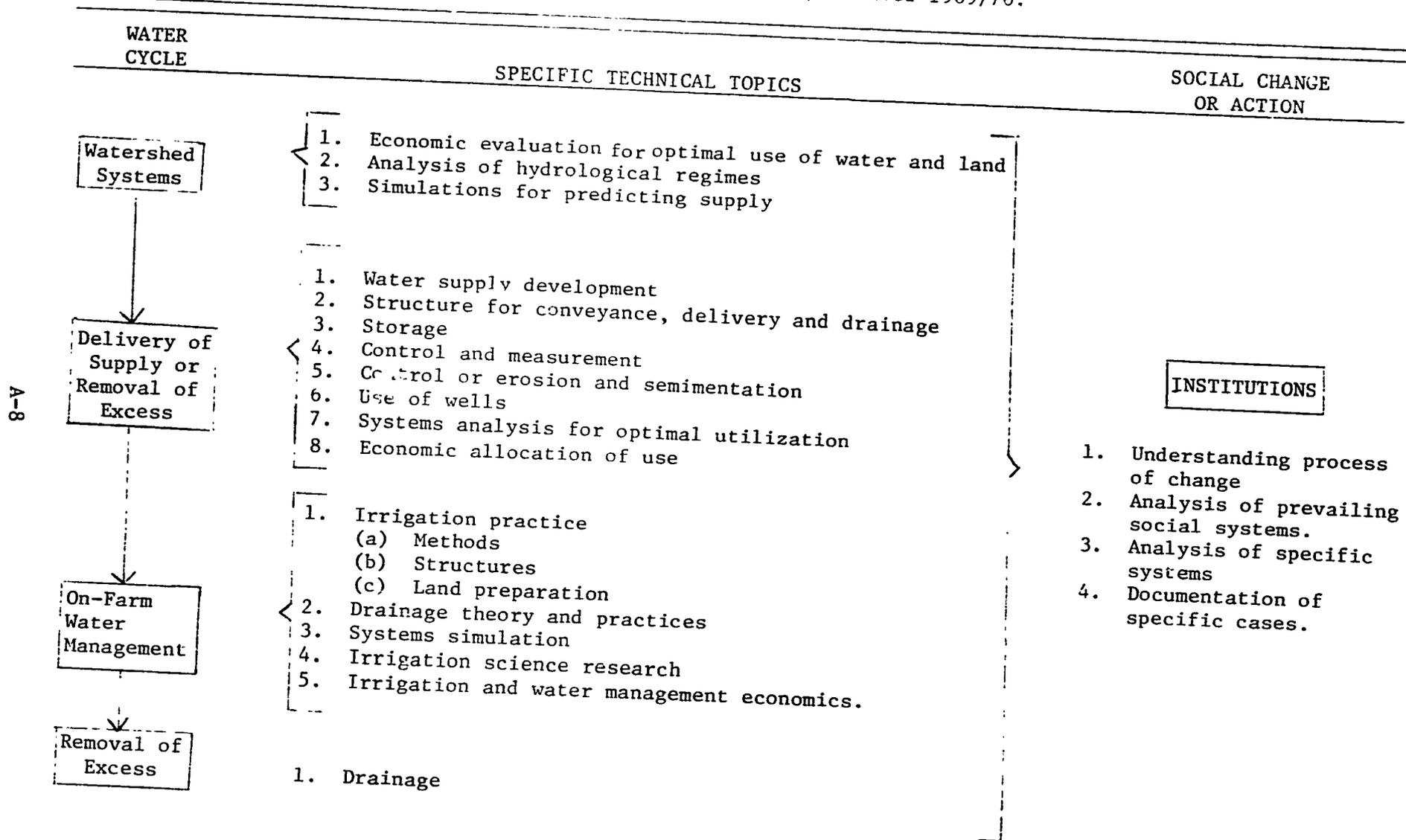
Optimum utilization of water resources: with special emphasis on water delivery and removal systems and relevant institutional development.

Utah State University

On-farm water management for increased agricultural production.

Figure 1 shows systematically how these assignments relate to management of the physical water cycle for use in agriculture. The University of Arizona has responsibility in the first box, shown in the first column; Colorado State University has responsibility for the second and the fourth; and Utah State University for the third. The second column identifies specific technical topics and the third column considers institutions.

Figure 1. System Diagram of CUSUSWASH 211(d) Program as Implemented 1969/70.



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Clearly, interactions between the various elements of the water management system are essential. Knowledge of on-farm water needs is essential in order to properly design water delivery and removal systems; likewise, a knowledge of watershed characteristics and a mechanism for predicting water production from them is necessary both to the design of delivery and removal systems and to optimizing the use of available water supplied on the farm. Adequate institutional structure impinges at all three levels; without this structure neither optimal watershed management, operation of delivery and removal systems, nor management of water once it reaches the farm can be very efficient. Operational coordination by CUSUSWASH has been designed to make sure that products of increased capability flow freely among the several institutions, and to provide mechanisms whereby personnel and consulting advice and know-how desirable for planning and operating the program may be drawn from the common pool. This requires that CUSUSWASH continue both advanced planning and evaluation, and development of specific mechanisms of communication and exchange. Throughout FY 1971 consideration was given to the possibility of increasing the CUSUSWASH capability in attaining all objectives through basic changes in its organization and structure. The search continues.

CUSUSWASH's conceptual plans called for increased capability in "soil and water management for increased crop production and water use" by the University of California. The importance of this input into the system seems self-evident and the 211(d) recipient universities look forward to adding that capability.

## ACCOMPLISHMENTS OF CUSUSWASH INSTITUTIONS

DURING FY 1971

If the first year's operation under the grants were to be characterized by any one single term, it would have to be known as the year of initiation. The availability of funds under the grants made possible undertaking of essential work in some instances long deferred in fulfilling cherished aims of the member universities. New staff was recruited, new courses offered and a significant start was made on over a dozen other important activities.

The challenges and objectives of the CUSUSWASH universities, however, remain essentially unchanged, and a cogent portion of the first year's report treating with these is repeated here.

Basically, as set forth by the CUSUSWASH universities in their proposals, increasing institutional capability for international service consists of:

- 1) Improvement of teaching capability.
- 2) Development of increased research competence.
- 3) Development of increased capacity for consulting and service.
- 4) Increased involvement in international programs.

Each of these objectives, if they are to be effective, require both increased technical competence and capability, and increased understanding on how that competence may be extended effectively to developing countries. But increased capacity of the institutions is more than that portion that is specifically financed by 211(d) funds. These funds have opened up new opportunities for initiatives across the board. Related research programs, new courses, language training, library acquisitions and area studies and

collections have reached a new high level because of 211(d) interest and support.

In achieving their objectives, the CUSUSWASH universities are:

- 1) increasing the breadth of their teaching program
- 2) preparing plans for needed research
- 3) expanding full-time professional core staff
- 4) expanding graduate student research-training programs
- 5) developing programs of faculty and student exchange
- 6) developing needed new facilities
- 7) finding and introducing into the program new well-qualified graduate students
- 8) expanding library collections, especially with reference to problems of developing countries
- 9) conducting short courses, institutes, seminars, etc., particularly interdisciplinary ones
- 10) developing specific publications, textbooks, monographs, etc. and teaching materials and aids
- 11) developing programs of information exchange with developing countries
- 12) increasing staff understanding of the problems of developing countries
- 13) increasing appropriate language capability of staff and students
- 14) collecting and analyzing existing information, especially that related to problems of the developing countries

The progress reported on the first year's operations varied with the individual initiative and covered the spectrum from "less than hoped for" to "significant", but in the case of each initiative a start had been made.

If a single term were sought to characterize the second year's operation, it would probably be "consolidation". The programs initiated during the first year were continued. In some instances they were expanded. In other cases they are undergoing review and adjustment to make the new mechanism work more smoothly and effectively.

## INCREASING THE CAPABILITY FOR TEACHING

The availability of 211(d) funds continue to contribute significantly toward the building of increased capability at the grantee universities in their specific areas of interest toward increasing their capacity to serve in international programs.

### Change in Curriculum

In addition to the new course offerings covered in the first year's report, Arizona has concentrated on development of Computer Assisted Resource Educational System (CARES) and a course in basic forest hydrology using CARES techniques is being prepared. Requisite special programming language, mathematical models, etc. are in the process of development.

The Department of Agricultural Engineering completed the revision of its course, International Agriculture. A new course was added to the Watershed Management curriculum, WSM 305, Modeling of Small Watershed Hydrology.

At Colorado State five new courses were offered, these being:

- 1) Institutions and Economic Development - Latin America
- 2) Economic Analyses and Water Resource Development
- 3) Geography of Underdeveloped Areas
- 4) Geography of Native Farming Systems
- 5) Industrialization and Urbanization in the Third World

Plans are advancing in the Department of Political Science to offer nine new courses in the area of Public Administration. Four other courses have been revised and strengthened.

At Utah State University, two new courses were organized and taught.

The first, a graduate course in Water Chemistry, was offered in the Department of Civil Engineering and the second, a course on the Fertility and Management of Irrigation Soils, was offered in the Department of Soils.

A series of slides have been assembled and an accompanying script has been prepared in both the Spanish and English language for use in both on-campus and foreign teaching of Sprinkler Irrigation. The short course in Irrigation Science has been revised and the committee on curriculum continues to review the needs for additions to the curriculum in the field of on-farm management and needed revisions in courses now being offered. The capabilities of the staff to undertake new courses is under constant evaluation.

#### New Staff Members

Distinguished specialists have been added to the staffs of Colorado State and Utah State Universities to increase balance and total staff strength and to make possible greater utilization of total staff competence in teaching and in the conduct of research and consulting. Colorado State added Dr. Ronald Tinnermeier to the Department of Economics, Dr. Wayne Clyma and Professor William W. Hansen to the Civil Engineering Department, and Dr. Garth Jones to the Department of Political Science. Maxwell E. Becker was added as a technical administrator. Utah State added Dr. Eddie Middlebrooks to the College of Engineering, Dr. Jose Alfaro to the Department of Ag and Irrigation Engineering and Professor Cleve Milligan returned from a tour of duty in Latin America and assumed part-time duty in the Department of Ag and Irrigation Engineering under 211(d). All of these individuals bring to their respective assignments a great depth of training, experience and strength.

### Seminars

During the past fiscal year an International Interdisciplinary Seminar has been conducted by Professor Henry Caulfield at Colorado State University. What was tantamount to interdisciplinary seminars were also conducted there over a period of months prior to the visit by 16 faculty members and graduate students to the Balsas River Basin in Mexico.

At Utah State University a highly successful seminar on Water Resource Planning was conducted. For this Aron Wiener of Israel was brought to Logan to spearhead the program. This class was attended by over 25 people.

The short course on Irrigation was given for the 20th consecutive year and brought to Utah State 23 representatives from ten countries.

A wide variety of additional seminars are being considered for inclusion in the programs of the member universities in coming years. These will accelerate the flow of essential information in the water management area and capitalize on the expertise of the constantly increasing staffs or member universities. This expertise will be supplemented by outside consultants, as need is indicated and opportunity permits.

### Graduate Student Exchange

All three universities are active in graduate student exchange involving directly Brazil, Colombia, Venezuela and Pakistan. Many graduate students also come from other countries around the world to participate in the training programs which have been offered continuously and successfully for nearly a century, but now significantly accelerated.

### Libraries

211(d) grant funds have aided grantee university libraries in the acquisition of relevant publications needed in increasing their support. During FY 1971, for example, over 1600 new publications were added to the "on-farm water management library" of Utah State University alone. Over 400 publications were added to the Colorado State University Water Management library and many important works were added at Arizona. Of equal or even greater importance in this quest for excellence is the contribution grant funds have made toward the organization of bibliographies on specialized fields and subjects, and the adaptation of these for computer use.

### Research

The 211(d) grants continue to make possible initiation or continuation of graduate research having international significance and thereby add to the capability and accomplishments of members in research and training. This subject is discussed in detail elsewhere in this report.

### New Training Methods

Progress is being made in developing new teaching methods and facilities at all three grantee universities. The effort, started during the first year was continued during the second year and will continue throughout the tenure of the grant. Use of computers, mathematical models, a wide selection of visual aids, laboratories, graduate student discussion and study rooms, and other such devices and facilities are all being considered and where indicated are being added to assist in the teaching efforts of member universities.

### Consulting

Major progress has been recorded in the actual consulting assignments filled as well as in increasing the competence of staff to initiate consulting efforts.

At the University of Arizona over a dozen individual international consulting jobs were performed. At Colorado State the consultant assignments were fulfilled as follows: A total of 108 international trips were taken of which 12 were paid in part or fully by AID Contract funds. In addition, a total of 143 domestic trips were made of which 23 were paid in part or fully by AID Contract funds. Forty-two percent of all the CSU international trips were water management related and seventy-eight percent of all the domestic trips were water management related. At Utah State 25 staff trips resulted in over 50 specific consulting assignments being undertaken. Details on these consultations appear in Part II, III and IV of this report.

INCREASED GAINS EXPECTED IN TYING THE GRANT  
RECIPIENT UNIVERSITIES TOGETHER

While each university member of CUSUSWASH had a recognized capacity for working alone on various technical assistance projects, a strong conviction was and is held that the sum of the knowledge and staff of the four member universities added together would be far greater than any single university could muster. It being further held that in tying the universities together and providing for: 1) exchange of information in all its forms, 2) systematic discussions of individual problems among professionals engaged in similar or related efforts, 3) rotation of responsibilities in the conduct of seminars and 4) the utilization of other methods of achieving unified competence; great gains could be recorded.

The CUSUSWASH format provides a convenient method for the pooling of resources for the joint undertaking of projects and programs beyond the capacity of any individual member, and yet assures each university its right to maintain individuality and identity. Consideration is being given to all possible ways of enhancing the possibility of attaining CUSUSWASH objectives including exploration of legal ties such as incorporation.

Under the following topics specific examples of gains achieved are discussed.

Face-to-face Disciplinary Discussions

During the last fiscal year two large, semi-annual CUSUSWASH meetings were held which involved a total of 85 top executives, staff members and graduate research assistants from the four CUSUSWASH universities and AID Washington. These meetings were structured to permit a free exchange of

ideas at both the inter-university and interdisciplinary levels and have led to greater understanding among the CUSUSWASH members regarding the individual university programs, aims, potentials and capabilities.

In the CUSUSWASH mechanism, opportunity is available for the organization of committees, task forces and working groups to undertake and deal with common problems regardless of the disciplines involved. Through these forums a free exchange of information on complex subjects, programs and problems can be aired and competence from the requisite disciplines can be assembled to meet any observed need. The mechanism, moreover, provides opportunity for continuing dialogue among the deans, department heads, faculty and research specialists at any time, on any subject, and the frequency of such discussions has increased over the year to assure a greater exchange of information and development of sounder solutions to presented problems.

#### Information Exchange

As noted in last year's report, one of the first actions toward coordinated effort was to name a CUSUSWASH publication committee with a charge to study and improve the flow of information. The committee devised a seal for CUSUSWASH and research results are now being published under a common imprint and are being circulated among the universities. During the past year three CUSUSWASH publications were issued and several dozen others are now in process.

During the last year special seminars were conducted at Logan on the general subject of water resources planning, which brought to Logan the distinguished service of Aron Wiener, to be complemented by staff specialists from Logan, The seminar was participated in actively by CUSUSWASH university

members, particularly Colorado State University and Utah State University.

The use of microfiche, microfilm, television, visual aids, coordinated voice and slide recordings in the dissemination of information is being considered and progress is being made in the use of all of these.

The joint sponsorship of all of these means of information collection and dissemination under CUSUSWASH appears to have gained momentum and effectiveness.

When the Publications Committee was created, the information exchange envisioned lead to the appointment of special committees to take over segments of the work originally assigned to that Committee. During the July 8 and 9, 1971 CUSUSWASH meetings in Logan, a library Committee was appointed to accelerate and sharpen the exchange of information on holdings of the libraries of the member universities. Substantial progress has been made by each of the universities over the past year in garnering and making available "fugitive material" which has existed in each of the libraries without its being available for use by library patrons.

#### Mutual Support in Staff, Students and Faculties

A start was made in FY 1971 in the exchange of staff. Dr. Howard Peterson of Utah State spent some four weeks at Colorado State teaching an interdisciplinary course on Water Quality and Environmental Engineering. The three directors of the grantee universities plus a California representative constitute a committee to explore the capabilities of each university in order to identify the most useful prospects for mutual support in staffing, students and faculties.

Further exchanges are being explored. In this regard a procedure has been devised and is being implemented which will result in a free exchange

on the qualifications of the staff members of member universities for undertaking special exchange assignments.

#### Seminars

While the committee is studying the potential for a jointly sponsored seminar, the only effort approximating joint sponsorship that has reached fruition was in the June 7-18 Water Resources Planning Seminar conducted in Logan. The work continues, and other initiatives will be explored and, if practical, implemented.

#### Committee on Integrated Approaches to Water Management Problems

The Committee on Integrated Approaches to Water Management Problems, previously appointed on an ad hoc basis, has been given continuing status. It is currently working actively in developing ways of improving coordinated technical efforts. A subcommittee of the Committee, known as the Irrigation Management Project (IMP) Committee is currently actively meeting in an attempt to attain some integration of work going on at the member universities in the area of Irrigation Management as it pertains to the total program of CUSUSWASH.

#### Establishing the Office of the Executive Secretary

Proceeding from the stated conclusion in Dean Peterson's letter to James K. McDermott, dated March 1, 1971, the grantee members of CUSUSWASH proceeded with the selection and employment of a half-time CUSUSWASH Executive Secretary. Although not actually achieved in the fiscal year 1971, the office is now established in Logan, Utah, and is housed in

Rooms 403 and 405 of the Eccles Business Building. Mr. William I. Palmer was selected as Executive Secretary and Mrs. Diane England is serving as secretary to the Executive Secretary. A budget of \$25,000 has been subscribed by grantee universities from 211(d) funds with the concurrence and support of AID Washington and the office is in full operation.



## ENTRAINMENT

Under Title 211(d) grants have been made to universities and colleges to increase their capability to perform assigned functions in the training of professionals from the developing countries. The total investment has not been large. The impacts of this investment, however, have been great and have extended throughout the entire staffs of the universities and throughout their entire operations in connection with international development and foreign assistance. This process of extending benefits, capabilities and accomplishments beyond the basic grant, is termed entrainment.

The evidence of entrainment is readily apparent in many areas. The quantifying of entrainment benefits, however, is more difficult to do. As of this point in time only a few precise measurements are available and the challenge to quantify rather than describe entrainment values looms large and will be a continuing effort.

The impact of the 211(d) grants to the grantee members of CUSUSWASH are described in the case of six major areas of interest. In describing these it should be noted that it is difficult, if not impossible, to draw a sharp line between contributions made directly by the university and those that came through investment of 211(d) funds. The significant fact is that the total competence of the grantee universities has been increased by a much greater amount than the amount the grant would make possible standing alone.

### Building of Staff

The availability of grant funds to supplement those that would have been regularly budgeted for the employment of staff obviously makes it possible to bring to the campuses additional staff numbers. Under the

211(d) grants highly qualified staff members have been added at all three of the grantee universities.

The availability of even relatively small amounts of grant funds tends to invite the universities "to go the additional mile" and invest such additional funds as they can find to round out and improve the total staff.

As the total staff is increased, additional activities can be undertaken. It is obvious that staff over and above the number needed to carry out the programs and directives of the Boards of Regents and the State Legislature does not exist in any depth. Accordingly, as a general proposition, if additional efforts are to be undertaken, either the staff must be supplemented or other activities must be curtailed. Grant funds have made it possible to supplement existing or foundation staff capability by the simple expedient of adding new staff members.

#### Staff Capability, Balance and Utility

The entrainment phenomena is nowhere more evident than in improvement of staff capability, balance and utility. The grant recipient members of CUSUSWASH have benefited greatly in these matters. It works like this:

1) The addition of carefully-selected, potentially highly-valuable, but nevertheless, junior staff members often can free up time of senior staff members and make increasing portions of their time available for grant associated activities.

2) The addition of an administrator can result in his taking over many of the administrative chores and burdens now reposing upon deans or department heads and thereby enhance their productivity in technical areas.

3) The addition of a key professional may add stature and balance to an organization that increases the potential of the entire staff. It may also open up new avenues to be explored in research programs that were previously inaccessible.

4) The availability of additional funds from the grant may be used to improve the overall capability of the staff by enabling the university to search out the particular expertise needed to provide balanced staff competence and when found provide whatever incentive is required to attract the individual to the campus. In doing this, only limited amounts over and above regular departmental budgets may frequently be all that is required. Moreover, the grant itself tends to attract the desired individual by providing assurance of a challenge and funding of a reasonable program.

### Teaching

The availability of supplementary financing through 211(d) grants has enabled the member universities to provide improved teaching facilities and devise new methods of teaching. The impact of these developments extends far beyond those staff members most directly concerned with the "increasing competence in water management" and will extend far beyond the term of the grant.

The development of improved methods and facilities draws deeply upon not only assigned new staff members, but also upon the ideas, suggestions, and efforts of the basic or original staff. The facilities and systems evolved, moreover, will have a lasting effect on both domestic and international programs of member universities that will continue long after the expiration of the grant. The development of a computer-oriented instruction program, known as CARES, Computer Assisted Resources Educational

System, at the University of Arizona is typical of this effort. Once this program has been perfected along with the models program and other devices and services essential to it, it can be called upon for a great variety of services to accelerate and make effective methods of information dissemination in any language the world over.

Colorado State is developing interdisciplinary seminars to bring social and physical sciences to bear in proper mix in water management for agriculture programs. They are also developing sound movies, photographic slides and other visual aids that can be employed by the entire staff as opportunity is presented.

At Utah State work is advancing in the use of visual aids which will assure that on-farm water management courses will be given effectively in any language. All three universities are working to increase or improve technical information and to make it widely available through presentation of technical papers, professional publications, books, textbooks, monographs, or articles.

The entrainment effect is operating and in each case is significant because "seed capital" made available in relatively small amounts stimulates individual staff members who are paid largely from university funds to extend and improve their knowledge and effectiveness in this broad field of international development.

#### Acquisition of Library Materials

Perhaps the most lasting values accruing from monies that come to CUSUSWASH universities because of 211(d) grants is found in the strengthening and enlargement of the universities' libraries in making them more accessible and readily usable. In this area entrainment is graphically

represented. At Utah State University, for example, the investment of \$20,833 in 211(d) money has been overmatched by an investment of \$29,475 during FY 1971 from regular library money. At Arizona and Colorado State like entrainment is apparent.

The chance to add to library holdings by the judicious use of 211(d) money tends to invite dedication of regular university funds in amounts greater than either the grant budget or the regular budget. Grant monies thus tend to bring the logical and reasonable aims of the library within the realm of the attainable and to stimulate the additional inputs from regular funds while this condition exists. The quality of the libraries is enhanced with the addition of each purchased book.

The challenge of making library holdings more accessible and usable for the patron has resulted in development of various extremely convenient and usable bibliographies and is now leading to installation of rapid retrieval systems.

Two other examples of entrainment are evident in the library programs of the member universities. These are:

- 1) Hundreds of important publications accrue to grantee libraries as gifts simply because requests are being sent to donors under an active library program.
- 2) Experience to date indicates that thousands of valuable works are being made accessible and usable by finding and organizing "fugitive material" existing in special collections, archives, and other separately maintained places

#### Ability to Conduct Research in Assigned Areas

It is axiomatic that the greater the depth and strength of staff

available for research activities and the greater the wealth of bibliographic material available, the greater is the university's ability to undertake meaningful research projects and programs; the greater also, the number of areas or fields into which this research effort can be directed.

In all, over 30 research graduate assistants were aided as a result of the AID grants. Their exposure to proven technical direction by outstanding scientists assures a continuity of competence and research ability at the CUSUSWASH universities. Many projects were carried out in the international setting and a larger number are underway on the campuses of member universities.

#### Travel

A level of entrainment is exercised on the entire staff of grantee universities by the judicious use of both domestic and international travel. The domestic travel enables the individual staff members to attend conferences, and symposia and participate in all forms of information exchange in this country, while international travel makes possible for the top professionals to become the eyes and ears of the university in assigned areas of interest and to bring back information on specific subjects of interest and cultural observations needed in the total training effort. The product of both U. S. and international travel in net, is to bring back vast amounts of scholarly information to illuminate and edify staff member and students who remained at home.

Throughout last year 144 trips have been made by 78 CUSUSWASH university members to participate in meetings, conventions, conferences, etc. in the U. S. and 162 trips have been made by 72 staff members in the interests of international programs. Many of these trips would not have been made

had it not been for the 211(d) program; yet, the percentage of the total cost of travel actually borne by the 211(d) budget is small.



## INCREASING RESEARCH COMPETENCE

The competence of grantee universities to undertake and accomplish meaningful research particularly in the international sphere has been materially enhanced by the availability of 211(d) funds. These funds have been available to support specific projects and graduate students working on them. They have aided in securing new professional staff to guide individual research efforts and have supported staff travel to friendly developing countries through which a greater perception of research potentials and requirements has been gained.

At the University of Arizona strengthening the research capability in the area of systems analyses in watershed management is tied to the procedures used to increase its teaching competency. To utilize the computer-oriented instructional program, CARES, necessitates the simultaneous development, modification and evaluation of models and procedures employed in this subject matter area. Research projects in progress within the Department of Watershed Management that relate to this area are as follows:

- 1) Development of stochastic models of precipitation.
- 2) Computer simulation of the hydrologic response of watersheds to precipitation inputs.
- 3) Prediction of snowpack water balance by means of seasonal energy balance.
- 4) A decision-making model for optional resource development.
- 5) Development and testing of transpiration retardants.
- 6) Climatological patterns and their effects on agriculture and forestry.
- 7) Development of electrical analog models in watershed hydrology.
- 8) Development of computer language to be used with CARES.

The Department of Agricultural Engineering continued its efforts in its rainfall multiplication experiment. The digital computer model which was developed to predict the success of modified dry-farming through rainfall multiplication was extensively revised. Subroutines were added to permit faster program analyses and more flexible operations. An iterative solution for several crops and area ratios is now possible. The Department of Agronomy continued its cooperation on the above project and in the area of water-use efficiency.

#### Colorado State

The large research capability of Colorado State University has been measurably enhanced by the grant and 211(d) funds. In Ag Engineering the research effort has been extended to include conveyance, control, and measurement of water in conveyance channels. In the same department, research dealing with Combination Check-Drop Energy Dissipators was completed during the year. The departments of agronomy, sociology and anthropology, geology, and political science, all have exciting research projects underway or programs that will lead to research projects.

In all, 21 graduate research assistants have benefited from Grant funds. The time element of the benefit for each GRA at Colorado State varied from 1/4 to 7-1/2 months. The GRA's attend the International Interdisciplinary Seminars and participate in both leadership of the meetings as well as discussions. Some participated in the field trip to Mexico, some in weekly project leaders' meetings, and all received faculty consultation and guidance on an interdisciplinary basis with regard to research programs and projects, course offerings, and special activities on problems and needs of the less developed countries.

### Utah State University

The large coordinated program of research in the field of on-farm water management includes work sponsored by the Utah Agricultural Experiment Station, the Environmental Protection Agency, the Office of Water Resources Research and AID Research contract AID/csd 2167 as well as that supported directly from 211(d).

As teaching competence and library resources have increased, so has research capability. Each new staff member is expected to assume some research responsibility and each graduate student supported by the grant is engaged in research. At least a part of this research is conducted in one of the Latin American countries. In all, 11 graduate students have been supported at least in part by the grant. Two have completed theses that have been filed with member universities and USAID. Research has led to preparation and submission of many separate reports besides the theses mentioned.

### Linkage

Linkage with leaders of the developing world in the broad field of water management for agriculture is established each time a visit to a foreign country is made to work on a consulting assignment, to attend formal meetings or in response to invitations to "visit and discuss". In a like manner, linkage is established each time a representative of a foreign country attends meetings in the U. S. or visits with university officials formally or informally. Each time a graduate student attends a member university or each time a followup contact is made with the graduate after his return to his native land, linkage is established or strengthened.

Records of all such linkage are being or will be maintained by the member university sponsoring the contact, with the aim in mind of making future contacts more objective and effective.

A major CUSUSWASH activity in the coming year will be to assemble a "Who's Who" type directory of scientists of competence and institutions of competence in water resource management and associated activities. This directory, while based on the experiences of individuals from member universities, will be available to all CUSUSWASH members to sharpen and improve their international operations.

The subject of linkage is discussed in the reports of the member universities and based on these reports and their individual judgments, several hundred important contacts are estimated to have been established throughout the world to link the resources of the member universities with the problems and programs for water management for agriculture in the developing world.

Of the dozens of linkage examples accruing from a better and broader staff, which in turn is traceable at least in part to 211(d) grants, three specific examples may be helpful here.

1. The UCOWR universities IHD fellowships. During 1972-1973, 58 such fellowships are to be offered by UCOWR universities are pledged to offer eleven of these with Arizona offering one, California two, Colorado State six, and Utah State two. These assistantships and fellowships are offered to university graduates outside the United States and will bring students to the campuses of the CUSUSWASH universities, thus providing opportunity for additional training and the development of linkages with other countries.

2. Dr. Maurice Albertson of Colorado State and William I. Palmer of

Utah State are members of the Executive Committee of the United States Committee on Irrigation Drainage and Flood Control, thus linking the CUSUSWASH universities with the irrigation, drainage and flood control program leaders throughout the world.

3. Dr. A. A. Bishop of Utah State is Chairman of the Executive Committee on Irrigation and Drainage of the American Society of Civil Engineers.



ORGANIZATION OF  
COUNCIL OF UNITED STATES UNIVERSITIES  
FOR  
SOIL AND WATER DEVELOPMENT  
IN  
ARID AND SUB-HUMID AREAS

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211(d) Project Directors

University of Arizona

Malcolm Zwolinsk

Colorado State University

Maurice L. Albertson

Utah State University

A. Alvin Bishop



PART II  
UNIVERSITY OF ARIZONA

ANNUAL TECHNICAL REPORT 211(d) PROJECT  
AID/csd 2457

August 31, 1971

UNIVERSITY OF ARIZONA

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## SUMMARY OF CONTRIBUTIONS TO THE UNIVERSITY CAPABILITY

### GENERAL

Strengthening the University of Arizona's competency in the area of watershed management utilizing systems analysis techniques applied to problems of less developed countries has taken several forms. The addition and revision of pertinent course curricula, the analyses of research programs and the addition of new faculty are items that occurred in the early stages of the 211 (d) Grant. The improvements in teaching facilities, the accomplishments in the research program and the rendering of service that occurred during the second year of the Grant will be briefly reviewed under the headings of teaching, research and consulting.

#### Teaching

The efforts for increasing the University's competency in teaching has been directed so that a lasting benefit will be available to the less developed countries after expiration of the 211 (d) Grant. Thus, a major activity has been the development of a computer-oriented instruction program given the name CARES - Computer-Assisted Resource Educational System. The heart of this facility is a small, inexpensive computer, a high-speed paper tape reader and teleprinter, together with a

programming language, the necessary models, relationships, etc., and the dialogue between student and "instructor". As an aid in visualizing the hydrologic response of watersheds, treated or untreated to precipitation inputs, a Passive Electronic Watershed Model is being developed.

Not to be overlooked is the continuing efforts of various University departments to revise its teaching program in keeping with the Grant's objectives. Although a major effort was made in this direction during the first year, the departments of Watershed Management, Agricultural Engineering and Agronomy continue to revise some of their water-related courses.

#### Research

Increasing the University's research capability has been mainly concerned with the development and modification of the various hydrologic models, the decision-making models and the procedures that will be utilized by CARES, the teaching facility. Several hydrologic models are nearing completion such as a stochastic precipitation model and a resource management decision-making model. The development of a programming language and the required dialogue for CARES has been initiated. Under preparation is a computer-oriented instruction for a course in basic forest hydrology.

An electronic circuit analysis program has been adapted for rapid numerical analysis of the Passive Electronic Watershed Analog Model. This will allow the model to be used for quantitative purposes as well as for visual observation of the hydrologic response of a watershed.

## Consulting and Services

Encouraged by the University, several of the staff made consulting trips, primarily to Latin American countries. In one instance, a trip to Northwestern Mexico for the purpose of discussing the possibility of Mexico becoming a training center for Latin America on certain range management and water-related areas was favorably received. Another trip was used to determine the nature of watershed management problems in the Far East. Representatives from Pakistan, Indonesia and India expressed a deep concern for these problems in their respective countries.

### OBJECTIVES AND SCOPE

Under the 211(d) Grant, the University of Arizona's assignment of responsibility is in the area of watershed management with special emphasis on the science and methodology of applying systems analysis techniques to problems of less developed countries. The specific technical topics involved include:

1. Economic evaluation of land management practices for optimal use of water and land.
2. Analysis of hydrologic regimes.
3. Simulation models for predicting water supply.

A more detailed description of the objectives and scope of the University of Arizona program was presented in the first annual (1969-70) report submitted by CUSUSWASH.

#### MAJOR ACCOMPLISHMENTS

Accomplishments during the second year of the Grant have followed along the lines initiated the preceeding year. Coordinating on-going teaching, research and service programs with objectives related to the 211(d) program involves interdisciplinary ties with such departments as Agricultural Engineering, Agronomy, and Water Resources and Systems Engineering.

##### Development of Teaching Competence

A major effort in strengthening the teaching capability of the University is in the continuing development of a computer-oriented system for instruction in resource management. The acronym CARES -- Computer-Assisted Resource Educational System-- has been applied to this procedure. It utilizes a teaching-research facility, the core of which is a small, relatively portable and inexpensive 8K to 32K computer with magnetic tape transport, a high-speed paper tape reader and teleprinter, all of which should be readily available to emerging nations. The facility is a completely interfaced hydrologic data acquisition-analysis system. In addition to the computer it includes software and hardware for working with live-telemetered

data.

Financial support from the International Biological Program, Analysis of Ecosystems funded by the National Science Foundation is directed mainly towards the data acquisition aspects of the facility. The use of 211(d) funds has been in connection with the instructional program of the facility (CARES).

To instruct in the area of watershed management utilizing systems analysis techniques, computer programs are essential in developing the components or sub-routines such as stochastic models of precipitation which are inputs to watershed models used to predict hydrologic products, water and sediment, resulting from various land treatment practices. Superimposing decision-making models on the above physical models makes the use of computers an absolute necessity in analyzing the hydrologic potential of a watershed. Going one step further the computer can also be used as an instructional tool.

While not a new concept, computer assisted instruction (CAI) is currently being practiced at a growing number of institutions for a variety of subjects, one of which may very well be watershed management. In a 1968 report on an Office of Naval Research Contract (N00014-68-C0236) it was stated that there are at least three educational requirements which make CAI inevitable. These are: (1) the trend to individualize instruction, (2) the growth and complexity in information to be acquired, and (3) the shortage of qualified instructors.

Instruction in watershed management, a relatively new science, utilizing systems analysis, a relatively new set of techniques, is an area where all three requirements are met.

Students in resource management, upon graduation, will have to wrestle with problems of quantification in the real world. They will be obliged to face problems having complex physical, biological, sociological and economic attributes. They will have to synthesize information from many areas of knowledge, apply the information to solving problems, and adapt to change.

This will require a basic understanding of the physical, biotic and human environment and most important, a capability of translating this understanding into planning and decision-making. Simple answers to the complex problems facing managers today are, increasingly, less possible. The applied utility of computers often provides the only approach to obtaining workable solutions.

Computer-oriented instruction permits the student resource manager to be trained by the very system that will become one of his most important tools when he graduates. By compressing time and eliminating tedium with the computer, the student can be exposed to a greater number of more complicated and more realistic situations. The instructor, freed from routine and time-consuming functions can devote more of his attention to student needs, course content and course structure. He is moved into the more demanding dual role of

tutor and lecturer.

A computer-oriented instructional program for a course in basic forest hydrology is currently being prepared, a major portion of which will deal with the various processes and their interactions that influence the movement of water through a watershed. A special programming language is being developed concurrently. It is intended that the required dialogue between student and the "instructor" will be available in several languages.

Continued activity occurred in the development of the Passive Electronic Watershed Analog Model discussed in the initial report. An electronic circuit analysis program has been adapted for rapid numerical analysis of the analog. This will allow the model to be used for quantitative purposes. Thus, not only will students be able to visualize the effects of a given watershed treatment on the model, it may be possible to quantify the results. The mathematical description of the analog is readily amenable to computer assisted instruction techniques. Efforts have just been started towards packaging the electronic equipment into a portable field unit and developing descriptive material that describes the relationships between the electronic response and the behavior of the physical system. With this accomplished, the dialogue for a CARES program can be prepared.

The Department of Agricultural Engineering completed the revision of Agriculture 190, International Agriculture. A new course was added to the Watershed Management curriculum, WSM 305, Modeling of Small Watershed Hydrology. This allows WSM 345, Advanced Watershed Management, to concentrate on the use of systems analysis techniques for optimizing the management of watersheds. Watershed Management personnel assisting in the instruction of Hydrology 214S, Field Hydrology (Summer Camp), stressed the need for more effective planning, development and utilization of water resources in less developed countries.

Library acquisitions in the pertinent subject matter areas were continued. In addition, a bibliography on snow hydrology was compiled.

#### Development of Research Competence

Strengthening the research capability of the University of Arizona in the area of systems analyses in watershed management is tied to the procedures used to increase its teaching competency. To utilize the computer-oriented instructional program, CARES, necessitates the simultaneous development, modification and evaluation of models and procedures employed in this subject matter area. Research projects in progress within the Department of Watershed Management that relate to this area are as follows:

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## Development of Competence for Consultation and Service

The University has continued to encourage staff members to offer consultation in watershed management. Closer cooperation in research and training in certain aspects of range management and water utilization between Northwestern Mexico and Arizona was the prime motive of a trip to Hermosilla, Sonora by Professors M. M. Fogel and E. L. Smith and Extension Specialist, B. N. Freeman. A leading proponent of this endeavor is a former Department of Watershed Management now working in Mexico. The possibility of using the research and training facilities currently being constructed as a Latin American training center was also discussed. The Mexican federal government, the State of Sonora and private individuals are cooperating in this investigation center.

During a trip to New Zealand to present a research paper at a meeting jointly sponsored by UNESCO and the International Association of Scientific Hydrology, Dr. Fogel discussed watershed management problems with many of the participants from the less developed countries. In general countries with large populations, such as Indonesia, Pakistan and India could readily identify their watershed management problems as being associated with increasing and regulating streamflow and conservation in the water-source areas. They differentiated between these problems, which they believed to be in large part population induced, and their irrigation problems.

As part of the USAID/Brazil Contract, Drs. Barnes and Matlock of the Department of Agricultural Engineering visited Brazil on consulting assignments.

Twenty-four University of Ceara' faculty and Peace Corps--Columbia participants such as Tom Skinner have trained at the University of Arizona and taken work developed by the 211 (d) program. Several people from LDCS such as Zere Gebrehewit of the Ethiopian Ministry of Agriculture from the AID missions are working directly in the 211 (d) program area.

#### Universities Contribution and Entrainment

With the added competency gained by the University through the 211 (d) Grant, the entrainment effect of other resources towards the support of related studies continues. Taking advantage of this increased capability to obtain other grants and research contracts the University contributes by normally being required to support the research on some kind of matching basis. During the past year, grants or contracts have been awarded from NSF, OWRR, USDA and several private companies to do research in areas closely related to the objectives of the 211 (d) Grant. Additional support is also being sought from NASA, OWRR AND BLM AND HGW.

A more direct involvement concerns the time of the Project Director and other closely associated personnel which have been paid from University funds. Additional

spaces and related facilities have also been provided for use by the Watershed Management Department in carrying out its 211 (d) functions.

The development of the instruction program for CARE is a tedious process and must go through a number of iterations of the sequence--program evaluate, de-bug and validate. Because of their interest in the CARE program the University Computer Center is donating as much free time on their terminal as needed for developing the programs.

Four faculty received partial funding of their salaries from 211 (d) with the University contributing most of the salaries. Three other faculty who receive no support from 211 (d) are also devoting the bulk of their efforts to the to the 211 (d) project.

The Desert Biome portion of the International Biological Program, analysis of ecosystems, whose objective is to develop computer models of desert ecosystems, plans to concentrate their watershed modeling efforts at Tucson. Primarily, this is due to the impact 211 (d) has given the Universities watershed modeling efforts.

The University of Arizona has contributed space, remodeling expenses and equipment to facilitate work under 211 (d). Actually, over \$20,000 of capital equipment (over a period of 4 to 5 years) has been committed to the project from State and other funds.

## WORK PLAN

Many of the activities initiated during the first two years will be continued in the next year. As before, major emphasis will be placed on the development of CARES-the computer-oriented instruction program. The less developed countries will derive a lasting benefit with the realization of this system. The research program will continue its efforts to provide much of the inputs that will be needed for such a system.

Recognizing that perhaps the University's weakest phase of the 211 (d) Grant is its consulting activities, the University intends to become more familiar with the programs of the other CUSUSWASH members. In this way, consultation may be accomplished on a team basis rather than on an individual University basis. Solution to watershed management problems requires knowledge of the entire system including the delivery of water and on-farm irrigation practices.

Table I. Expenditures for Fiscal Years 1969-71 and Anticipated Expenditures through 1973-74.

	<u>69-70</u>	<u>70-71</u>	<u>71-72</u>	<u>72-73</u>	<u>73-74</u>	<u>Total</u>
Salaries	38,113	40,221	40,000	35,000	30,000	191,334
Wages	9,430	4,015	5,000	4,000	2,000	24,445
Fringe Benefits	<u>3,771</u>	<u>4,892</u>	<u>4,100</u>	<u>3,700</u>	<u>3,400</u>	<u>19,863</u>
Sub Total	51,314	57,128	49,100	42,700	35,400	235,642
Stipends	6,213	9,640	14,000	10,000	8,000	47,853
Travel						
Foreign	--	2,620	4,000	4,500	3,500	14,620
Domestic	3,368	3,253	2,000	2,000	1,000	11,621
Equipment	2,694	7,985	3,500	3,500	3,500	17,179
Computer	1,348	100	1,400	2,000	2,000	6,848
Operations	<u>2,993</u>	<u>4,864</u>	<u>4,000</u>	<u>2,300</u>	<u>2,080</u>	<u>16,237</u>
TOTALS	67,930	81,590	78,000	67,000	55,480	350,000



PART III  
COLORADO STATE UNIVERSITY

ANNUAL TECHNICAL REPORT 211(d) PROJECT  
AID/csd 2460

August 31, 1971

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## I. SUMMARY OF CONTRIBUTIONS TO THE UNIVERSITY CAPABILITY

A review of the total 211(d) Grant program for FY 1970-71 leaves little doubt as to the effectiveness of the Grant in stirring the interests of GRA's and faculty and, thus, further increasing the capabilities of Colorado State University with regard to teaching, research, and service in the area of water resources as related to less developed countries.

### A. New Staff Personnel

There have been a number of additions to our teaching staff having experience in water resources. Dr. Ronald Tinnermeier joined the Department of Economics staff in March 1971. From 1967 to 1971 he was in Peru as an Assistant Professor of Economics with the Agricultural Mission, and also spent a year at Bogota, Colombia, with the Land Tenure Center. Presently he is involved in both 211(d) and CUSUSWASH activities as well as teaching. Dr. Wayne Clyma joined the Agricultural Engineering staff in June 1971 and, at present, is working on salinity in irrigation water. He is also working with Professor George Smith on Integrated Management of Ground and Surface Water. Professor William W. Hansen joined the Civil Engineering Department in June. He is presently working on a mathematical model for the Indus Basin Development in Pakistan as well as other related research. Dr. Garth Jones joined the staff at CSU in August of 1970 as a Development Specialist in Public Administration and Economics. Dr. Jones has had considerable international experience, especially in the field of Public Administration, recently as Chief of Party, University of Southern California in Pakistan, and later as Chief of Public Administration Division, AID Mission to Pakistan. He has made an excellent contribution to CSU's participation in international and interdisciplinary activities. Maxwell E. Becker joined the CSU staff in March 1971, as a technical administrator. He is responsible for both the technical and administrative requirements for the 211(d) program, the Water Management Research Project in West Pakistan, the AIT Project in Thailand, as well as to assist in developing new projects and programs. He has had wide international experience in technical assistance, administration, and research, especially in the field of forestry during the past 17 years.

These men joined the faculty and staff on the basis that they want to be involved in water resources activities related to the needs of the less developed countries. CSU continues to correspond with many other highly qualified scientists, some of whom appear to be interested in the needs of less developed countries and may join the CSU staff at a later date.

## B. Graduate Research Assistants

In all, 21 Graduate Research Assistants have benefited from Grant funds. The time element of the benefit for each GRA varied from  $\frac{1}{4}$  to  $7\frac{1}{2}$  months. The GRA's attend the International Interdisciplinary Seminars and participate in both leadership of the meetings as well as discussions. Some participated in the field trip to Mexico, some in weekly project leaders' meetings, and all received faculty consultation and guidance on an interdisciplinary basis with regard to research programs and projects, course offerings, and special activities on problems and needs of the less developed countries. This resulted in graduate students taking courses in other disciplines outside of their field of specialty.

## C. New Course Offerings

211(d) funds have, both directly and indirectly, had a bearing on new course additions and course reorganizations.

For example: The course Institutions and Economic Development: Latin America, was initiated by the Department of Economics to emphasize the role of institutions in the process of economic development as well as to emphasize the interdisciplinary aspects of the development process. Another course offered for the first time, Economic Analysis and Water Resource Development, was given in response to the growing interest in water resources at the graduate level at CSU and promotes interdisciplinary approaches to problems of water resources management. The course was offered without support of 211(d) funds which is another example of the entrainment effect mentioned in Part III of this report. Two new courses, Geography of Underdeveloped Areas, and Geography of Native Farming Systems, contain a wealth of material germane to the purposes and goals of the 211(d) program. Thomas Harblin of the Sociology and Anthropology Department introduced a new course, Industrialization and Urbanization in the Third World in selected underdeveloped nations.

In addition to the new course offerings above, the Department of Political Science plans to offer 9 new courses in the area of Public Administration and 4 within the area of Environmental Politics and Administration. Also, 4 other courses have been revised and strengthened. Here, again, the entrainment effect of course reorganization and new course offerings is apparent. The men primarily responsible for the above, Phillip O. Foss, Chairman of the Department; Henry P. Caulfield, Leo J. Cefkin, Garth N. Jones, John A. Straayer, Norman I. Wengert, and others, happen also to be actively engaged in the International Interdisciplinary Seminar program supporting the CSU/AID

Contracts and actively promoting interdisciplinary approaches to solving problems of the less developed countries.

D. Publications

211(d) Grant funding was used in publishing two reports. They are:

1. The Effect of Data Limitations on the Application of Systems Analysis to Water Resources Planning in Developing Countries, May, 1971, Author: L. Garcia-Martinez.
2. Check-Drop-Energy Dissipator Structures in Irrigation Systems, May, 1971, Authors: G. V. Skogerboe, V. Somoray, W. R. Walker.

E. Special Activities

1. Seminar

The International Interdisciplinary Seminar in Water Resources Management was conducted during the academic year 1970-1971, and met for two hours each week throughout the academic year. Faculty members from seven academic departments constitute the Program Committee which critically reviews the seminar program each year and develops the plan for its conduct for the succeeding year. The Chairman of the Committee is Professor Henry P. Caulfield, Jr. of the Department of Political Science. The list of papers presented at the seminars, speakers, together with other information is given in Section III of this report.

2. Water Resources Library

As a result of considerable basic bibliographical searching accomplished at CSU during the past several years, it is apparent that there is a considerable body of valuable water resources literature not readily available. Much of this literature is of a fugitive nature, i.e., reports and papers with limited distribution and difficult to obtain. To overcome this problem as well as to more effectively meet increasing international and national responsibilities in Water Management Research, it is proposed that the CUSUSWASH Universities participate in an inter-university agreement to establish a library system that will eventually make all types of water resources information, including interdisciplinary approaches to water management on a world-wide basis, more readily available.

### 3. Role of Universities in the Future

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 thrust of this program is in water resources development, including agriculture, engineering, watershed management, geology, economics, and various aspects of the biological and social sciences. There are 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, education, and service in the different departments of Colorado State University.

However, today CSU feels that the Land-Grant University--at least in Colorado, has largely achieved its initial goals of developing excellence in Agriculture and the Mechanical Arts as established by the Morrill Act of 1862. This Act provided services to areas of important need 100 years ago, but what are the areas of need today? Should the university in the second century of its existence expand its goals and horizons to become more instrumental in finding solutions to the current and future social and environmental problems of society both at home and abroad? To better answer these questions, CSU is planning a conference devoted to examining what new directions United States colleges and universities should take to serve more effectively as instruments of planned social change and how best to implement these new directions. The conference will have a dual theme:

1. The role colleges and universities in the U.S. are able to play, and should play, in planned international development.

2. The extent colleges and universities can fruitfully expand their original horizons and address themselves to other problems in this country and abroad such as urban social problems and the nature of the human environment.

The above topic provides a fertile seed bed for designing new plans and approaches by CSU and other universities to far better fulfill the objectives of the 211(d) Grant program in the future.

## II. OBJECTIVES AND SCOPE

### A. Objectives

The major objectives of the Grant program are to increase and expand the 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.

### B. Scope

1. Using funds from the Grant, Colorado State University continues to improve its level of excellence with respect to planning, development, management, and utilization of water resources with special emphasis on water delivery and removal systems and relevant institutional development related to the needs of the less developed countries. This is being accomplished through the following steps:

- a. Expanding the professional staff in the various departments of the University which are now involved, or which would like to be involved, in water resources activities related to the needs of the less developed countries.
- b. Expanding the number of graduate students in these departments from, or interested in, the less developed countries.
- c. Expanding departmental research programs and activities related to the needs of the less developed countries.
- d. Expanding course offerings in these departments--including interdisciplinary courses--which are related to the less developed countries.
- e. Expanding special activities, and initiate new ones, 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 less developed countries.
- f. Helping to alleviate the critical shortage of qualified professional personnel with international interests, experience, and expertise, and with cross-cultural insights.
- g. Expanding 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. It would be understood, however, that substantial specific services in this area will be funded by AID and any other sponsoring agencies under separate contractual arrangements.

- h. Improving understanding of the nature of the less developed societies, and finding ways and means of assisting them to resolve crucial problems relating to water resources development and management.
- i. Developing 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 less developed countries.

## 2. Types of Specialization in LDCs

- a. Development of water supplies from various sources.
- b. Conveyance, delivery, and drainage of water in open and closed conduits, including rivers, canals, irrigation ditches, tunnels, and pipelines.
- c. Storage and use of water in reservoirs, both above and below ground.
- d. Control and measurement of water in storage, and water being conveyed either for delivery or for drainage.
- e. Control of erosion and sedimentation with respect to storage.
- f. Use of wells as a source of water or for storage of water underground.
- g. Use of systems engineering for development of optimum solutions to problems of water resources utilization.
- h. Understanding social, economic, political, and cultural factors in technological change, and the processes of developmental change.
- i. Analysis of prevailing social systems, their structural-functional characteristics within specific less developed countries to determine:

\*The kinds of structural changes necessary for maximizing water resource development and management, including the use of necessary new inputs.

\*The sources of resistance to these necessary changes, and

\*Effective ways of dealing with social resistance.

- j. To analyze specific organizational and administrative structures for agricultural development in specific less developed countries to determine needed changes for better water utilization in maximizing agricultural production.
- k. 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 less developed countries.
- l. 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.

### 3. Plan of Operation

Some broad and continuously expanding aspects of the plan of operation used as a guide in managing Grant funds includes the following:

- a. Obtaining and analyzing existing information on water delivery and removal systems related to the less developed countries.
- b. Obtaining and analyzing existing information on development of institutions relevant to optimum utilization of water resources in the less developed countries.
- c. Preparing plans for additional research programs which will increase the knowledge of methods, techniques, and procedures for optimizing the utilization of water resources in the less developed countries.
- d. Increasing the breadth and depth of teaching and educational materials for the subjects of this proposal and for the situations in various less developed countries.
- e. Soliciting especially well qualified graduate research assistants, from both the United States and the less developed countries, who expect to work in some aspect of international development upon completion of their training.
- f. Expanding the water management research library collection, especially with respect to the water resources problems of the less developed countries.

- g. Developing a program of student and faculty exchange with selected less developed countries.
- h. Planning, initiating, and expanding an interdisciplinary seminar on development and the interrelationship of the many factors involved in development--especially in the less developed countries.
- i. Conducting 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.

### III. MAJOR ACCOMPLISHMENTS

CSU accomplishments may be characterized by their entrainment effect, the elements of which are fully described below. The manner of funding is also essential in determining the type and scope of accomplishments. The funding from 211(d) Grant at Colorado State University continues to be used very carefully in relatively small amounts to entrain other funds and personal time and effort from various sources that exist in the university structure and in various professional organizations. Also, the funding in small amounts stimulates the individual to entrain other funding and efforts to support and expand the interest and capability of personnel and organizations with respect to international development.

CSU accomplishments are also characterized by their interdisciplinary approach to international development involving technical, social and cultural factors. One aspect of this approach, and a very effective one, is developed through the International Interdisciplinary Seminar in Water Resources Management described in detail below.

On the basis of accomplishments thus far, it can be concluded that the 211(d) Grant funds for increasing institutional capability can serve as pump-priming money to entrain the time and effort of various faculty and graduate students together with funds from numerous other sources already existing in the university structure or which have the potential for being brought into the university structure.

#### A. Entrainment Effect

The 211(d) Program has charged CSU with the responsibility of involving not only the technical aspects but also the social science aspects of improving the capability of CSU to perform various functions beneficial to international development. We have taken the position that we can best improve our capabilities through improving our human resources, our various educational and research programs, and our service activities--all of which have been the assigned responsibilities of Land-Grant Institutions since they were first created more than 100 years ago. The various parts of this total effort consist of the following:

##### 1. Providing new staff

The capability of CSU in international development is quite strong in some disciplines, but needs considerable strengthening in other disciplines. For this reason funds in small amounts have been provided to make it possible to employ several new staff members. Although the funds provided through the Grant have been a small percentage of the total necessary to employ and service these individuals, the funds have been used in such a way as to insure that

each individual employed has a capability in a technical area of concern to the LDC's and an interest in working in international development either in the United States or overseas, or both. By this means a small amount of money has been spent from the Grant and yet an individual with the desired qualifications has been obtained and paid for largely by funds which have been entrained from other sources.

## 2. Improving staff capability

Many of the existing staff members at CSU have exceptional capability in technical fields of interest under the 211(d) Grant Program. However, the efforts of most of these individuals have not been directed toward the area of international development. By using small amounts of funding from the Grant, it has been possible to get a rather large number of the faculty to direct their technical capability toward international development. Thus, the entrainment effect has also been used here to bring other funds to bear on the 211(d) Program.

Staff capability has been increased by having individuals make trips to the LDC's to become acquainted first hand with the LDC's and their problems, by paying one or two months of his salary per year so that he will have time to direct his existing technical capability toward the problems of international development, by providing him a graduate research assistantship so that the faculty member is directing at least one graduate student toward the application of his technical field of specialization to international development, and by helping to make arrangements for various staff members to be consultants on problems of international development, both in the United States and overseas, with various agencies concerned with this effort. Again, the objectives of the Grant are accomplished largely by funds entrained from other sources.

## 3. Increasing or improving technical information

The capability of CSU to perform services in the field of international development is largely dependent upon the generation of additional or improved technical data and information regarding the various facets of international development. This is true not only in engineering and agriculture, but also in the social sciences with respect to the techniques of helping development actually to occur. To accomplish this objective, small amounts of money have been provided to various professors and programs where effort is already under way or could be initiated without large-scale funding from the Grant. Here again the intent is through the entrainment effect to stimulate a professor with existing technical capability to direct his efforts toward

international development. In some cases a graduate research assistantship is provided which will cause a graduate student and his professor to become heavily involved, both in the development of research and special studies and in publishing--to provide in the literature additional information required for better international development.

The 211(d) Grant has resulted in a number of papers and other professional publications being prepared in the general direction of international development which otherwise would have been prepared with a different approach or would not have been prepared at all. Small amounts of funding have also been used for the purchase of publications which bear upon some aspects of international development.

In each of the foregoing cases the entrainment effect is operating because the graduate research assistantship is not expensive and yet both the class work and the research of the graduate student is directed entirely toward international development, and the professor must be largely oriented in the direction of international development despite the fact that his funding is for only a small part of his total time. Likewise, the library and other parts of the university which purchase publications use their own funds to purchase additional publications on topics related to international development because they observe the extent of interest on the part of the faculty and the graduate students.

#### 4. Strengthening organizational structure

Although accomplishing the objectives of the 211(d) Grant requires the expansion and improvement of human capability--both students and faculty--it is also of utmost importance that the necessary organizational structure be provided which will permit these individuals to be effective, both now and in the future. Such organizational structure includes various types of programs--academic, research, and service. The academic programs include combinations of courses which are designed around the theme which expresses the purpose of the 211(d) Grant. In all participating departments courses have been added and existing courses have been reoriented so that there is a heavy emphasis on international development and the technical areas of concern under the 211(d) Grant. This is true also of the research programs and other activities of a service nature. Assistance has been given to various "centers" and committees within the university structure to guide their activities into international development. The entrainment effect is in operation here because small amounts of funding have resulted in very largely directing the efforts of the entire organizational structure toward international development.

Faculty and graduate students have also become increasingly involved in professional society activities, both international development societies such as the Society For International Development and the regular professional societies, by guiding various committees, meetings, and programs in the direction of international development.

B. Improving International Interdisciplinary Competence Through Water Resources Management Seminars

International development is a process which takes place with many factors being involved. Not only are technical aspects necessary for international development to occur, but also the social and cultural factors are of paramount importance in understanding how development actually occurs. Unfortunately, most faculty involved in the technical aspects of development have very little understanding of the social and cultural factors involved, and likewise those faculty specializing in the social and cultural aspects of development have only a superficial grasp of the technical aspects with which they are involved. For this reason an International Interdisciplinary Seminar in Water Resources Management has been created to provide an opportunity for interaction among faculty and graduate students originating from a multitude of disciplines. Faculty and graduate students from one discipline hear the presentations of faculty and graduate students from other disciplines and participate in discussions from various points of view.

This seminar has already proven to be highly effective in increasing the capability of CSU faculty in the area of international development. The entrainment effect is involved because it results in those who are funded in part through the 211(d) Grant spending a much greater proportion of their time thinking about and working on international development. Likewise, the Seminar has entrained large amounts of time and effort of other faculty and graduate students who are not funded under the Grant.

1. Seminar Background

In implementation for the second year 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," the International Interdisciplinary Seminar in Water Resources Management was conducted during the academic year 1970-1971, and met for two hours each week throughout the academic year.

Faculty members from seven academic departments--Agricultural Engineering, Agronomy, Civil Engineering, Economics, Fishery and Wildlife Biology, Political Science, and Sociology--constitute the Program Committee which critically reviews the seminar program each year and develops the plan for its conduct for the succeeding year. The Chairman of the Program Committee and the faculty member in charge of the conduct of the seminar is 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.

## 2. Seminar Guidelines

Guidelines for conduct of the Seminar, which were adopted in the fall 1969, are still in effect. They provide that the purposes of the interdisciplinary seminar (with respect to water resources management generally, but especially in LDC's) are to:

- a. Identify the factors involved in such management and their interrelationships;
- b. Relate these factors and their interrelationships to optimum water resource utilization;
- c. Develop models reflecting alternate strategies for achieving of one or more conceptions of optimum utilization of water resources;
- d. Test these models in relation to the experience of practitioners and observers of water resources management;
- e. Recommend research to test these models explicitly and in greater depth;
- f. 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
- g. 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.

### 3. Types of Seminar Papers

- a. Interdisciplinary seminar papers prepared by faculty-student teams on major interdisciplinary problems in water resources management.
- b. Country by country presentations on cultural and institutional factors pertinent to water resources management with particular focus on change from traditional to modern agriculture.
- c. Outstanding speakers on topics particularly pertinent to the concerns of the Seminar.

### 4. Interdisciplinary Seminar Papers Presented

- a. "Fisheries, People, and Priorities," W. Harry Everhart, Professor, Department of Fishery and Wildlife Biology; Howard Alden, Associate Professor, Department of Recreation Resources; Charles W. Thomas, Professor of Engineering, Department of Civil Engineering; Thomas Van Valey, Assistant Professor, Department of Sociology and Anthropology; and Holmes Rolston, Assistant Professor of Philosophy, Department of Philosophy.
- b. "Integration of Vector Prevention and Control into Multipurpose Management of Water Resource Development Projects," Dr. A. D. Hess, Assistant Director of Ecological Investigations Program and Chief, Fort Collins Laboratories, U.S. Public Health Service; Mr. Louis J. Ogden, Assistant Chief, Ecology and Control Unit, Zoonoses Section, Fort Collins Laboratories, U.S. Public Health Service; Mr. Fred D. Hamston, Assistant Chief, Biology and Control Unit, Arboviral Disease Section, Fort Collins Laboratories, U.S. Public Health Service. Opening discussion by Colin Webster and Ray Ericson, graduate students in the Department of Political Science and Department of Watershed Sciences, respectively.
- c. "Optimal Timing of Water Application," Dr. Raymond L. Anderson, Research Economist, USDA Economic Research Service; Dr. Garth N. Jones, Professor, Department of Political Science; Dr. Bashir M. Malik, Post-Doctoral Fellow, Agronomy.
- d. "Green Revolution: Farm Size, Mechanization and Employment," Dr. Huntley H. Biggs, Assistant Professor, Economics Department, and "Some Political and Social Consequences," Robert F. Schmidt, Graduate Research Assistant, Political Science Department.
- e. "Modeling Water Quality in Rivers," John Hendrick, Graduate Research Assistant, Civil Engineering Department.

- f. "Conjunctive Use of Ground and Surface Waters," Robert L. Longenbaugh, Assistant Professor, Department of Civil Engineering; Robert A. Young, Associate Professor, Department of Economics; and George E. Radosevich, Attorney and graduate student in Department of Economics.
  - g. "Dynamic Optimizing Model for Comprehensive River Basin Planning," Dr. Maurice L. Albertson, Professor of Civil Engineering; M. T. Chaudhry, Graduate Research Assistant, Department of Civil Engineering; John Davenport, Graduate Research Assistant, Department of Civil Engineering; and Dr. Archie D. Hess, U.S. Public Health Service.
  - h. "Land Classification," Dr. John O. Reuss, Associate Professor, Department of Agronomy; Mr. R. D. Heil, Assistant Professor, Department of Agronomy and Mr. J. Stuart Krebs, Assistant Professor of Geography.
  - i. "The Effluent Society: Water Reuse and Recycling," Dr. Albert G. Mercer, Associate Professor of Civil Engineering; Dr. David W. Hendricks, Associate Professor of Civil Engineering; and Mr. Noel Hobbs, Chief Planner, Denver Water Department.
5. Country by Country Presentations
- a. "Cultural and Institutional Problems in the Transformation of Traditional to Modern Agriculture--Introduction to Forthcoming Country by Country Presentations," Linwood Hodgdon, Professor of Sociology.
  - b. "Transforming Traditional Agriculture: Schultz's Economic Model and a Critique of This Model," Professor Linwood Hodgdon, Professor of Sociology.
  - c. "Toward an Interdisciplinary Model of Development in Under-Developed Countries--Part I," Dr. Loyal M. Hartman, Professor of Economics.
  - d. "Toward an Interdisciplinary Model of Development in Under-Developed Countries--Part II," Dr. Loyal M. Hartman, Professor of Economics.
  - e. "A Classification System for Ideological Components in International Development," Robert Schmidt, GRA, Political Science Department.
  - f. "Cultural, Institutional and Agricultural Change in North Africa: Morocco, Algeria, and Tunisia," Dr. Hubert J. Morel-Seytoux, Professor of Civil Engineering.
  - g. "Development and Water Management in Mexico," Dr. Gene Wilken, Associate Professor of Geography.

- h. "Problems of Development in Botswana," Dr. Leo Cefkin, Professor of Political Science.
- i. "Water Resources of Thailand: Distribution, History and Institutions for Development," Edmund F. Schulz, Associate Professor, Civil Engineering Department.

6. Presentations By Outstanding Speakers

- a. "The Bureau of Reclamation's Foreign Activities," The Honorable Ellis Armstrong, Commissioner, Bureau of Reclamation, Department of the Interior, Washington, D.C.
- b. "The Role of the U.S. University in International Development," Dr. Erven Long, Associate Assistant Administrator, Office of AID Research and University Relations, Bureau for Technical Assistance, Agency for International Development, Washington, D.C.
- c. "Dynamic Optimizing Models for Comprehensive River Basin Planning--The Results of the Harvard Water Program and Subsequent Developments," John Wilkinson, Director, Water Program, Arthur D. Little, Inc., Cambridge, Massachusetts.
- d. "International Boundary and Water Commission, United States and Mexico," The Honorable J. F. Friedkin, United States Commissioner.
- e. "Observations on African and Mekong Water Planning," Dr. Gilbert White, Professor of Geography and Director, Behavioral Science Institute, University of Colorado, Boulder.
- f. "Regionalism and Development--Case Studies Drawn From South Asia," Dr. M. Rashiduzzaman, Visiting Professor of Political Science, Columbia University, New York (1971-72 and regularly, Reader in Political Science, Dacca University, Pakistan.
- g. "The Changing Culture in Ceylon," Dr. Walpola Rahula, Buddhist monk and scholar from Ceylon.
- h. "Some Experiences With Agricultural and Water Resources Programs in Developing Nations--Particularly Iran," Dr. Harold Frederiksen (Civil Engineer), Deputy Director of Engineering, Development and Resources Corporation, Sacramento, California.

7. Special Interests Presentations

- a. "Emerging Conceptions of Developmental Assistance: Implications of President Nixon's Proposal," Dr. Garth Jones, Professor of Political Science, CSU.

- b. "The Peace Corps and the Process of Modernization: Reflections of Returned Volunteers," John Davenport, Trust Territories, Public Works; Philip Hosterman, Afghanistan, Public Works; Karl Paasch, Kenya, Agriculture; and Colin Webster, Thailand, Public Health.
- c. "Future Directions of the Land-Grant University at Home and Abroad," Dr. Maurice L. Albertson, Professor, Civil Engineering; Mr. Jan Carlson, Director, Student Activities, Student Center; John Davenport and Philip Hosterman, Graduate Research Assistants, Civil Engineering. Discussants: Dr. Garth Jones, Professor, Political Science; Dr. M. W. Felton, Assistant Director, Extension Service, CSU; Robert Schmidt, Graduate Research Assistant, Political Science.

#### 8. Faculty-Student Field Trip To Lower Balsas River Basin Project, Mexico

In addition to planning the foregoing seminar program, the Program Committee reviewed the recommendations stemming from the Faculty-Student Field Trip, June 5-7, 1970, to the Lower Balsas River Basin Project, Mexico (see p. C-31, Part III (Colorado) of CUSUSWASH Annual Technical Report for 1969-70, dated August 31, 1971) and agreed that a second trip should be undertaken. Accordingly, 16 faculty members and graduate students from seven different academic disciplines undertook the field trip to the Lower Balsas River Basin Project, March 16-24, 1971, with the financial support provided by the 211(d) Institutional Grant to CSU. Dr. Huntley H. Biggs, Assistant Professor of Economics and a specialist in Latin American economic development, was team leader. The principle objective of the Institutional Grant is to enhance the competence of CSU in the water management problems of the less-developed countries. It is recognized that institutional arrangements and cultural factors have a definite bearing on the water management problems as they exist in different countries. Because of the long history of Mexico in the development of water resources, it follows that a knowledge of the Mexican experience would enhance the understanding of water management problems as they exist in the context of a less-developed country. The institutional arrangements in Mexico for developing and administering water and land resources provide valuable lessons for those intending to pursue their professional interests in the less developed parts of the world. Also, the proximity of Mexico, which provides a distinct culture contrast, affords convenient and economical access for U.S. universities. With one exception, the 16 participants (five faculty and eleven students) in the field trip to Mexico were U.S. citizens interested in developing their professional competence to deal with water management problems in the less developed countries of the world. The total cost per participant was \$300. (For a full report on this field trip see Section III, Travel.)

## 9. Seminar's Contributions Towards Grant Goals

The continued implementation of item eight of the Operational Plan for carrying out the Grant Agreement, the International Interdisciplinary Seminar in Water Resources Management which, upon its inception, was an entirely new approach to education in water resources management at CSU, 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 less-developed countries in water resources management.

## 10. Seminar's Planned Work For FY 1971-1972

The general plan developed by the Program Committee for conduct of the International Interdisciplinary Seminar on Water Resources Management in 1971-1972 calls for the following three types of seminar presentations:

- a. Interdisciplinary Modeling of Water Management Problems  
Emphasis in the development of papers to be presented to the Seminar will be placed on rigorous construction of interdisciplinary models. Problems will be selected which appear to have good prospects of successful solution and that include variables from three or more academic disciplines. Recruitment of balanced faculty-student team to prepare approximately five such papers will be undertaken.
- b. Theories of Modernization of Development of Less-Developed Countries. A faculty-student group especially interested in this subject will develop a program of presentations to cover selected models of modernization and development that have been developed by various scholars both in the United States and abroad.
- c. Review of the Comprehensive Framework Study of the Flatte-Niobrara Sub-Basin. This study is a part of the larger Comprehensive Framework Study of the Missouri River Basin (one of eleven such large studies now underway or recently completed in the United States) that has been recently completed by the Missouri Basin Inter-Agency Committee, which is composed of represen-

tatives of the several Federal departments and agencies and of the States that are concerned. A faculty-student group especially interested will undertake review of the Platte-Niobrara reports and prepare papers for presentation to the seminar. Criteria to be developed to guide the review will relate: (a) to the appropriateness of the study design, professional competence exhibited in conduct of the study, and the usefulness of the results in terms of the needs of the United States; and (b) to the usefulness of such an approach to planning water and related land resources use in less developed countries.

As in the first two years of the International Interdisciplinary Seminar, 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.

However, after reviewing the conduct of the Seminar for 1970-1971, the Program Committee decided that steps should be initiated to formalize the conduct of the Seminar within the administrative structure of the University, to obtain concurrence of the Faculty Curriculum Committee of the Faculty Council that the International Interdisciplinary Seminar in Water Resources Management be included among the regular course offerings for which academic credit is granted, and to have information about the Seminar included in CSU's General Catalog. The Program Committee plans to develop proposals along these lines and pursue acceptance of them during 1971-1972.

#### C. Other Accomplishments, FY 1970-1971

The total 211(d) Grant man-month input on the activity accomplishments by the participant disciplines indicated in Tables I and II, Section IV, amounted to 12.4% for the CSU faculty, while that of the graduate research assistants, including clerical and labor, reached a total of 24.9% on a 12-month basis. These figures decisively underscore the "entrainment" effect described in Section III.

Other CSU accomplishments, beside the International Interdisciplinary Seminar on Water resources Management, include the interdisciplinary activities of faculty and GRA's in accordance with the objectives of the 211(d) Grant program as follows:

##### 1. Recruitment

Dr. Wayne Clyma joined the Agricultural Engineering staff in June 1971 and, at present, is working on salinity in irrigation water. He is also working with Professor George Smith on Integrated Management of Ground and Surface Water.

Professor William W. Hansen joined the Civil Engineering Department in June. He is presently working on a mathematical model for the Indus Basin Development in Pakistan and other related research.

Dr. Garth Jones joined the staff at CSU in August 1970 as a development specialist in Public Administration and Economics. Dr. Jones has had considerable international experience, especially in the field of public administration, recently as Chief of Party, University of Southern California, and later as Chief of Public Administration Division, AID Mission to Pakistan.

Dr. Ronald Tinnermeier joined the Department of Economics staff in March 1971. From 1967 to 1971 he was in Peru as an Assistant Professor of Economics with the Agricultural Mission, and also spent a year at Bogota, Colombia, with the Land Tenure Center. Presently he is involved in both CUSUSWASH and 211(d) activities as well as teaching.

The men joined the faculty and staff on the basis they want to be involved in water resources activities related to the needs of the less developed countries. CSU continues to correspond with many other highly qualified scientists, some of whom are interested in the needs of less developed countries and may join the CSU staff at a later date.

## 2. Faculty Research Activities

Research at CSU in the Department of Agricultural Engineering has been extended during FY 1970-1971 to include conveyance, control, and measurement of water in conveyance channels. The research efforts with respect to "Combination Check-Drop-Energy Dissipators" has been completed and the report is presently under final review. This report covers current concepts and procedures pertaining to design of these structures in irrigation conveyance systems, written by Gaylord V. Skogerboe, Venus T. Somoray, and Wynn R. Walker, was presented at the annual winter meeting of the American Society of Agricultural Engineers in Chicago in December 1970. In addition, parts of the draft of the final report were reproduced for distribution to students of AE 455, Irrigation Structures. Current research and analysis directed toward conveyance and measurement of water in conveyance channels in being undertaken by Mr. Tsu-Yang Wu, from Taiwan; Mr. Va-Son Boonkird, from Thailand; Mr. Ray S. Bennett, of the United States; and Mr. James H. Barrett, of Australia. Mr. Bennett has concluded data collection in the laboratory and is currently analyzing the data to develop rating curves for a wide variety of cutthroat flume sizes. Mr. Wu has also completed data collection on the hydraulic and rating effects caused by a longitudinal slope in the same cutthroat flumes. Both Mr. Wu's and Mr. Bennett's research are being closely coordinated to determine both the general relationship

of discharge rating in various flume sizes and the effects on these ratings caused by an imposed slope in the flume which is a common field occurrence resulting from uneven settlement in the foundation of the flume. Mr. Eoonkird's work will be initiated during this report period relating to "Free Surface Subcritical Flow in Culverts." This area of research is an important area of needed evaluation because of the common occurrence of this regime of flow in culverts. In addition, the numerous culvert installations provide excellent water measurement structures, thus avoiding construction of standard measurement devices. Mr. Barrett has been working on developing criteria for analyzing various open channel constrictions found in irrigation distribution systems. Although the laboratory portion of his study will begin in July of 1971, he is currently completing an evaluation relating the Chezy and Manning channel roughness factors to the submerged flow equation developed by Professor Skogerboe at Utah State University. This will provide a basis for relating channel resistance in both the constricted and unconstricted open channel. To facilitate the data analysis required for Mr. Wu, Mr. Boonkird, Mr. Bennett, and Mr. Barrett, a submerged flow model has been developed by Mr. Walker of the Agricultural Engineering Department. The digital computer program has been used extensively during both Mr. Wu's and Mr. Bennett's research and has been shown to be a valuable tool. Mr. Barrett and Mr. Walker are currently developing a more comprehensive program to use in Mr. Barrett's analysis and which can be used to develop discharge ratings for submerged sections.

The departmental staff of Agronomy continues to investigate quality criteria for irrigation water on the Pakistan Water Management Project. This is closely coordinated with the educational program. In addition, field studies have been conducted at Fort Collins to evaluate irrigation and crop use efficiencies. Lysimeter facilities were used for precision measurement of evapotranspiration rates under varying meteorological conditions in order to relate potential and actual E.T. evapotranspiration. Data from outside sources were used to help evaluate the irrigation schedule methods under different climatic conditions. Some excellent data of this type is now available from other countries and needs evaluating.

Professor Biggs served as a team leader for the presentation on March 3 dealing with "The Green Revolution." In preparation, this team met six times to provide a background to the main topic. These sessions were devoted to the following talks:

- October 8 "The Green Revolution: Requirements and Consequences." Professor Biggs, Department of Economics.
- December 1 "An Interdisciplinary Approach to the Consequences of the Green Revolution," Group Participation.

- February 4 "Economic Implications of the Green Revolution." Professor Biags, Department of Economics.
- February 15 "Political Consequences of Regional Economic Disparities." Rev. Robert Schmidt, Department of Political Science.
- February 22 "Institutional Aspects of the New Seed-Fertilizer Technology," Professor L. Hodgdon, Department of Sociology.
- March 1 "A Synthesis." Group participation.

Research continued in a number of fields and areas bearing on the problems of development, including:

"Crop Climate Modification by Native Farmers" (draft now under review - Wilken).

"Resource Management and Farming Systems in East Africa" (proposal submitted to NSF in March, 1971 - Wilken).

"Tepetate, A Problem Soil in Mexico" (joint research by Wilken and Geology Department, funded by FIC 1970-71).

"Ecologic Implications by Economic Development" (paper in preparation - Wilken).

Professor Caulfield has continued his role as Chairman of the International Interdisciplinary Seminar in Water Resources Management, the implementation of item eight of the Operational Plan for use of the AID Grant. He serves as Chairman of the Program Committee for the Seminar composed of eight faculty members, implements the committee decisions by arranging for specific seminar presentation, chairs the meetings, and helps guide discussion to meaningful conclusions. In addition to his chairmanship of the International Interdisciplinary Seminar in Water Resources Management during 1970-1971, Professor Caulfield has participated in several of the meetings of the Council of U.S. Universities for Soil and Water Development in Arid and Sub-Humid Areas and is serving as a Consultant to the Water Section Resources at Transport Division, United Nations, in the preparation of draft paper on "Water Resources Policies." Professor Caulfield was a member of an international panel of experts which met in Buenos Aires, Argentina, in June 1970, and gave pertinent considerations to the topic of the paper. He is scheduled to attend the second meeting of the panel in Delft, Netherlands, to review the draft paper in September 1971. Dr. Garth N. Jones attended the Joint Utah State University/ Agency For International Development Conference held at Logan, Utah, August 17-24, on Institution Building. He chaired the Committee on the Pre-Planning Stage and drafted the final committee report. He also participated as a member of the Water Development Workshop Program of the Agricultural Development Council (ADC) and attended the first workshop session at Utah

State University, February 12-13, 1971; met with Harold Capener, Gilbert Levine and others at Cornell University on April 5 and 6, to develop research and training program on systems for water development in the less developed countries, and on April 7 discussed this proposal at ADC headquarters in New York. This activity was financed by ADC. Dr. Jones also presented a paper on December 23, 1970, to the senior scholars and professional staff of the East-West Center, Hawaii, on "Emerging Conceptions and Patterns of Development Assistance." His trip was independently financed. A research model for the evaluation of on-farm distribution systems was completed. This is based upon a simulation model developed by Raymond Anderson, ERS USDA, and Arthur Maass of Harvard University. It is proposed to test this model on one or more Southeast Asian irrigation systems, possibly those found in Indonesia and in the Philippines. The draft proposal has been completed. Preparation of titles for the CSU library acquisition on development administration and water management as well as a number of fugitive materials has already been turned over to the CSU library. In addition, for political science research, a large number of research items have been acquired, much of it of a fugitive nature.

While Sociology and Anthropology faculty time amounting to three and one-half months was provided by 211(d) funds, the actual time spent by the faculty (e.g. Drs. Dotson, Knop, Sardo, Van Valey and Vlachos) on aspects of the 211(d) in the department was twice as great. In addition, Dr. Linwood Hodgdon served as a department representative on the 211(d) Seminar throughout the academic year for which he was given one-half a month release time by 211(d) funds. The 211(d) project has stimulated professional interest in international development, particularly in natural resources, within the department. Likewise, the project has provided members of the faculty with a professional experience to acquire and broaden their knowledge of natural resource development on the international scene. The research of the program has been directed toward the following goals:

- a. A continuation of the work towards creation of a data bank containing demographic and other information on the international and national level. Computer tapes for the State of Colorado as well as secondary census materials have already been acquired. Censuses of other countries are being collected systematically to the extent possible. The census of Venezuela is in CSU's collection, and arrangements are made to supplement our collection of Greek yearbooks with the Greek census returns of 1971.
- b. Outlining some models on the impact of urbanization and industrialization on the quality of life. A problem of special interest has been the transformation of rural localities and the disappearance of farm land. A project has been initiated concerning economic and social costs and benefits of migration on selected Colorado communities.

- c. Collecting information and works concerning models of water resources on both quantity and quality problems. Emphasis is placed on land use, natural resources availability, receptivity towards change and organizing schemes of systems approach. A paper has been submitted to the Rural Sociological Society entitled "Organizational Aspects of Irrigation Companies."

Special activities include:

- a. A special monograph series, as well as a series of methodological notes, and a Newsletter. The methodological notes and monographs include such topics as: Simulation models and systems approach in natural resources (esp. water systems); demographic profiles and population projections; urban simulation and gaming; internal and international migration as factors in the developmental process; planned change and modernization with emphasis on the interplay between social and technological factors.
- b. We are anticipating two monographs by July 1971--one dealing with the general population characteristics of Colorado (1970 Census). The other monograph will focus on international migration and will analyze the trends of emigration from Greece between 1950-1970 and the impact of the large population outflow on the prospects of Greek development. A third monograph is scheduled on "Natural Resources and Developing Countries," a joint effort of a number of Sociology faculty interested in problems of development and modernization.

Other activities include:

- a. Providing the focus and a significant motivating force for a number of faculty and graduate students to turn attention to problems of developing countries, especially as they refer to the utilization of natural resources. It is expected that the data bank created, the expanded computer capability, the development of courses, seminars, and symposia, and all other training opportunities will provide the basis and at the same time reinforce the departmental commitment in the area of development.
- b. The exchange of information and research plans in the area of natural resources and water management with a number of institutions and agencies abroad. Professional contacts have been made with the University of West Pakistan, Lyallpur; University of Sao Paulo, Brazil; and Pierce College, Athens. Efforts have also been made to initiate a study of "Metropolitan Intelligence Systems in Developing Countries." A lecture was given to the

Technical Chamber of Athens, Greece, and contact for future cooperation has been established with the Metropolitan Athens Water Company.

- c. An exchange program has also been initiated with various population centers in the country and it is envisaged that regular contact and exchange will continue with various research organizations and centers, both in the U.S. and abroad.

### 3. GRA Research Activities

Four graduate research assistants, John Davenport, Alain Deredec, Philip Hosterman, Michael Schiefer in the Department of Civil Engineering are supported in part, and to a lesser extent seven GRA's, J. Duke, G. Lewis, G. Overacker, E. Rios, D. Taylor, P. Thiemert, and S. Doddiah (11 GRA's in all), are supported by the Grant to study water management and system analysis for the developing nations. An example of the type and scope of work accomplished by graduate research assistants as well as the effectiveness of the use of 211(d) funds for training and building interest in working with less developed countries on water resource development is the following research activities report by John T. Davenport.

"In fall quarter I expanded on some earlier work by Phil Hosterman and wrote a short paper with M. L. Albertson entitled, "LDC/CSU Development Worker Program. This paper outlined some possible ideas for CSU if it were to become much more intimately involved in international development than it is at present. A good percentage of these ideas stem from my own experiences in Peace Corps. However, writing this paper introduced me to some of the literature on development. I have continued to pursue this topic as one of my interests outside coursework.

During the academic year I attended nearly every 211(d) Interdisciplinary Seminar and was a participant in two of them. In one I was a panel member discussing the Peace Corps and in the other I presented the "LDC/CSU Development Worker Program" paper with Albertson and Hosterman.

From coursework from Charles Walter Thomas and Henry P. Caulfield, I have developed an interest in evaluation of water resource projects. This interest has been pursued inside and outside of coursework. I have studied specific evaluative criteria used by the U.S. government as well as the more general topic of technology assessment.

Over the spring break I traveled to the Balsas River Basin in Mexico with several students and faculty under the 211(d) Program. Here I was able to have many long conversations about development with Walter Illsley and other group members. I also observed several water resource development projects in a developing country setting.

In June I attended the two-week Water Resources Planning Seminar at Utah State University in Logan, Utah. This Seminar was very beneficial to me. The principal speaker, Mr. Aaron Wiener of Tahal, Israel, provided me with a wealth of new concepts with which to analyze water resource development in the Third World. Mr. Wiener also indicated to me that there may

be a place for me on a new research project that Tahal has with the World Bank. This project intends to investigate improving investment efficiencies for the World Bank in Latin American development projects. A particular focus will be on water resource projects.

During spring and summer quarters I have assisted M. L. Albertson and R. N. Hubbell in preparing for a Planning Meeting to be held September 3-5, 1971, at B-700 Park. This meeting will lay plans for a conference in 1972 devoted to investigating new directions for the Land Grant Universities with regard to international development. My efforts have consisted of helping draft letters and abstracting pertinent articles and books which deal with this subject.

I will attend the Planning Meeting September 3-5, 1971, and assist in tape-recording, note-taking, and other tasks to insure the meeting runs smoothly.

Beginning September 1, 1971, I will join Henry Caulfield and assist him with his O.W.R.R. Grant. This project intends to work on a methodology by which water resource planning policy can better be established and water resource projects can better be evaluated. The recent "Orange Books" of the Water Resources Council spell out the conceptual framework; and this project intends on making this framework implementable.

I expect my association with this project will be invaluable as far as backgrounding me further in water resource project evaluation. This project is, by necessity, a very interdisciplinary effort; and Henry Caulfield is an interdisciplinary person. To approach the field of evaluation, I must be able to analyze projects from several vantage points.

I expect my own dissertation will center on this topic of water resource project evaluation. At this time it seems that a good starting point would be to do some kind of post-audit analysis on an existing project. The purpose of this analysis would be to test out some of the findings of the O.W.R.R. Grant. The biggest problem will probably be the selection of a suitable project. An immediate task before me would be to study carefully all available literature on post-auditing.

There are three alternatives in doing this kind of study:

1. If Mr. Wiener decides for certain that I could join his project next summer (1972), I could perform this study in an international setting. The project will probably be located in Mexico City and may involve travel to one or more Latin American countries. Such a study would combine both my interests of evaluation and development. It could also strengthen the findings of the O.W.R.R. Project by subjecting them to an international analysis centering on development. This is the most desirable alternative to me. Further development of this idea must await word from Mr. Wiener.
2. If the project with Tahal doesn't materialize, I could possibly remain an additional year with Henry Caulfield and do this study with some U.S. project. This could be selected from the U.S. Bureau of Reclamation's files in Denver, for instance.
3. I could rejoin the 211(d) Project after one year and pursue the international development aspects of water resource project evaluation.

At this time my main concern is getting word one way or the other from Mr. Wiener. I expect to know more about this matter in mid-September after Henry Caulfield meets with Wiener in Delft, Netherlands.

I will continue to participate in the 211(d) Interdisciplinary Seminar during the coming year."

The following graduate students in the Political Science Department participated in the Interdisciplinary Water Management Seminar:

Robert Schmidt delivered a paper January 6, 1971, "Classification System for Ideological Components in International Development." Colin Webster participated in a panel on the role of Peace Corps in the development process February 17, 1971. Robert Schmidt participated in discussions on Green Revolution, March 3, 1971. Colin Webster participated in discussions chaired by Dr. M. L. Albertson exploring the role CSU may perform in the education of development personnel.

Other graduate student activities:

Colin Webster, a master candidate, divided his research time between Pakistan Water Management and preparation of an organization and management manual for irrigation companies. John Fly, a graduate assistant, despite the kidnapping of his father in Uruguay last August and the need for his services by his family in trying to obtain his father's release, continued under the supervision of Professor Caulfield a substantial program of study during 1970-1971 towards a M.A. degree and has drafted a preliminary design for a master's thesis pertaining to comparative political characteristics of developing nations. Mr. Fly plans to continue this academic program related to the 211(d) Program in 1971-1972.

Professor Biggs of the Department of Economics has taken the responsibility for supervising the study and research programs of the graduate students being funded under 211(d): Ph.D. candidate, P. Sananikone, and M.S. candidate, Larry Caswell. During the year, both students have regularly attended the International Interdisciplinary Seminar and actively participated in the team activities concerning the Green Revolution. Mr. Caswell and Mr. T. Harris, who will be funded as a GRA for FY 1971-72, represented the Department of Economics on the field trip to Mexico.

Mr. Caswell has completed the course requirements for the M.S. degree with emphasis on economic development and natural resources economics. He is currently working on his thesis entitled, "The Impact of Public Investment in Irrigated Agriculture on Mexican Economic Development," under Professor Biggs' supervision. This work should be completed by the end of the summer, 1971, but will require close supervision by Professor Biggs as part of his Grant responsibilities.

Mr. Sananikone is an outstanding Ph.D. student in the Department with an M.S. degree from the University of Colorado. Having completed the M.S. degree in November, 1970, he is pursuing course work for the Ph.D. degree with fields of specialization in economic development, natural resources economics, and international economics. Each of these fields

is essential in order for him to qualify for holding a position in the Planning Commission of his home country, Laos. During the year, both graduate students have assisted Dr. Biggs in conducting research. Mr. Janasikorn anticipates writing a dissertation on a development project within the Southeast Asian area. During the summer, 1971, working under Professor Biggs' supervision, he will be investigating possible topics for his dissertation research.

The Department of Sociology is presently using the services of a GRA, Craig Brown, who has been working on population projections and is also helping in the computer analysis of the 1970 Census returns for the State of Colorado. He is also helping in the construction of a systems model for the analysis of natural resources. The group has already offered an assistantship to a foreign student from Greece who is going to help in a project on the impact of urbanization in developing countries on natural resources.

#### 4. Course Changes

The Department of Economics offered a new course entitled EC 464, Institutions and Economic Development: Latin America. This course was initiated in direct response to the need for a course emphasizing the role of institutions in the process of economic development. The approach emphasized the interdisciplinary aspects of the development process, the majority of the class being noneconomics majors. Because of his experience and interests in Latin America, Professor Biggs selected this area as a case study. In addition, this course complements and places in perspective the contemporary economic problems analyzed in EC 466, Economic Development of Latin America. During the winter 1971, Professor Lee Gray offered for the first time a graduate course entitled, EC 542, Economic Analysis and Water Resource Development. This course was developed in response to the growing interest in water resources at the graduate level at Colorado State University. It was offered without the support of 211(d) funds, but it is directly supportive of the goals of the Institutional Grant among which is the promotion of interdisciplinary approaches to problems of water resources management. (A number of students from areas outside of economics attended the course.) Additionally, this course expands the Department's offerings within the Ph.D. field of specialization in natural resources economics. Not only does natural resources, as a field of concentration, have the largest number of Ph.D. candidates from economics, but also it has traditionally attracted many graduate students from departments outside of economics, thereby encouraging interdisciplinary research efforts. Dr. Gene C. Wilken introduced two new courses, "Geography of Underdeveloped Areas" (spring 1971) and "Geography of Native Farming Systems" (fall 1970), both of which contain substantial amounts of material germane to the purposes and goals of the 211(d) program. An additional series

of courses on problem environments is being developed by Professor Stuart J. Krebs to eventually include "Arid Lands", "Mountain Regions", and "Arctic or Polar Lands" (titles tentative). Investigation of settlement and development in these difficult environments will be of particular value in increasing the competency of CSU as a center for development studies.

The Department of Political Science has recently reorganized substantially the Political Science curriculum. Two new concentrations were developed, one in the area of Public Administration and the other in Environmental Politics and Administration. Nine (9) new courses will be added within the field of Public Administration. They are:

- Public Personnel Administration
- Administrative Systems and Analysis
- Organization, Theory and Behavior
- Problems of Public Financial Management
- Comparative Development Administration
- Administrative Law
- Manpower Policy and Development
- Executive Processes and Development
- Administration of Financial Resources

Four (4) courses have been revised and strengthened in Environmental Politics and Administration. They are:

- Current Environmental Problems
- Legal Processes and Environmental Control
- Politics and Policy in Natural Resources Administration
- Politics and Policy in Water Resources Planning and Management

In addition to the above, the course on Politics of Development and National Building in the Area of Comparative Government has also been substantially changed and strengthened.

Dr. Thomas Harblin of the Department of Sociology and Anthropology initiated a new seminar entitled, Industrialization and Urbanization in the Third World, fall quarter, five credits. This seminar focused on the processes of industrialization and urbanization and their implications for change in selected underdeveloped nations (e.g. China, Latin-America, West Africa, etc.).

Dr. Linwood Hodgdon of the same Department continued to represent the Department in the 211(d) Interdisciplinary Seminar--International Water Resources Management. Dr. Hodgdon assumed major responsibility for planning the Seminar for the fall and winter quarters. In addition, he presented two papers, entitled:

"Cultural and Institutional Problems in the Transformation From Traditional to Modern Agriculture"

"Transforming Traditional Agriculture: Schultz's Economic Model and a Critique of this Model"

## 5. Workshop Activities

At the request of Dr. Wayne A. Schutjer, Director, Research and Training Network of the Agricultural Development Council, the Department of Economics sponsored a Workshop on Teaching Land Policy at Colorado State University, April 29-30, 1971. Personnel from the Department of Economics who have been active in the 211(d) Grant program included Ronald L. Tinnermeier, Gene C. Wilken, James A. Munder, and Kenneth C. Nobe. Raymond L. Anderson, Economic Research Service, USDA, stationed at CSU was also included. Other invited participants included faculty members in agricultural economics, resource economics and geography from The Pennsylvania State University, Michigan State University, University of Hawaii, Oklahoma State University, University of Massachusetts, University of New York (Amherst) and the University of Minnesota. Dr. Wayne Schutjer of ADC and Dr. Gene Wunderlick, ERS, United States Department of Agriculture, also participated. The general purpose of the workshop was to consider how graduate level education in the area of land policy can be made more useful to students from LDC's and to the U.S. students specializing in agricultural development. Thus, the workshop effort provided direct support to the CSU 211(d) Grant efforts.

## 6. Publications

### a. Published research, including press items, are:

\*Bibliography, Garth N. Jones and three co-authors-- Shaukat Ali, Richard Barber and Jim Chambers. Planning, Development and Change: Bibliography on Development Administration, Honolulu, East-West Center Press, 1970.

\*"Accounting and Budgeting Reform in Pakistan for National Development; Reconsideration of Fundamentals," Co-author Saiyid M. Hamid, NIPA/Karachi. In press, National Institute of Public Administration Journal, Karachi.

\*John A. Straayer, "Public Problems and Non-Decision Making," Natural Resources Journal, July 1970. This article does not bear directly upon developing states, but is concerned with public water management.

### b. Research in progress includes:

\*Monograph, Garth N. Jones, "Monastery Model of Development: Towards a Strategy of Large Scale Planned Change": Under publication consideration.

\*Pakistan Government and Administration. Materials collected, Garth N. Jones co-editor with B. A. Abbas and Rashiduzzaman. Awaiting political developments in Pakistan before finalizing draft for publication. A book of readings.

\*Emerging Conceptions and Patterns of Development Assistance: Implication of President Nixon's Message. Draft completed by Garth N. Jones.

\*Department of Administrative Science, Case Study in Planned Organizational Change in a Developing Society by Garth N. Jones. Under publication consideration, University of Southern California.

c. Other

\*John A. Straayer conducted an "Institute on Local Water Management" in May 1971, with HUD financial support. This Institute involved no AID funds, but did have some additional payoff relative to the goals of the 211(d) Program.

\*Professor Norman I. Wengert conducted a graduate level seminar of "Institutions for Metropolitan Water Resources Management," summer 1971. This related tangentially to the goals of the 211(d) Grant, but at no cost to US/AID.

\*Professors D. W. Hill and R. L. Meek completed the final report of a four-year study entitled, An Exploration of Components Affecting and Limiting Policy-Making Options in Local Water Agencies. This research was funded by U.S. Office of Water Resources Research. While it relates only indirectly to overseas development, this research, in combination with activities supported by the State of Colorado and other sources, complements, and affords reciprocal intellectual support to the activities supported by US/AID.

D. Relationships of Accomplishments to Grant Program Objectives

The following examples and statements are given to show more clearly CSU accomplishments in Water Resources Management and their relationships to specified Grant program objectives given in Section II of this report:

One example of 211(d) fund use is that provided Professor Skogerboe, Department of Agricultural Engineering, which has allowed him to expand the number of graduate level students from less developed countries while at the same time gaining an appreciation for the irrigation practices in these countries. During the report period research has been accomplished which will serve to alleviate the needs these countries have concern-

ing water measurement, conveyance, and control. The course, AE 455, Irrigation Structures, which came as a direct result of the project, is to be offered again and will be strengthened by the research being completed. Probably one of the more important results accrued from the project thus far is the experience being obtained by working in this area. The investigators are better prepared to act in an advisory and consulting capacity, both to students and individuals or agencies who may be interested in service abroad. This was well demonstrated by the participation in the "Irrigation Practices Training Course" conducted by the Agricultural Engineering Department for the first time last year. Since the course is to be conducted again this year, the experience gained will be a benefit in handling the course.

The competence of the Agronomy staff in international problems concerning water management has been increased considerably by participating in interdisciplinary seminars, from foreign members of the staff, including foreign visitors, and by contacts and linkages established through U.S. and international travel.

The Department of Civil Engineering, with use of 211(d) funds, has improved its level of excellence in planning, developing, managing and utilizing water resources as related to water delivery and removal systems including relevant institutional development associated with the needs of less developed countries. For example, Dr. Morel-Seytoux established many good contacts in North Africa and as a result an educational exchange program may be initiated. He also presented a paper at an International Conference in Israel. In addition, he gave a course at CSU on "Optimization of Large Scale Water Resources Systems Under Uncertainty," which is particularly relevant to underdeveloped countries.

During 1970-71, the Department of Economics Developed new courses specifically designed to enhance the knowledge of persons having professional interests in dealing with water management and related general development problems of the less developed countries; has actively participated in interdisciplinary efforts under the International Interdisciplinary Seminar; provided leadership in the organization and executive of a field trip for the purpose of analyzing the development process and problems in communities of the Balsas River Basin, Michoacan, Mexico; pursued research interests and publications in the area of economic development; supervised a graduate student's program of study and research; and sponsored an ADC Workshop on Teaching and Policy.

During the year the entire Political Science Department component has been strengthened--its faculty, curriculum, research capacity, development of new talent, and institutional linkages with U.S., national and international water-related agencies. Research undertakings have been facilitated

and the diffusion of water resource knowledge and technology abroad as well as in the U.S. has been increased. However, substantial funds from government agencies other than 211(d) appropriations were used to achieve these ends.

This year, the training opportunities for the Social Science's graduate students have been increased significantly through use of 211(d) funds, especially as related to establishing international and national data banks designed to provide continuously updated findings and materials related to the demographic and modernization characteristics of various nations as well as for regional units. Progress has also been made in using data banks to establish more effective sample designs of larger ecological units such as river systems, irrigation systems, etc., to be used for undertaking research on problems of development change. Also, information is now being collected on both quantity and quality of water resources, availability of natural resources, land use, including associated problems and schemes of systems approach as solutions. A special monograph series has been initiated which will deal with the above subject material.

#### E. Future Plans, FY 1971-72

The effects of past years planning, coordination, and integration of 211(d) Grant activities at CSU will come into sharper focus this year. Frequent interdisciplinary conferences, the International Interdisciplinary Seminar, semi-annual meetings, frequent contacts with the Project Leaders and personnel of the Project Office, all serve to constantly make the 211(d) program at CSU more effective, and more efficient with the passage of time. Some of the activities and plans considered for the future are as follows:

It is anticipated by the Agricultural Engineering Department that all of the graduate students working in this area during this period will complete their theses. Mr. Wu will complete his thesis by July 31, 1971, while Mr. Barrett will complete his by December 31, 1971. As presently anticipated, both Mr. Boonkird and Mr. Bennett will complete their theses during the early spring of 1972. We are planning on Mr. Albert Koenig arriving at Colorado State University to begin work on his M.S. program in January, 1972. Mr. Koenig would be given a graduate research assistantship under the 211(d) funding and would do his work on a topic regarding irrigation structures. The notes and handouts for the AE 455 class will be improved upon prior to the winter quarter of the 1972 school year. In addition, it is presently contemplated that the class will also be upgraded by student exercises using the computer program developed for the project so that experience can be gained and more sophisticated design can be made. In order to expand the research at Colorado State University, two papers concerning cutthroat flume studies have been submitted for presentation at the American Society of Agricultural Engineers' annual winter meeting in Chicago.

The Department of Agronomy plans to expand the competence of its staff, including arousing the interests and capabilities of graduate students in water management problems in the less developed countries. Emphasis will be placed on a) evaluation of water quality criteria for irrigation under a wide range of soil and crop conditions and, b) evaluation of irrigation and crop use efficiencies under various methods of irrigation scheduling.

Civil Engineering plans to continue the effort to obtain new faculty with an interest in overseas development of the underdeveloped countries and expertise in water resources development, planning, management, systems analysis and computer programming. Four new faculty are needed in this area. The Department will continue to upgrade and broaden present faculty in the water resources problems of the developing countries and increase competence in water management, systems analysis and design. To accomplish this, graduate students will be financed for specific projects presented by a faculty member and overseas travel for consultation with foreign officials and study of specific problems will be financed either in part or totally. Staff personnel will also continue to take part in seminars where problems associated with the development of water resources are presented.

The proposed plan of work by the Economics Department designed to further the objectives of the 211(d) Grant funds will be primarily focused in three areas: a) participation in interdisciplinary research activities under the International Development Seminar; b) research and publication on subjects dealing with problems of the less developed countries; and c) increased professional qualification through enhanced competency in quantitative methods for developmental planning. More specifically: Professor H. H. Biggs will design a research project, under the Water Management Project in Pakistan, for the purpose of testing some of the hypothesis developed in this article, "The Green Revolution: Farm Size, Mechanization, and Development." Professor Biggs will also supervise the thesis research efforts of three graduate students to be funded under the 211(d) Grant. Jim Sananikone will be doing preliminary research for his Ph.D. dissertation on the Mekong River Project. Tiffen Harris will be investigating possible M.A. thesis topics in the area of water resources management in developing countries. And Larry Caswell will also complete his M.A. thesis on "The Impact of Public Investment in Irrigated Agriculture on Mexican Economic Development." Firmer contacts with individuals and institutions in Mexico will be made based on contacts initiated in the spring of 1971 and hopefully will be repeated in the spring of 1972. Professors Wilken and Krebs of Geography will continue to participate in the Interdisciplinary Seminar. Professor Krebs will initiate courses on problem environments which will not only increase the quality of

instruction at CSU but will add measurably to his professional competence. Professor Krebs has had considerable research experience in Chile and elsewhere. Professor Wilken will complete a book entitled, "Geographic Aspects of Development" (title tentative). He will also continue research on resource management and native farming systems, with special reference to the role of these systems in the developing world. With the impetus provided by the 211(d) Grant program, Geography can expand and add valuable dimensions.

Over the next three years, building upon the previous five years of systematic development, the primary goal of the Department of Political Science is to strengthen further its capacity in the area of politics, planning and administration (management) of natural resources with special emphasis upon the development and the protection of water resources in the arid and semi-arid regions of the world. Recognizing that the solutions to this area are perplexing and difficult, that a number of countries are confronted with problems in this area and have established research centers, and that it often has an international dimension, a comparative approach is being followed which requires first hand knowledge of water development problems. Future plans, some of which have already been partially achieved, are as follows:

#### Faculty Development

- \*Secure three additional senior faculty members with established reputations (Norman Wengert, Henry Caulfield and Garth N. Jones joined the Department during academic years 1969-70 and 1970-71).
- \*Improve capabilities of at least five other senior and junior faculty members including Phil Foss, Duane Hill, Roy Meek, John Straayer, and Robert Lawrence who already have reputations in the area of water and resource politics, planning and administration.

#### Research Capacity

Enhance research capacity and produce studies in:

- \*Functional problem areas of water management and planning, particularly in agricultural societies.
- \*Development politics and administration, particularly in the regional areas of South and Southeast Asia and Africa.
- \*Institutional and organizational arrangements for responsible and efficient water resource use.

#### New Professional Talent

Produce yearly from five to ten graduate students in resource management and development.

## Summary Note

The final purpose of the Department of Political Science is to establish within the next five years a unique center of excellence in developmental resource politics, planning, and administration. Considerable progress toward this end has been made with the acquisition of a mature and balanced faculty. The weak areas are now namely in the areas of curriculum and qualified American and foreign graduate students. Library materials need to be strengthened, particularly in certain regional areas. Rapid progress is being made in these areas and within the next two years the Department will be in a much improved position to play a more meaningful role in assisting U.S. and international agencies in constructive development programs.

The Department of Sociology and Anthropology, with respect to the 211(d) Grant program, plans to increase its overall competence and effectiveness in performing teaching, training and research functions related to international development, and, specifically to the development of natural resources and water management. The Department, therefore, will expand opportunities for the involvement of its faculty to deal with the substantive and research questions related to the preceding aspects of development. It will raise the ability of its students (particularly at the graduate level) to understand and to acquire skills for dealing with planned technological change. The Department will broaden its course offerings in the areas of planned change, demography-ecology, evaluative research, etc., as related to the developing nations. Finally, the Department will increase the scope of its informational base on the social and cultural aspects of natural resources and water management within the context of international development. The budget request for the Department of Sociology and Anthropology for 1971-72 is entirely directed toward contributing to the continuation and strengthening of the Department's Demographic and Modernization "Center". The concept of the "Center" within the department (described in previous pages) is viewed as increasing our competence in the area of development, including water management.

## F. Travel

International and U.S. travel are indispensable activities in meeting the objectives of the 211(d) Grant program. Oftentimes such travel is accomplished at some cost to the traveler from at least several standpoints, 1) financial and, 2) other commitments on his time. However, the contacts and linkages made with other scientists and institutions of the world, as well as teaching and rendering research and other types of services, outweigh occasional losses of time and funds. To the

University scientists, these contacts are of far greater value than riding a plane and seeing "new sights." Furthermore, these contacts, linkages, and relationships, when taken as a whole, are of significant national importance--far greater perhaps than is generally recognized.

In the interest of fulfilling 211(d) Grant objectives and other AID contract agreements, the following CSU personnel have undertaken international and domestic travel:

1. International Travel

Dr. Maurice L. Albertson

Visited the Asian Institute of Technology, for which he is the Campus Coordinator, located at Bangkok, Thailand, for a period of five weeks. During that period he also visited West Pakistan where, as Project Director for the Water Management Contract, he reviewed the research project with AID Mission officials as well as the sociology project initiated with the West Pakistan Agricultural University. In addition, he visited the International Rice Institute in Manila where discussions were held regarding agricultural irrigation, water research engineering, soil and plant studies.

Dr. Bert L. Ellenbogen, Chairman, Department of Sociology and Anthropology

Dr. David M. Freeman, Assistant Professor, Department of Sociology and Anthropology

Visited Greek government officials and scholars in Athens for the purpose of discussing water management studies having a significant sociology component as well as establishing a center for research in water management and socio-economic development. They also visited West Pakistan where they helped to establish some sociological courses and research projects at West Pakistan Agricultural University as well as participated in water management research program discussions with government officials.

Dr. Manuel Alers-Montalvo

In July and August, 1970, Dr. Manuel Alers-Montalvo, Director of the Center for Latin American Studies, visited with officials from universities and other institutions of Peru, Venezuela and Costa Rica in regard to specific ways in which CSU could be of help to their institutions in solving problems in water resources management. Specifically, to explore the possibilities of exchanges between faculty and students between these universities and CSU, as well as opportunities for collaborative research projects in the

social sciences, natural sciences and agriculture. In addition, Dr. Alers-Montalvo presented a paper at the Congress of Americanists in Lima, Peru.

Dr. Hubert J. Morel-Seytoux, Associate Professor, Civil Engineering Department

Dr. Morel-Seytoux visited several North African countries in June/July 1970, namely, Morocco, Algeria, Tunisia, and Lybia. As a result of this trip, a system of communications was established with competent persons in positions of responsibility. Hopefully, it will be possible to proceed with special studies of water resources development in North Africa in the near future.

Dr. Edmund F. Schulz, Associate Professor, Department of Civil Engineering

Made a round-the-world trip April/May of this year establishing linkages with more than 100 outstanding scientists and high government officials in India, Pakistan, Thailand, Taiwan, Japan, and Hawaii. Some of his activities included presenting a paper at the Symposium of Water Resources, Indian Institute of Science, Bangalore, India; consultation with hydrologists in the above listed countries regarding modernization of methods of acquisition and retrieval of hydrological data including ground water recharge experiments; discussions with agricultural engineers regarding consumptive use of water under the impact of multiple cropping practices; and acquiring data on optimum timing of irrigation on multiple cropping sequences through observing farming practices after harvesting crops-- such data are essential to set up computer based simulation models.

Dr. John O. Reuss, Associate Professor, Department of Agronomy

Dr. Huntley H. Biggs, Assistant Professor, Department of Economics

During June 1970, a group from CSU took a field trip to Mexico to investigate the water projects in the Balsas Basin. The above named faculty members accompanied the group to determine whether such a trip might be beneficial to faculty and graduate students associated with the Water Management Project to repeat in following years. The final report recommended a future trip be scheduled. This was endorsed by the International Interdisciplinary Committee. Accordingly, a field trip was organized and accomplished during 1971 supported by 211(d) funds.

The report of this field trip taken in March of this year and prepared by Dr. Biggs is given below in its entire

context as an example of the entrainment effect of a small amount of money in furthering the goals of the Institutional Grant.

Interdisciplinary Team Field Trip To The Balsas River Basin,  
Michoacan, Mexico, by Huntley H. Biggs, Team Leader

Background: Being a semi-arid country, one of the key aspects of the Mexican development strategy has been the stimulation of regional progress through the construction of multi-purpose water projects. Perhaps no other LDC has had such a long history of water resource development experience as Mexico, even going back to pre-Columbian times. A number of River Basin Commissions have been established with the responsibility for promoting development in all of its aspects including health, education, agricultural production, irrigation works, electrification, and transportation. While most of the persons managing the River Basin Commissions are engineers, they are constantly faced with problems requiring interdisciplinary solutions.

One such Commission is the Balsas River Commission established as the Commission of Tepalcatepec in 1947. Fortunately, CSU has connections with an individual, Walter Illsley, who has been intimately associated with the development of this River Basin since its inception under President Lazaro Cardenas. Mr. Illsley received an M.A. degree in International Economics from Johns Hopkins University. He was in China from 1946-1953, part of his time being spent with the Agricultural Rehabilitation Program of the United Nations Relief and Rehabilitation Agency. For the past 16 years he has been living in Mexico practicing a weaving skill, which he acquired in China, and promoting community development projects on a voluntary basis. In addition, he has conducted several tours of U.S. university students and faculty in the Michoacan area of Mexico. These include Montana State University, Friends World Institute in Long Island, and Putney School in Vermont. Mr. Illsley is a person thoroughly familiar with Mexico's culture and her development problems as they exist both at the community and at the national levels. He is also one of those rare individuals who is capable of exchanging ideas with persons from all disciplines and from all social levels.

During June 1970, a group from CSU took a field trip to Mexico to investigate the water projects in the Balsas Basin with Walter Illsley. Two faculty members, John Reuss from Agronomy and Huntley Biggs from Economics, accompanied the group to determine whether such a trip might be beneficial to faculty and graduate students associated with the Water Management Projects. In that final report it was recommended that a field trip be organized for 1971 with the support of 211(d) funds.

Furthering the Goals of the Institutional Grant: One of the objectives of the Institutional Grant is to enhance the competence of CSU in the water management problems of the less-developed countries. It is recognized that institutional arrangements and cultural factors have a definite bearing on the water management problems as they exist in different countries. Because of the long history of Mexico in the development of water resources, it follows that a knowledge of the Mexican experience would enhance the understanding of water management problems as they exist in the context of a less-developed country. The unique institutional arrangements in Mexico for developing and administering water and land resources provide valuable lessons for those intending to pursue their professional interests in the less-developed parts of the world. Also, the proximity of this distinct culture affords a convenient and economical access for U.S. universities to an LDC.

In keeping with the philosophy of an interdisciplinary approach to water management problems, the team was composed of representatives from each of the departments receiving funding under the Institutional Grant. In this manner the viewpoints of many disciplines could be brought to bear on whatever was being observed or experienced in the field. As a result, penetrating observation could be made to enhance the learning experience.

An additional purpose of the trip was to make contacts with various Mexican educational institutions to learn of their interests and level of professional capabilities. It was anticipated that perhaps more permanent contacts could be developed for the future.

Finally, it was hoped that this experience would stimulate the graduate students to identify research possibilities either of a general nature or specifically with regard to Mexico. The identification of research problems would make the individuals put their formal classroom knowledge to work in approaching practical problems in the field.

Personnel: The Institutional Grant leaders in each department were requested to select one faculty member and two graduate students to participate in the field trip. The following guidelines were suggested for graduate student selection: 1) if possible, he should be a participant in the 211(d) Grant or the Water Management Project, 2) he should have a long-run professional interest in international research and development, and 3) if possible, he should be a U.S. citizen, as one of the primary objectives of the trip is to give the student exposure to the foreign culture and its associated developmental problems." The following persons went on the trip:

<p>Agricultural Engineering:  R. Bennett  D. Buchleiter</p> <p>Agronomy:  J. Reuss (faculty)  P. Copley  J. Green</p> <p>Civil Engineering:  J. Davenport  P. Hosterman</p> <p>Economics:  H. Biggs (faculty)  L. Caswell  T. Harris</p>	<p>Geography:  G. Wilken (faculty)</p> <p>Political Science:  G. Jones (faculty)  C. Webster</p> <p>Sociology:  L. Hodgdon (faculty)  A. Rizwani  C. Brown</p>
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Organization: The field trip was organized by H. H. Biggs, Economics. Prior to departure three meetings were held to provide background information:

March 1 - Organizational meeting to convey tentative itinerary, tourist cards and make financial arrangements.

March 5 - Professor G. Wilken (Geography), "Physical and Cultural Geography of the Balsas River Basin." Professor Wilken has had much field experience in Mexico and Central America.

March 8 - Larry Caswell, graduate student in economics, "Water Development and Regional Progress in Mexico." Mr. Caswell is writing his M.S. thesis on "The Role of Irrigated Agriculture in Mexican Development."

After the trip, two meetings were held to discuss and evaluate the trip. A representative from each discipline gave a presentation concerning the value of the trip from the viewpoint of its particular discipline, made recommendations, and pointed out several research possibilities. These meetings should prove useful for organizing future field trips.

Itinerary: The following is a brief itinerary followed by the group:

March 16 - Flight from Denver to Mexico City. Overnight train from Mexico City to Morelia.

March 17 - Visit to Tecnologico de Morelia, a school for training industrial engineers and technicians. Interview with the director of cultural development and the President of the Universidad de San Nicolas to discuss their academic programs and inform them of WATREMAN Program at CSU. Overland to Uruapan.

March 18 - Interview with Ing. Moriz, director of the Lower Balsas River Basin Commission Office. The development of the

Basin explained and projections for the future discussed, particularly the impact of the Villita Project on the development of the coastal area. Discussion ranged over topics from many disciplines. Afternoon trip to highland Indian villages to contrast development in indigenous and mestizo communities. Visited Capacuaro, a stagnating community, and Paracho, a progressive community specializing in handicraft manufacturing.

March 19 - Trip to the Tierra Caliente with stops and tours of major water projects: Zumpimito and Cupatizio. Toured an ejido (cooperative) melon packing plant under contract with a North American packer. Observed and discussed wet rice growing operation with an ejiditario.

March 20 - Visited ejido operation near Paracuaro. Fields very stony but ejido lacked access to credit for clearing. Visit to experimental station at Atunez where personnel explained efforts to acclimate dairy cattle from abroad to local conditions. At the Rio Balsas Commission Office at Villa Italia, discussed problems of crop planning with representatives of the Melon Growers Association, and problems of fertilizers and soil nutrients with local agricultural engineer. On trip to Playa Azul stopped to observe a number of slash-and-burn operations in various phases, and visited with subsistence peasant family.

March 21 - Trip to Las Penas. Observed rural school initiated by Walter Illsley and supported now by Commission. R.&P.

March 22 - Visited copra marketing cooperative at Melchor Ocampo which was formed to break the monopsonistic element in the market. Talk presented by Ing. Trujillo at Balsas Commission Office at Orilla concerning the Villita Dam Project that is under construction. Tour of the dam site and works. Observed experiment conducted by Ing. Casellejo to terrace mango trees, and thus, improve the productivity of hillside areas currently uneconomically exploited by slash-and-burn for maize production.

March 23 - Return overland to Uruapan and departure by train for Mexico City.

March 24 - Return from Mexico City to Denver.

Expenditures: Each individual received an allowance of \$300 which covered the following expenses: round-trip air fare Denver to Mexico City; rail fare Mexico City to Morelia, and Uruapan to Mexico City; rental and gasoline for two vehicles (4½ days); stipend for Walter Illsley; and room and board for eight days in Mexico. This allowance was just sufficient to meet the above expenses.

Evaluation: Each of the departments submitted a report which included an evaluation, recommendations and possible research topics. The next two sections will be devoted to summarizing these comments. The individual reports are on file in the Project Director's Office. It is safe to say that the trip was successful in meeting its objectives.

Mexico is a semi-arid country which has recognized water supplies as a constraint to development and which has undertaken efforts to alleviate that constraint. The integrated approach to total development practical by the activities of the River Basin Commission is an unique one which has met with a high degree of success in the Balsas Basin. The group was quite interested in meeting the public officials at the Commission offices who daily are faced with development problems from many disciplines, and at many levels. While Mexico is a country that has embarked on the path of development, casual observation attests to the fact that the distribution of the fruits of progress have not been widespread, a fact of concern to government officials.

This trip affords an experience that is beneficial to persons with various backgrounds. It is particularly enlightening for U.S. students who have not had an experience in an LDC. For them it offers the possibility of seeing development problems, and specifically water resource development problems, in an institutional and cultural context similar to one in which they intend to pursue their professional careers. This acquaintance provides the individual the opportunity for becoming aware of areas in which further study and preparation is needed before accepting a foreign assignment.

For the student from an LDC, the trip gives exposure to an LDC which has attained some measure of success in developing water resources and is moving on the path toward total development. Many of the problems faced by Mexicans will be shared by the foreigner and institutions when he returns to his home. A knowledge of the Mexican development alternatives and institutional arrangements could be invaluable by providing beneficial comparative experience.

For the individual with international experience, Mexico offers an excellent basis for comparison. One of the most interesting aspects of the trip was the contribution made by faculty members who could make comparisons and contrasts from their own experiences in LDC's in other parts of the world.

It is doubtful that any other trip can afford one a broader experience in an LDC in such a short period of time. This is due primarily to the leadership of Walter Illsley. Because of his rare quality of being able to communicate with persons at all levels, the group was able to obtain the views of government officials in responsible developmental decision-making positions, subsistence peasants, middle-class

ejiditarios and businessmen. Mr. Illsley is truly a practitioner and agent of development whose long experience in Mexico and intimate acquaintance with the region made the trip truly an enlightening experience for all, regardless of age, international experience, or formal training. This trip offers a valuable learning experience at very little cost.

Recommendations: 1. Advance preparation. Many individuals suggested that greater efforts be made to provide the group with an advance knowledge and background before departure. Therefore, it is suggested that during the winter quarter a seminar for credit be offered which would acquaint field trip personnel with various aspects of Mexico. There are a number of books which have been recently published that would be useful in this regard dealing with such subjects as: water resource development in the Balsas Basin (Barkin and King), federal development policy (Wilkie), economic development (Reynolds), and agricultural development (Venezian and Gamble). The seminar would be an interdisciplinary seminar, bringing materials together from many areas focused on the Mexican example. CSU's Center for Latin American Studies could provide a pool of faculty resources, from any discipline, many with experience in Mexico. Because of his professional background (M.A. in Latin American Studies) and field experience (Argentina), Professor Biggs from Economics may be a candidate for providing the major leadership for this seminar.

Attempts should be made to provide for more structured discussions in the field. These would be focused on field observations, calling upon contributions from each of the disciplines attending. Upon return, a series of meetings should be held in order to put into perspective the various experiences encountered by the group.

2. Association with Mexican institutions. Contacts have been made during the past two years with educational institutions in the region. The orientation of the University of San Nicolas at Morelia is toward the Humanities, Law and Medicine. As a college of the University at San Nicolas, the Agrobiology College at Uruapan, insited in 1970, trains agricultural technicians. Because of its lack of laboratory facilities, there is practically no research being conducted. Thus, the possibilities of initiating a cooperative research effort with a CUSUSWASH institution seems improbable in the near future. However, it does seem reasonable to explore the possibilities of initiating a cooperative program on a more modest basis at the outset. For example, members of their faculty or well-qualified students could enroll in courses at a U.S. university which are vitally needed to promote research at the College. Once a few individuals receive such training, a modest research program may be initiated with CUSUSWASH.

This would call for placing some U.S. personnel at the College in Uruapan, not only to assist in the research, but also to provide instruction to faculty and students. Such an effort would make a vitally important contribution to the instructional and research program at this College.

A second contribution that such a program would make is to encourage graduates of the program to undertake field research in the rural areas where their contributions can be great rather than seeking employment in the urban areas. This is one of the strongest arguments for developing a cooperative program with a college that draws its students from an agrarian region and focuses its efforts on solving problems of a regional nature, rather than seeking a program with a metropolitan institution.

3. Participation of other CUSUSWASH Universities. It is hoped that the experience of CSU will stimulate the other CUSUSWASH Universities to participate in this program in the future. This field trip offers an excellent opportunity for faculty and students from the various universities to become acquainted with each other and to share their professional interests. The cross-fertilization and interchange would be most beneficial in furthering the aims of the mutual cooperation among the various institutions in the CUSUSWASH.

## 2. U.S. Travel

The following CSU personnel attended the listed conferences and meetings:

George Smith to Nebraska: Applied Mathematical Programming in Water Resources

J. Anderson and M. Sonnen to CSU: Urban Water Institute

Donald Taylor to Boston: Engineering Foundation Conference and ASCE headquarters

Garth Jones to Salt Lake City: Regional Conference on Institution Building

John Straayer to Los Angeles: 1970 American Political Science Meeting dealing with political research in developing countries

M. L. Albertson to Bozeman, Montana: Symposium on Interdisciplinary Aspects of Watershed Management

Scott Tucker to Vail, Colorado: A.W.W.A. and W.P.C.A. Annual Conference - presented paper on "1970 Urban Water Systems Institute"

D. M. Ogden to Miami: Council of Colleges of Arts and Sciences

M. L. Albertson to Roanoke, Va.: Universities Council on Water Resources

Scott Tucker to Washington, D.C.: Water Pollution Control Federation Conference

M. L. Albertson to Washington, D.C.: ICID 5th Technical Conference

M. L. Albertson to Boston: Formal Dedication of Water Resources and Hydrodynamics Laboratory at M.I.T.

M. L. Albertson to Miami: Irrigation and Drainage Specialty Conference

E. C. Vlachos to Washington, D.C.: Meeting of Society for International Development

R. L. Anderson to Tucson: CUSUSWASH Meeting on Integrated Approaches to Water Resources Problems

B. L. Frantz and M. L. Albertson to Washington, D.C.: Review of 211(d) program with AID officials

M. L. Albertson to Phoenix: ASCE Meeting on Water Supply for Irrigation and Drainage

Wynn Walker to Chicago: Annual Meeting of American Society of Agricultural Engineers

G. N. Jones to Syracuse: Workshop of the Comparative Administration Group of American Society for Public Administration

J. L. Cefkin to New York: United Nations Conference

J. A. Straayer to Phoenix: Deliver paper to the American Academy for Advancement of Science

M. L. Albertson and E. C. Vlachos to Toronto: Semi-Annual Meeting of the Council Members of the Society for International Development

J. Davenport, P. Hosterman, D. Bennett, A. Karplus, P. Fawkes and Bidwell to Logan: Water Resources Planning Seminar

## G. Linkages With Scientists and Institutions

With regard to CSU's commitments to 211(d) Grant program, the faculty and GRA's are asked to make a record of each linkage established while attending meetings or conferences abroad or in the States, as well as linkages made in an advisory or other capacity. This information will be collected at the Project Office and maintained in a central file for ready reference and analysis.

Forms have been prepared. One form is for listing information regarding scientists of competence in water management, and the other for recording institutions of competence in water management. These forms are given to CSU personnel and are returned to the Project Office upon completion. Note the many linkages established in the previous Section F, International and U.S. travel. The linkage information in the Project Office files is organized, in the main, under the following headings:

1. Linkages with Scientists and Institutions by Countries.  
The following are examples:

Pakistan

- a. West Pakistan Agricultural University, Lyallpur

Dr. M. A. Kazi, Dean, Faculty of Agricultural Engineering & Technology

Dr. Haider Ali Chaudhari, Dean, Faculty of Agricultural Economics & Rural Sociology

Dr. Ali Muhammad Chaudhari, Head, Department of Farm Management

Dr. Muhammad Rafique Raza, Head, Department of Rural Sociology

Etc.

- b. Directorate of Agricultural Engineering, Lyallpur

Mr. Abdul Hamid Chaudhary, Director

Mr. Roshen Ali, Assistant Agricultural Engineer

Mr. Aziz, Research Engineer

- c. Punjab Agricultural Research Institute, Lyallpur

Dr. Saeed Ahmad, Director

Mr. Hayat Bhatti, Agricultural Chemist

Mr. Muhammad Nasin, Assistant Agricultural Chemist

d. Other Pakistani Institutions with which we have linkages are:

Agricultural Development Bank of Pakistan

Agricultural Development Corporation

Agricultural Research Council, Pakistan Secretariat

Pakistan Administrative Research Council, Lahore

Agricultural Research Institute, Hyderabad

Agricultural Research Institute, Peshawar

Board of Economic Inquiry, Peshawar University

Bureau of Statistics, Department of Planning and  
Development, GOP, Lahore

Director of Nutrition and Research, Ministry of

Health, Labor and Social Welfare, GOP, Islamabad

Economic Affairs Division, Secretariat, Rawalpindi

Irrigation Research Institute, Lahore

National Economic Council, GOP, Rawalpindi

National Institute of Public Administration, Karachi

National Science Council, Karachi

Pakistan Academy for Rural Development, Peshawar

Pakistan Academy of Sciences, Islamabad

Pakistan Forest Research Institute, Peshawar University

Pakistan Institute of International Affairs, Karachi

Planning and Development Department, GOP, Lahore

Social Science Research Center, University of the Punjab  
Lahore

West Pakistan Institute of Management, Karachi

West Pakistan Water and Power Development

Authority, Lahore

Etc.

## Thailand

CSU has been closely connected with the Asian Institute of Technology (formerly SEATO Graduate School of Engineering) for the past 11 years. The President of the Institute is from CSU as are 12 other faculty members. During the 10 years of its existence, the enrollment of students has climbed from an initial group of 19 students to the present level of over 200 representing 19 countries. To date 357 students have received the Master of Engineering degree; the list is comprised of students from Afghanistan, Hong Kong, India, Korea, Malaysia, Pakistan, Philippines, Taiwan, Thailand, Turkey, and Vietnam. Dr. Maurice L. Albertson, in 1959 as Director of CSU Research Foundation, was Head of the Operational Survey team to establish the engineering graduate school. He has served as Campus coordinator for the School since its inception in 1959 and has had a major role in selecting U. S. supporting staff personnel and in obtaining funds and equipment.

CSU linkages through the AIT Board of Trustees alone cover many Asian countries at high levels of government and private sectors. A few are listed as follows:

- Dr. Puey Ungphakorn; Governor Bank of Thailand, Bangkok
  - Dr. Kamhaeng Balangkura, Secretary General Office of the National Education Council, Bangkok
  - Mr. S. Y. Dao, Secretary General Council for International Economic Cooperation and Development, Taipei
  - Colonel Ir. Kuntoadj, Technological Institute, Bondung, Indonesia
  - Dr. Oscar Mapua, President, Mafrua Institute of Technology, Manila, Philippines
  - Dr. M. A. Rashid, Vice Chancellor, East Pakistan University Engineering & Technology, Dacca
  - Mr. J. A. Richards, Ministry of Education, Kuala Lumpur, Malaysia
  - Dr. Bui Tien Rung, Saigon, Vietnam
  - Mr. Chang Chieu Kiat, Deputy Director of Education, Ministry of Education, Singapore
  - Dr. A. R. Zubair, Vice-Chancellor, West Pakistan University of Engineering and Technology, Lahore
- Etc.

## Other Countries

Omitted

## 2. International Institutions On Irrigation And Drainage

Through Dr. Maurice L. Albertson, CSU has had and continues to maintain a direct linkage with the International Commission on Irrigation and Drainage with the main office in New Dehli, India. Dr. Albertson served for two (2) years as Chairman of the Executive Committee of the U. S. National Committee on Irrigation and Drainage. He has also served for approximately five (5) years as a member of the Permanent Paper Committee. Dr. Albertson remains as an exofficio member of the above committees, attending the meetings and serving as an advisor.

CSU has maintained linkages with the following institutions in varying degrees of magnitude:

Austrian National Committee on Irrigation and Drainage  
( I & D )

Australian International Committee on I & D  
Irrigation Department, Burma

Canadian International Commission on I & D  
Directory of National Productivity Centers in Asian  
Productivity Organization, including International  
Commissions on Irrigation and Drainage in:

Japan, Dominican Republic, Ecuador, France, Germany,  
Ghana, Great Britain, Guyana, Hungary, India, Indonesia:

Directory of intergovernmental organizations other than  
U.N. including International Commissions on I & D in:

Iran, Irag, Israel, Italy, Lebanon, Malawi, Malaysia,  
Mexico, Morocco, North Nigeria, Peru, Philippines,  
Senegal, Spain, Sudan, Surinam, Swaziland, Syria,  
Thailand, Turkey, U.A.R., Uganda, Venezuela, Vietnam  
and Zambi.

3. A Partial List of Overseas Participation During the  
Past Two Years By CSU Staff Personnel (Direct Linkages)

University of the Andes Watershed Management Exchange  
Agreement, Merida, Venezuela

International Atomic Energy Agency, Vienna, Austria

Systems Approach to Analysis of Hydrologic Processes and  
Environments, University of Hawaii

\*Faculty of Veterinary Science, University of Nairobi, Kenya

International Symposium on Pesticide, Tel Aviv, Israel

Interdisciplinary Study of Water Resource Development  
Programs in area of Michoacan, Mexico

Africa Ecology Study, East Central & South Africa

Educational and Scientific Organizations of Peru,  
Venezuela and countries of Central America

NATO Institute, Ramsey, Isle of Man

International Symposium on Hydrometry, Koblenz, Germany

International Biological Program, Kenya; Rome

International Ornithological Congress, The Hague, Netherlands

Meteorological Institute of Hamburg

Escola Superior de Agricultura, Laurus, Brazil

Market Advisor to Government of Panama

International Study on Ethiopia, Kenya, Tanzania,  
Zambia, Malawi, Rhodesia and Botswana

Wildlife Study in Iran

Snake Venom Research, Southeast Asia

Professor of Physics, University of Antioquia, Medellin,  
Colombia, Zoologist Studies, Austria

Consultant in Operation of Computer Services and Systems,  
Philippines

\*CSU has staffed more than 6 faculty members including many  
more on short term assignments on this project designed to  
assist in Africanization of the Faculty of Veterinary Science.

4. A Partial List of Foreign Student Directly Connected  
To Our Research Projects

Name & Home Institution	Department	Degree
*Kahn, Hamidur R. Pakistan Univ. of Engineering & Technology Dacca/Pakistan	Civil Engr	PhD
*Mr. Kahn received his M.S. from AIT in Bangkok		
Kahn, Saeed Ahmad West Pakistan Agricultural University/Pakistan, Lyallpur	Economics (arrive Oct.)	M.S.
Kahn, Muhamad Jamell West Pakistan Agricultural University/Pakistan, Lyallpur	Economics	M.S.
Rizwani, Abdur-Rehman University of Punjab Lahore, Pakistan	Sociology	PhD
Deredec, Alain School of Hydraulic Engr. Faculty of Science Groenoble, France	Civil Engr	M.S.
Lemna, Wendin-Agegnehu Awasha Valley Authority Ethiopia	Civil Engr	PhD
Chaudry, Mohammad Talib West Pakistan Water & Power Development Authority, Lahore	Civil Engr	PhD
Doddiah, Suresh National Institute of Engr Mysore, India	Civil Engr	M.S.
Mahmood, Khalid Punjab College of Engr & Technology/Pakistan, Lahore	Civil Engr	PhD
Nazar, Ata Kabul University Kabul, Afghanistan	Civil Engr	M.S.
Worku, Debebe Ethiopia-Haile Selassie I University/Addisa Ababa	Economics	PhD

Name & Institution(cont'd)	Department (cont'd)	Degree (cont'd)
Tuffour, Samuel Ghana-University of Ghana, Legon	Civil Engr	PhD
Garcia, Luis E. University of San Carlos Guatemala	Civil Engr	PhD
Monadjemi, Mehdi University of Tehran Tehran, Iran	Agronomy	PhD
Chaughtai, S. A. University of Punjab, Lahore	Economics	

Foreign students enrolled at Colorado State University early in 1971 numbered 337 representing 60 foreign countries. The largest representatives come from the following geographical areas:

Canada---35	Africa---30
West Indies--- 3	South Asia---53
Latin America---41	S. E. Asia---22
Europe---25	Far East---82
Mid-East---37	Pacific--- 9

## II. Total Outreach Water Management Research

In sections of this report regarding "entrainment effects" and "linkages" most of the material presented related specifically to 211(d) funding. This included, of course, international and domestic travel.

The above, however, does not reveal the total thrust or outreach of CSU, using other than AID funding, in the field of water management research. CSU faculty acting in the capacities of consultants, advisors, and the like, made the following international and domestic contacts during the period, July 1, 1970 to June 30, 1971:

### 1. International Contacts

Funding from sources other than AID provided funds for 96 official international trips by CSU faculty on invitational and consultation bases. Twelve (12) trips were paid in part or wholly by AID funds for a total of 108 trips. Out of this total, 45 trips or 42% were related to some aspect of water management research. Participating CSU faculty on some of these international consulting trips are as follows:

- a. From 30 May to 25 September 1971, Dr. Vujica Yevjevich, Civil Engineering Department, accomplished the following:
  - \*With NSF as the sponsoring agency and CSU as the U.S. coordinating academic institution, consulted with officials of the University of Sarajevo and other institutions of Yugoslavia regarding implementation of the new cooperative research project between USA and Yugoslavia on karst hydrology and karst water resources.
  - \*Lectured at the Technical University of Lund, Sweden.
  - \*Submitted a paper on a) "Significant Tests of Periodicity in Hydrologic Time Series," and b) was Secretary of Meeting of the International Group on Stochastic Hydrology at the International Symposium on Mathematical Models in Hydrology held in Warsaw, Poland.
  - \*Attended the Assembly of the International Association for Scientific Hydrology in Moscow, USSR, and IUGG Symposia, presenting a paper on "Sources of Stochasticity in Geophysical Processes" and actively participating in the Assembly of IASII.
- b. 13 October to 5 November 1970, Dr. Daryl B. Simons, Associate Dean of Engineering, consulted with Brazilian officials in Rio de Janeiro regarding a Meteorological/Hydrological Field Program in 1972.
- c. 5 November to 23 November 1970, Dr. Daryl B. Simons, Associate Dean, College of Engineering, traveled to

Dacca, East Pakistan, to consult with World Bank officials on possible geomorphology and hydrology studies in East Pakistan.

- d. 19 October to 31 October 1970, Dr. E. V. Richardson, Administrative Engineer, Atmospheric Science, consulted with Brazilian agencies regarding facilities and support for a Meteorological/Hydrological Field Program to be conducted in Rio de Janeiro in 1972.
- e. 5 November to 23 November 1970, Dr. E. V. Richardson, Civil Engineering, accompanied Dr. Daryl B. Simons, above, to East Pakistan.
- f. 1 January to 22 January 1971, Professor S. Karaki, Civil Engineering, continued discussions with World Bank officials on developing research contacts for geomorphology and hydrology studies in East Pakistan.
- g. 10 September to 29 September 1970, Professor Gaylord V. Skogerboe, Agricultural Engineering, presented a paper at the International Symposium on Hydrometry at Koblenz, Germany; also participated in meeting at the Hydraulic Research Station at Wallingford, England.
- h. 17 September to 3 October 1970, Professor Everett C. Nickerson, Civil Engineering, was an active participant in NATO Advanced Study Institute on Air/Sea Interaction; also consulted with Cambridge University personnel on Fluid Mechanics, Great Britain.
- i. 14 September to 4 October 1970, Professor George N. Van Dyne, Natural Resource Ecology, gave papers on grassland ecology studies at Symposia in Uganda; Kenya; and Rome, Italy.
- j. 14 August to 7 September 1970, Dr. Robert E. Dils, Dean of Forestry and Natural Resources, presented a paper on Forest Influences and Watershed Management at United Nations/USSR Invitational Seminar held at Moscow, USSR.
- k. 13 August to 20 September 1970, Dr. Daryl B. Simons traveled to Lahore and Rawalpindi, West Pakistan, to investigate possibilities of CSU participation in a study of comprehensive water research project on the Ganges River.
- l. 19 August to 5 September 1970, William Williamson, Office of Education Media, visited Pakistan to film educational film, "Land Forming for Irrigation."
- m. 9 January to 20 January 1970, Dr. V. Yevjevich, Civil Engineering, Chairman of U.S. participation for the

U.S.-Japan Bilateral Seminar in Hydrology; also gave a paper.

## 2. Domestic Contacts

Funding from sources other than AID provided funds for 120 official domestic trips. Twenty-three (23) trips were paid in part or wholly with AID funds for a total of 143 domestic trips. Out of this total 113 or 79% were related to some phase of water management research. Participating CSU faculty on some of these consulting trips within the confines of the U.S. are as follows:

- a. 29-30 June 1971, Professor Ralph J. Kotich, Range Science Department, participated in the Multi-State Workshop in Soil and Water Management at Kansas State University.
- b. 29 June to 9 July 1971, Dr. Duane W. Hill, Civil Engineering Department, completed research work for Task 7 of the OWRR Project on Metropolitan Water Intelligence Systems.
- c. 20 June to 25 June 1971, Dr. Norman A. Evans, Environmental Research Center, participated in the American Water Resources Association Conference at Cornell, N.Y.
- d. 20 June to 23 June 1971, Professor Marshall S. Moss, Civil Engineering Department, gave lectures at Washington, D.C. on Urban Water Systems for the World Bank.
- e. 30 May to 2 June 1971, Dr. V. Yevjevich, Civil Engineering, delivered a lecture to the International Symposium of Stochastic Hydraulics at the University of Pittsburgh.
- f. 12 May to 15 May 1971, Professor Henry P. Caulfield, Jr., Political Science Department, met with OWRR officials to discuss "Development of Techniques for Estimates of the Potential Water Resources Development in the Western Region of the U.S. for the Achievement of National and Regional Goals.
- g. 11 January to 15 January 1971, Professor David W. Hendricks, Civil Engineering Department, presented a paper on Water Reuse Systems Analysis at the American Society of Civil Engineer's National Meeting on Water Resources at Phoenix, Arizona.
- h. 12-13 January 1971, Dr. A. R. Chamberlain, President of CSU, presented a paper at the American Society of Civil Engineer's National Water Resources Engineering Meeting, Phoenix.

- i. 19-20 November 1970, Professor C. H. Wasser, Range Science Department, participated in a conference on "Conflicts in Water Resources Planning--What Are the Remedies?" held at the University of Texas.
- j. 19-20 November 1970, Professor Henry P. Caulfield, Political Science Department, presented a paper on "Institutional Arrangements for Water Resources Management," at the University of Texas.
- k. 18-20 November 1970, Professor B. R. Sabey, Department of Agronomy, represented CSU at the Western Soil and Water Research Committee Meeting held at Salt Lake City, Utah.
- l. 5-7 November 1970, Professor Henry P. Caulfield, Political Science Department, participated in Water Center Technical Committee to develop techniques for estimating potential of water resource development.
- m. 1-4 November 1970, L. Russell Freeman, Research Associate, Department of Agricultural Engineering, consulted with representatives of water pollution control agencies in California relative to "Data Acquisition Systems in Water Quality Management."
- n. 1-4 November 1970, Professor Henry P. Caulfield, Political Science Department, consulted with several federal agencies in Washington, D.C., on water management research programs and also attended Water Resources Conference at Miami.
- o. 2-6 November 1970, Professor Gaylord V. Skogerboe, Department of Agricultural Engineering, presented a paper at the 1970 ASCE Irrigation and Drainage Specialty Conference held in Miami.
- p. 1-3 November 1970, Associate Professor J. J. Hanan, Department of Horticulture, gave a paper at the annual meeting of American Society for Horticultural Science on "The Repercussions from Water Stress."
- q. 4-10 November 1970, Dr. Daniel M. Ogden, Jr., College of Humanities and Social Sciences, presented a paper to ASCE Irrigation and Drainage Division in Miami.
- r. 25-30 October 1970, Professor Gaylord V. Skogerboe, Department of Agricultural Engineering, presented a paper at the Sixth American Water Resources Conference held at Las Vegas, Nevada.
- s. 25-30 October 1970, L. Russell Freeman, Research Associate, Department of Agricultural Engineering,

presented a paper on water quality at the Sixth American Water Conference held in Las Vegas.

- t. 25-29 October 1970, David M. Hendricks, Associate Professor of Civil Engineering presented a paper at the Annual American Water Resources Meeting held in Las Vegas.
- u. 26-28 October 1970, Dr. Norman A. Evans, Environmental Resources Center, participated in the annual meeting of the American Water Resources Association, Las Vegas, Nevada.
- v. 26 October to 1 November 1970, Professor Norman Wengert, Political Science Department, gave a paper at a meeting of the American Water Resources Association in Las Vegas; also participated in a conference at the Water Center in Los Angeles.
- w. 25-30 October 1970, Thomas L. Huntzinger, Graduate Research Assistant, Department of Agricultural Engineering, presented a paper at the Sixth American Water Resources Conference held in Las Vegas.
- x. 25-29 October 1970, George E. Radosevich, Research Associate, Department of Economics, attended Sixth American Water Resources Conference held in Las Vegas.
- y. 8-10 October 1970, Professor Henry P. Caulfield, Political Science Department, actively participated in the Western Directors Meeting on Water Resources Research, Title II Proposal held in San Francisco.
- z. 4-6 October 1970, Dr. E. V. Richardson, Department of Civil Engineering, met with officials of the Central Nebraska Public Power and Irrigation District regarding erosion problems.
- aa. 15-17 September 1970, L. Russell Freeman, Research Associate, Department of Agricultural Engineering, represented CSU at the Second annual meeting of Regional Research Project W-107, "Management of Salt Load Irrigation Agriculture," held at Vernal, Utah.
- bb. 14-19 September 1970, Roy Edmonds, Research Assistant, Department of Sociology, collected data for a research project on consolidation of irrigation systems.
- cc. 23-27 August 1970, Dennis R. Linden, Department of Agronomy, presented a paper on "Ground Water Recharge as Affected by Surface Management and Vegetation," at the annual meeting of the American Society of Agronomy held in Tucson.

- dd. 18-21 August 1970, Robert Longenbaugh, Assistant Professor, Department of Civil Engineering, attended the ASCE 18th Annual Specialty Conference on Hydraulics at the University of Minnesota.
- ee. 2-7 August 1970, Dr. Hans L. Teller, Watershed Science, participated in a Watershed Symposium held at Bozeman, Montana.
- ff. 26 July to 2 August 1970, Dr. Hubert J. Morel-Seytoux, Department of Civil Engineering, participated in the Fifth International Conference on Water Pollution Research held in San Francisco.
- gg. 26 July to 3 August 1970, Dr. H. W. Shen, Department of Civil Engineering, participated in the ASCE Engineering Foundation Research Conference on Sediment Erosion in Urban Areas at Deerfield, Mass.; also discussed project matters with National Science Foundation, Washington, D.C.
- hh. 22-30 July 1970, Dr. Daryl B. Simons, Associate Dean, College of Engineering, presided at the ASCE Meeting of Regulation and Stabilization of Rivers, including task committees, held at New Orleans.
- ii. 20-23 July 1970, L. Russell Freeman, Research Associate, Department of Agricultural Engineering, attended the National Symposium on "Data and Instrumentation For Water Quality Management," held in Madison, Wisconsin.
- jj. 16-17 July 1970, Robert Gilham and Philip Hamaker, Research Associates, Department of Agronomy, on Consultation on irrigation research at USDA Field Station, Scottsbluff, Nebraska.
- kk. 28-30 June 1970, Dr. J. Paul Tullis, Assistant Professor, Department of Civil Engineering, consult and finalize details of program for Institute on Closed Conduit Systems at Los Angeles.

#### IV. EXPENDITURES

The actual and estimated expenditures for fiscal year 1970-1971 in the line item categories are stated in Table I. These expenditures are through 30 June 1971 and include all outstanding encumbrances as of that date. This table also reports the names and number of man months allocated to each department for both faculty and graduate students.

Table II shows the total actual and estimated expenditures in line item category for the first two years of the 211(d) Grant. This report shows the expenditures in comparison with the original budget. The amount reflected in faculty salaries has resulted in financial support for initiation of new courses, assistance in organizing and participation in the International Interdisciplinary Seminar, and salary support for international travel.

The expenditures listed in line item V covers clerical expense, office materials and supplies, as well as computer costs for faculty and graduate students' research projects.

Line item III (Travel) does not include outstanding encumbrances in the amount of \$8,662 for transportation costs issued on GTR's to be billed by AID/Washington. Sufficient funds are being withheld in the total budget to cover the costs.

The proposed budget allocations for fiscal year 1971-1972 will continue as proposed in the original budget plan as outlined in Table III.

TABLE I  
TOTAL EXPENDITURES FOR 1970-1971  
ON AID 211(d) GRANT

<u>Item</u>	<u>Man Months</u>	<u>Expenditures</u>	<u>Total</u>
I. FACULTY SALARIES			
Administration			
M. L. Albertson	1 3/4		
L. Scott Tucker	3 3/4		
M. E. Becker	3/4		
		7,747	7,747
Agricultural Engineering			
G. Skogerboe	1 1/2		
W. Walker	1		
		3,175	
Agronomy			
J. Reuss	1		
		1,292	
Civil Engineering			
Morel-Scytoux	1		
F. V. Richardson	1		
G. Smith	1/2		
R. Hansen	1/4		
G. Palumbo	3 1/2		
L. Stanfel	1		
		8,766	
Economics			
H. Biggs	3 1/3		
R. Tinnermeier	3/4		
G. Wilken	2		
		9,148	
Political Science			
H. Caulfield	2		
G. Jones	3		
		7,543	
Sociology and Anthropology			
K. Berry	3/4		
T. Harblin	1		
L. Hodgdon	1/2		
L. Vlachos	1		
		4,633	
		<u>34,557</u>	<u>34,557</u>
			42,304

<u>Item</u>	<u>Man Months</u>	<u>Expenditures</u>	<u>Total</u>
<b>II. GRADUATE RESEARCH STIPENDS - CLERICAL - LABOR</b>			
Agricultural Engineering			
J. Barrett	5 1/2		
R. Bennett	7 1/2		
V. Somoray	2 1/2		
		7,800	
Agronomy	-	-	
Civil Engineering			
J. Davenport	3 1/2		
A. Deredec	3		
S. Doddiah	1/4		
J. Duke	1 1/2		
P. Hosterman	4 1/2		
G. Lewis	1 1/2		
G. Overacker	1/4		
E. Rios	1		
M. Schiefer	3		
D. Taylor	1 1/2		
R. Thaemert	1 1/2		
Clerical-Labor	7 1/2		
		15,062	
Economics			
S. Allen - Clerical	1		
L. Caswell	6		
P. Sananikone	4 1/2		
		6,252	
Political Science			
H. Bidgood	3/4		
J. Fly	4 1/2		
C. Webster	1		
Clerical-Labor	3 3/4		
		4,312	
Sociology and Anthropology			
M. Brown	6 3/4		
Clerical - Labor	1/2		
		2,868	
Watershed			
R. Bassett	1 1/2	750	
			37,044
CONSULTANTS			7,568
PERA			4,269

<u>Item</u>	<u>Expenditures</u>	<u>Total</u>
III. TRAVEL		
International*	3,839	
U.S. Travel	<u>15,631</u>	19,470
IV. EQUIPMENT		3,118
V. OFFICE EXPENSE		
Clerical		
Labor		
Misc. expense		
Telephone, Xerox, etc.		
Computer Time		18,737
VI. LIBRARY AND PUBLICATIONS		
Brochure Mailing	282	
Library	<u>906</u>	<u>1,188</u>
GRANT TOTAL		\$133,698

\*Outstanding incumbrance on travel issued on  
GTR's to be billed by AID/WASHINGTON - \$2,132.

TABLE II

TOTAL EXPENDITURES THROUGH: 30 JUNE 1971  
ON AID 211(d) GRANT

<u>Item</u>	<u>Total Budget Two Years</u>	<u>Total Expenses Two Years</u>
Salaries	\$ 91,000	\$112,095
Graduate Research Assistantships	91,000	55,184
Travel	27,500	29,895
Equipment	19,000	3,331
Office Expense and Computer Time	19,000	33,472
Library and Publications	<u>7,000</u>	<u>7,005</u>
Totals	\$254,500	\$240,982

TABLE III

## 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
TOTALS	118	136.5	150.5	164.5	180.5	750

## V. WORK PLAN AND BUDGET FORECAST

### A. Special Library Facilities

As a result of considerable basic bibliographical searching accomplished at CSU, the Project Leaders of the Water Management Research group mentioned some months ago, the ever increasing need for collecting and making available all types of literature on Water Management Research and on Water Resources generally. It has been increasingly apparent that there is considerable valuable water resources literature not readily available. For example, at CSU in comparison to the total literature available in the United States and other countries of the world, our experience suggests that there exists an inadequate amount of water resources literature. In addition, some of this literature is scattered throughout the CSU library sometimes making it difficult and time consuming to search through masses of material to find the information sought. Even after some information is found, the searcher often has little or no idea as to the validity of the study or report with relationship to the total picture.

CSU feels that the bulk of useful articles on water resources are of a fugitive nature. That is, much of the material is illusive as the items are either mimeographed (or related form) or exists in small quantities. Typical of fugitive type literature is that produced by state and federal agricultural experiment stations, and by similar national institutions in the international field; and by private engineering firms, management consulting firm, and by other institutions both in the United States and in foreign countries. It appears that little of this type is indexed in the normal run of abstracts or references.

CSU believes also that an interdisciplinary approach to solving water resources problems both on the domestic and international scene, requires special library facilities having a central classification scheme based on water resources world-wide. Other purposes may be served too, such as the possibility of receiving sizable personal collections that might be given for use by such a special type library. A special collection could be of great assistance to scholars in becoming intimately acquainted with the literature, thereby giving them more creative time for research and a far better basis for analysis.

We are aware of the necessity to become associated first with other institutions having outstanding water resources library facilities such as the U.S. Bureau of Reclamation, and the Library of Congress. The University

of California at Berkeley has an excellent special collection of about 100,000 cataloged items on Water Resources. In the international field, India has a special collection of about 200,000 items located at the Headquarters Office of the International Commission on Irrigation and Drainage, New Delhi, India. What CSU will do with regard to establishing a water resources library will depend largely on the results of a study of the above named institutions and others as to what kind of materials can be provided to CSU and, of course, a host of other factors. This study will be made by a Library Committee appointed by Maurice Albertson, Project Director, and Le Moyne Anderson, Director of Libraries, CSU.

Recently, serious thought and action have been taken by Utah State University and Colorado State University to close this informational gap. CSU plans to place special emphasis on collecting fugitive literature of international and national significance; interdisciplinary type literature; and other types of literature in the field of water delivery and removal systems and relevant institutional requirements. USU has already done a great deal of work in searching their library, including archaeological files, and listing on library cards all references relating to on-farm water management. The University of Arizona has responsibility for collecting material in the field of watershed management. Obviously, interactions among the three elements of water management are essential. Also, without adequate institutional structure, none of the three levels can become very efficient. It is therefore very essential that library facilities be augmented, maintained, and placed under an effective system of control and operation. It is therefore proposed that the CUSUSWASH Universities, in order to more effectively meet increasing international and national responsibilities in water management research, participate in an inter-university agreement to establish a library system that will eventually make all types of water resources and related information on a world-wide basis more readily available.

Hopefully, assistance in this endeavor can be counted on not only from the universities, but also from AID, other agencies of the Federal Government, State organizations, institutions and foundations.

B. Proposal for Finding New Directions Land-Grant Universities Should Take as Agents of Domestic and International Social Change

Colorado State University is planning a week-long national conference in the summer of 1972 devoted to examining what new directions U.S. colleges and universities

should take to serve more effectively as instruments of planned social change, and how best to implement these new directions. The Land-Grant University, for example, has largely achieved its initial goals of developing excellence in "Agriculture and the Mechanical Arts" as established by the Morrill Act of 1862. This Act provided services to areas of important need a hundred years ago--namely, agriculture and industry.

The issue today is. Should the university in the second century of its existence expand its goals and horizons to become more instrumental in finding solutions to the current and future social and environmental problems of society both at home and abroad? We intend this conference to have a dual theme, namely:

1. The colleges and universities in the U.S. are able to play, and should play, a more active role in planned international development.
2. They can fruitfully expand their original horizons and address themselves to other problems in this country, such as urban social problems and the nature of the human environment.

To bring into detailed focus the purpose and mechanics of the 1972 conference, a mini-conference will be held this summer (1971) to which a small number of eminent national leaders of higher education have been invited to probe the following questions:

1. To what specific subjects should the conference address itself?
2. How can the "good ideas" of the 1972 conference best be nurtured to bear fruit?
3. Who are the people best equipped to participate in this conference and implement its objectives?

The decisions made at this and subsequent meetings could lead to greatly increased interest in international development and technical assistance, not only by CSU, but rendering such assistance through a consortium of universities, or inter-university bases.

C. Proposal for Integrated Management of Ground and Surface Water Resources

The objective of this proposal is to increase agricultural production given land availability, groundwater quality and quantity, surface water quality and quantity, and physical, legal, social, economic and other constraints. The study area would be located in Pakistan, Colombia, and a specific basin area in the United States. The study would be analyzed by an inter-university task group to develop the broad principles and methods of approach.

applicable to any area of interest. Also, the study will focus on a) short-range goals of improved management of existing systems, and b) long-range goals of planning system development in which the systems considered are given by the complex of physical, social, and institutional factors which influence integrated management of groundwater and surface water. The several sources of funding might be as follows:

Pakistan study: sub-project agreement with existing  
Water Management Research Project  
Colombia study: sub-project agreement with existing  
Water Management Research Project  
U.S. study area: USBR, OWRR, NSF

PART IV  
UTAH STATE UNIVERSITY

ANNUAL TECHNICAL REPORT 211(d) PROJECT

AID/csd 2459

August 31, 1971

UTAH STATE UNIVERSITY

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## SUMMARY OF CONTRIBUTIONS TO THE UNIVERSITY CAPABILITY

Much of the time and effort of the first year of the program was directed toward formulating plans, selecting personnel and, in general, arranging implementation of the plans. During the second year the activities have greatly increased and many of the anticipated improvements have been realized. New staff members have reported for duty and were effective in adjusting to assignments in research, teaching and consulting. All phases of the program are progressing as planned. There have been 17 foreign graduate students in Agricultural Economics, 19 in Agricultural and Irrigation Engineering, seven in Civil Engineering and nine in Soils that have benefited directly from the 211(d) program. Most of the total of 510 foreign students on campus have benefited indirectly.

### Teaching

Two scientists joined the staff during the year. Dr. Middlebrooks has cooperated in revision and teaching of four courses. Dr. Jose Alfaro has served as advisor to foreign students in the Department of Agricultural and Irrigation Engineering. He has also prepared to teach engineering courses in Spanish and to conduct in Spanish short courses in irrigation for non-English speaking students from Latin American countries. Professor Milligan was employed for a month to revise the irrigation courses he is to teach. After the second year of the program, it is evident that the teaching competence has been greatly increased, and included in the competence is the capability to teach courses in Spanish and Portuguese.

## Research

All members of the staff are engaged in some research. The new staff members have brought additional specialized competence. The benefits are realized through the direct research of the individuals and by the influence experienced through council of other staff and graduate students. Each of the eleven graduate students supported by the program are actively engaged in research and have or will conduct research in one of the Latin American countries. Some results of the research are becoming evident. Two theses have been completed and several manuscripts have been prepared for publication.

## Consulting and Services

### Consulting

More than twenty of the staff have participated in consulting activities related to water management. These 55 trips have varied from a few days to as much as several months and have taken the staff to thirty countries. The staff has also provided considerable council to various state and federal and private agencies.

### Language

Thirty-nine participants have benefited from the intensive language training program. Among these were graduate students, staff and wives. A local clergyman who works closely with students from Latin American countries also participated.

### Library

Many benefits have been realized or a direct result of the grant. During the year, \$50,307 was spent for library improvements in the general area of on-farm water management. Of this, the University provided \$29,474 and the grant \$20,833. A program is planned that will make the library holdings generally more available to those not on the campus. Utah State University is cooperating with the library committee of CUSUSWASH in a coordinated effort to make the improved library usable to more students and staff.

## OBJECTIVES AND SCOPE

During the second year of the program the activities in all places were greatly accelerated. The research, teaching and consulting competence was increased as proposed in the working plan and in harmony with the objectives of the original proposal. Although the program was greatly expanded during the past year, Utah State University has not materially altered the objectives of the USAID/csd-2459 Grant which were stated in the original proposal as follows:

The major objective of the Grant program is to increase and expand the existing competence of Utah State University in the science and technology concerned with "on-farm water management" with emphasis on the moisture environment on the farm as related to the special characteristics and problems of the less developed countries. Increased competence will be developed in the teaching and research activities as follows:

1. Expand its full-time professional core staff which will focus its teaching and research activities on the technical disciplines which relate to maintenance of a proper moisture environment on the farm under less developed country conditions. These include irrigation and surface and subsurface drainage. Irrigation and drainage are complex arts requiring the application of the best knowledge of water, soil, climate, and crop sciences and engineering. Existing courses in this area will be re-evaluated and reconstructed as appropriate. New graduate courses, special short courses, and seminars will be developed as required.
2. Expand its research in less developed countries to increase the knowledge and understanding of subjects such as water requirements of crops, moisture-fertilizer-crop response, management of irrigated soils, drainage requirements, salinity, water quality, movement of water in soils, methods of water application, management of irrigation water, and water-crop-soil system analysis.
3. Expand its total library holdings in irrigation and drainage and related disciplines, especially foreign and international publications, so as to become a center of information on world irrigation and drainage practices.

While Utah State University has considerable ongoing competence in these areas at the present time, the expanded full-time professional staff, courses of study, library information, and research will enable the University to respond much more adequately than heretofore to requests concerning agricultural related water management problems from such entities as: USAID/Washington, USAID/Missions, other state and federal agencies, other universities, educational groups, foreign governmental agencies, foreign water management institutions, local irrigation and drainage institutions, various business groups, various farm groups, and interested private citizens.

The increased interrelated teaching and research competence will include, but not be limited to, the following subjects as they relate to problems of the less developed countries:

1. Irrigation Practices. The theory and practice of maintaining the optimum moisture environment for plant growth by irrigation and drainage within the complex physical and institutional systems involved.
2. Drainage Theory and Practices. The investigation, design, and operation of drainage systems to assure the optimum soil-moisture environment and avoid or reduce flooding.
3. Water Resources Systems Simulation Engineering. Simulation of multi-purpose projects to provide adequate service for irrigation, drainage, flood prevention, and other purposes as related to on-farm water management.
4. Irrigation Science Research. The basics of consumptive use, infiltration, water physics, water quality, water-salt-soil interactions, within the framework of "on-farm water management" for maximum efficiency and economic returns.
5. Irrigation Economics. The economics of changing water management practices, costs, and economic efficiency of water utilization including the incremental value of water application and water application systems.

## MAJOR ACCOMPLISHMENTS

Much of the first year of the program was devoted to the justification of institutional needs, selecting staff and students, and in general, making certain that expenditures of the grant money would result in increased competence that would be effective. The second year the staff was employed and became functional. Interdepartmental meetings were held with related departments to insure the development of the interdisciplinary aspects. Each of the seven cooperating units now have staff members and graduate students participating in the program. Course offerings have been revised, some courses deleted, and new courses added as needed. Major Improvements have been made in the library service. These accomplishments are reported in more detail in Appendix C and in other sections of this report.

### Development of Teaching Competence

The first year a major effort was made to identify capable and qualified professionals who would complement the existing staff. This activity was continued during the second year and will continue throughout the grant period. During the latter part of the first year and throughout the second year, new staff members were added. Dr. E. J. Middlebrooks was hired in August, Dr. Jose Alfaro joined in midyear, and Professor Cleve Milligan returned from two and one-half years of service in Latin America. Dr. Middlebrooks has cooperated in the revision and teaching of four courses in engineering aspect of water quality and waste treatment. Dr. Jose Alfaro, originally from Peru and fluent in Spanish, served as advisor for the foreign students studying irrigation at Utah State University. He also prepared

himself to teach irrigation courses in Spanish. He assisted with the Irrigation Problem and Practices Short Course held each year during the summer and is now prepared to teach this course to Spanish speaking participants. This course is designed to serve foreign engineers and agronomists detailed to the United States by the government to study irrigation practices in the United States. It is sponsored by the USDA Foreign Agricultural Service and has been held at USU each year since 1953.

Professor Milligan was employed by the program for about a month and assisted the program by revising the course in Irrigation Science.

Dr. J. J. Jurinak of the Soils Department was selected to organize and teach a course in Water Chemistry. This course is taken by graduate students in Agricultural Engineering, Civil Engineering, and Soils. Dr. David James organized and taught a course on the Fertility and Management of Irrigation Soils.

At present, the Department of Agricultural and Irrigation Engineering has Dr. Jose Alfaro, Dr. Bruce Anderson, Dr. Glenn Stringham, Professor George Hargreaves, and Professor Byron Palmer who are qualified to teach any of the courses in Spanish. Dr. J. J. Jurinak can teach Soil Fertility and Water Chemistry in Portuguese. Dr. James of the Soils Department has considerable competence in Spanish and will soon have the proficiency to teach Soil Fertility in Spanish.

After only two years it is evident that as a result of the grant, the teaching competence has been greatly increased and included in this competence is the capability to conduct classes in Spanish and Portuguese.

Dr. Keller has been chairman of a committee to study the curriculum and to make recommendations for changes in course offerings. He is also active in the preparation of a textbook to be used in a course in irrigation.

Dr. Keller and Dr. Alfaro have prepared a series of 100 slides on sprinkler irrigation. The script for the series has been prepared in English and Spanish. The slides are being used in teaching on campus and consulting in foreign countries. The series was also presented to the Irrigation Problems and Practices Short Course. Many of the participants requested duplicate copies of the slide series.

#### Research Competence

The University has had a rather large program in research in the general field of on-farm water management and irrigation which includes the work sponsored by the Utah Agricultural Experiment Station, the Environmental Protection Agency, and the USAID Research Contract csd-2167. The teaching competence has been increased by the grant program and at the same time, the research has also been increased.

In all instances, the new staff members have several assignments or responsibilities which include teaching, research, and graduate student advisement and supervision. Each of the graduate students supported by the grant are engaged in research. This research is conducted, at least in a major part, in one of the Latin America countries. A list of the trainees and the departments in which they work is given in Table I.

Two of the trainees have completed their programs and their theses have been transmitted to CUSUSWASH members and USAID.

Fred Shewman, serving as a technician in collaboration with Howard B. Peterson, has completed a study on "Appraising the Capability of Soil to Remove Phosphate from Irrigation Water". This study is based in part upon Dr. Shewman's PhD dissertation, "Phosphate Content of Great Basin Ground

Table 1. Utah State University Graduate Trainees - 211(d)

Name	Program Began	Completed or Anticipated	Department Degree	Notes--Employment, Etc.
James Elmer Hardee	Oct. 1969	April 1971	AIE MS	Now employed Harza Engineering, Chicago
Thomas Lloyd White	Jan. 1970	July 1971	Ag. Econ. MS	Now employed Utah State Un., Research Ag. Econ. - Latin America
Herbert Paul	June 1970	June 1972	AIE PhD	Conducting research during the summer Had two years experience in Colo.
Mike Movnahan	June 1970	Jan. 1972	AIE MS	Now doing research in El Salvador
Lannv R. Ptacek	July 1970	Jan. 1972	AIE MS	In El Salvador Working on research with sprinklers
Richard Chase	Oct. 1970	June 1972	Plnt. Sci. MS	Now doing research on water weed control in El Salvador
Lee M. Bailey	June 1971		Ag. Econ. MS	Language training and course work during summer
D. Craig Anderson	June 1971		Pol.Sci. MS	Began course work during the summer
Phillip Lloyd	July 1971		Ag. Econ. MS	Conducting research in Ecuador
Morgan Ely	Sept. 1971		Civil Eng. PhD	Taking language training during summer prior to starting program.
Phil Tscheschike	Sept. 1971		AIE MS	To begin Sept. 25. Now at Colorado State University

Waters and Methods for Appraising Their Contamination Potential," which has been transmitted to USAID/Washington.

Dr. Middlebrooks and associates have prepared and published six papers. He has also prepared eleven research proposals and at present, four have received funding. Dr. Middlebrooks is also serving on the advisory committee of fourteen graduate students of which he is chairman or director of four.

Dr. David James has prepared three manuscripts that are currently "in press". He initiated a new research project on "Measurement, Prediction, and Control of Fertility in Irrigated Soils". Currently he is major professor for two PhD candidates and three MS students. Two of the graduate students he supervises are from Latin American countries.

#### Consulting

More than twenty staff members of USU have been engaged in consulting activities related to "on-farm water management" in the past year. These engagements have ranged from a few days to several months and have taken the staff to approximately thirty different countries. A partial listing of the staff involvement follows:

Aitken, Percy. May 30 to August 1, 1970. Bolivia to conduct field research for the economic phase of the research contract, USAID/csd-2167.

September 29 to October 27, 1970. El Salvador and Ecuador to conduct field survey.

April 7 to August 21, 1971. To Chile, Colombia, Ecuador, El Salvador and Bolivia to collect economic data and publications and conduct field research.

Alfaro, Jose F. April 21 to June 1, 1971. Caracas, Belem, Brazil, Peru and Paraguay to coordinate irrigation course for CIDIAT.

- June 5 to August 6, 1971. Utah, Washington, Idaho, California and Arizona in Capacity of co-leader of Irrigation Short Course under sponsorship of FAO.
- Anderson, B. H. November 15 to December 9, 1970. Colombia, Ecuador, Peru, Bolivia and Venezuela for CIDIAT and to review the University's S. A. program under the research contract, USAID/csd-2167.
- February 21 to March 7, 1971. Bolivia to supervise projects for USAID.
- July 25 to July 31, 1970. El Salvador to supervise projects for USAID.
- Austin, Lloyd. March 18 to present. Rio de Janiero for two year assignment under research contract, USAID/csd-2167.
- Bach, W. Kenneth. June 5 to August 6, 1971. Utah, Washington, Idaho, California, and Arizona in capacity of Technical Leader of Irrigation Short Course under sponsorship of FAO.
- Bishop, A. Alvin. September 15 to October 8, 1970. Japan, Pakistan, Afghanistan and Iran to conduct the 8th NESA Irrigation Seminar under sponsorship of USAID.
- July 22 to August 11, 1971. Romania to participate as a guest lecturer on a scientist exchange program.
- Christiansen, J. E. April 11 to May 9, 1971. El Salvador and Colombia for consulting work on drainage projects under research contract, USAID/csd-2167.
- May 11 to May 25, 1971. Colombia, Ecuador, and El Salvador to consult with Ecuadorian Ministry of Agriculture on water measurement for irrigation experiments for the research contract, USAID/csd-2167.
- Daines, David R. January 17, 1971 to Present. Ecuador for two year assignment under research contract, USAID/csd-2167.
- Davis, Lynn. November 25 to December 18, 1970. Venezuela and Ecuador to arrange Water Management Research and supervise graduate students and as consultant for CIDIAT.
- Gilbert, Norris. March 18, 1971 to present. Rio de Janiero for two year assignment under research contract, USAID/csd-2167.
- Glenn, Gary. July 29, 1971 to present. El Salvador to conduct field research under research contract, USAID/csd-2167.

Gomez, Enrique. June 6 to September 15, 1970. Bolivia field research under economic phase of research for research contract, USAID/csd-2167.

July 5 to August 15, 1971. Bolivia to set up data collection for OAS.

Griffin, Richard E. February 17 to March 2, 1971. Panama to visit drainage projects and obtain materials from library of Natural Resources of OAS.

August 11, 1970 to present. El Salvador for two year assignment under research contract, USAID/csd-2167.

Hanks, R. J. July 25 to August 16, 1970. Venezuela and Ecuador to participate in Seminar on developing experimental techniques in consumptive use studies for CIDIAT and research contract USAID/csd-2167.

Hargreaves, George. January 25 to February 28, 1971. Various South American countries to conduct research under research contract USAID/csd-2167.

June 19 to July 2, 1971. Nicaragua as consultant for U. N. Development Programs.

July 2 to August 17, 1971. Honduras, Guatemala, Nicaragua and Costa Rica as a consultant for USAID and ICE (Hydro-metrologica Project in Central America).

James, Dave. December 6 to December 13, 1970. El Salvador to be a consultant on design of fertilizer interaction experiments for research contract USAID/csd-2167.

Keller, Jack. November 14 to December 14, 1970. To France, Germany, Libya, Iran, Italy, and England in capacity of consultant for private industry.

January 22 to January 25, 1971. Nicaragua as a consultant for private industry.

LeBaron, Allen. November 25 to December 22, 1970. Venezuela, Ecuador and Bolivia as a CIDIAT consultant and to arrange research under 211(d) and as a consultant under the AID/Bolivian contract.

April 7 to May 22, 1971. Bolivia, Chile, Ecuador, and El Salvador to conduct the Agricultural Development Short Course and arrange research under the AID/Bolivian contract and to finalize contract for research contract USAID/csd-2167.

May 30 to July 2, 1970. Bolivia, Ecuador, Colombia, Venezuela, for short term consulting under research contract USAID/csd-2167.

- Olsen, Edwin C. November 17 to December 9, 1970. Colombia for short course in drainage under CIDIAT assignment.
- January 20, 1971 to present. Colombia for two year assignment for the research contract AID/csd-2167.
- Palmer, Byron C. April 1 to April 3, 1971 Georgetown, Guyana to discuss possible collaboration with Guyanese Ministry of Works, Hydraulics and Supply, in their irrigation and drainage program, for USAID.
- April 5 to April 8, 1971. Santiago, Chile to monitor water, fertilizaer interaction program and discuss with AID/Chile future activities for USAID.
- April 8 to April 13, 1971. Quito, Ecuador to monitor Water Law Digest Program and discuss future activities with AID/Quito and Ecuadorian Ministry of Works and Hydraulics for USAID.
- April 13 to April 16. Bogota and Barranquilla, Colombia to monitor salinity and drainage program and discuss future activities with AID/Bogota and the Colombian Agrarian Institute for USAID.
- April 17 to April 21. San Salvador, El Salvador to monitor sub-surface irrigation and intensive training program for USAID.
- April 21 to April 24. Managua, Nicaragua to discuss with AID officials possible collaboration in developing irrigation program for USAID.
- April 25 to April 30. Reio de Janeiro and Sao Paulo, Brazil to assist in development of work plan for new USU staff for USAID.
- Peterson, Dean F. August 27 to August 28; September 14 to September 15; October 21 to October 22; November 23 to November 24, 1970. Washington as Chairman of National Academy of Science to Panel on East Pakistan Water Development.
- December 7 to December 12, 1970. Paris, France to participate in working group on Long-Term International Programs in Hydrology, for UNESCO.
- December 12 to December 17, 1970. Israel for World Congress of Engineers to present address on agriculture and irrigation.
- December 18 to December 23, 1970. Iran, to consult with Ministry of Water and Power on Planning and review League Project of AID.
- March 21 to March 26, 1971. Paris, to participate in working group on Long-Term International Programs in Hydrology for UNESCO and meeting of Bureau of Coordinating Council, International Hydrological Decade.

Peterson, Dean F. (cont.)

June 18 to June 25, 1971. Paris, to participate in working group on Long-Term International Programs in Hydrology for UNESCO, and attend meeting of Bureau of Coordinating Council, International Hydrological Decade.

July 6 to July 10, 1971. Geneva, Switzerland, as alternate U. S. delegate to Coordinating Council for the International Hydrological Decade.

Peterson, H. B. July 25 to August 1, 1970. Venezuela, as a consultant for CIDIAT.

May 14 to June 15, 1971. Pakistan, Turkey and Iran to organize CENTO Seminar under sponsorship of AID.

January 1971. Rome to participate in Committee on Hydrologic Decade. The effects of agriculture on the hydrologic cycle.

Stutler, Kern. July 13, 1970 to present. Chile for two year assignment under research contract USAID/csd-2167.

Wennergren, Boyd. May 16 to July 2, 1971. Bolivia, Ecuador, Colombia and Venezuela for short term consulting assignment under the research contract USAID/csd-2167.

April 7 to May 22, 1971. Bolivia, Chile, Ecuador and El Salvador to conduct Agricultural Development Short Course and conduct and analyze field research and finalize plans for research contract USAID/csd-2167.

White, Thomas. July 9 to September 15, 1970. Ecuador to conduct field research for contract USAID/csd-2167.

#### Library Activities

In 1969, a five year program to strengthen library holdings on world irrigation and drainage practices, with a special emphasis on "on-farm water management" was initiated. The program envisioned the acquisition of library materials, development of information and cooperation with related disciplines. Progress on each phase is discussed in the following paragraphs.

### Acquisition of Library Materials

From a long list of from 3,000 to 5,000 publications considered for addition to the library's "on-farm water management" holdings, 1,350 were designated for purchase and have been ordered. In addition, several hundred gratis publications have been ordered. The Utah State University library maintains a special documents section of the library, and the holdings in this section relating to "on-farm water management" have been indexed and are available to the researcher. In addition to project purchases, the library subscribed to or renewed its subscription to 1,066 periodicals.

### Development of Information

Reference bibliographic collection. One high priority aim of the program was to secure an accurate listing of publications already available in the library. A second task of equally high priority was to make whatever was available, readily identifiable and usable. This problem was complicated by the fact that many of the University's holdings in the documents and archives sections of the library had never been properly indexed or cataloged. The results of this phase added over 5,000 books to the On-Farm Library.

Computer retrieval system. A computerized bibliography was developed and is available containing a complete inventory of the holdings on "on-farm water management". Future plans for the computer bibliography may include assigning all of the works a "key word" and initiating a rapid retrieval system. This direct access method would require much additional work as well as equipment and personnel.

Cooperative networks for knowledge. Steps already taken or recommended have assured cooperative use of the On-Farm Library by anyone

desiring to do so. It should be mentioned that extensive use is being made of the library by members of the research staff of the Snake River Conservation Research Center of ARS at Kimberly, Idaho. The possibility of the use of the holdings by other CUSUSWASH universities is now being explored and expanded.

#### Cooperation with Related Disciplines

Cooperation has been strengthened with disciplines related to agricultural and irrigation engineering. The designation of titles to be acquired to build a total library collection includes several hundred titles in closely related areas.

In the future it is hoped that all divisions of the university will continue to be brought into the selection of materials to be acquired. Related departments are being consulted in development of cooperative networks for knowledge acquisition and retrieval and are now involved in the 211(d) library program.

In order to assure continuing progress in the library program, the following recommendations have been suggested:

Primary effort should be focused on the continuation of the purchasing program and the search and evaluation of those materials already available in the library.

The computer segment of the library needs increased attention. A system needs to be implemented whereby the accuracy and completeness of the computer printout can be verified and kept up to date with the addition of new titles. The use of "key words" as a basis of a rapid retrieval system is being investigated.

Due to the bulk and inconvenience of the computer printout bibliography a library report in a concise form is under consideration with distribution to interested persons especially the other CUSUSWASH universities.

In order to assure the long range continuance of the program, the use of an "approval buying plan" in our acquisition program is being studied. It is planned that this be continued after the 211(d) program has phased out.

#### Language Training

The intensive language training program initiated the first year was continued through the second year. Mrs. Ann Johnson served as instructor and coordinator. Sections of beginning, intermediate, and advanced Spanish were conducted. There were 39 participants. Among them were staff members and wives and graduate trainees and wives. A local pastor also participated in order to be better able to communicate with the Latin American students that come to campus to study.

Every staff member and every graduate student going to teach or conduct research in one of the Latin American countries will have had language training or have gained proficiency in some other fashion.

#### University's Contributions

Improvement of the library continued to be a major objective of the program during the second year. Considerable time and money was expended to obtain new holdings and to organize the present holdings so as to be more readily available. The University made a substantial contribution toward the improvements. The Director of the Library, Dr. Milton Abrams,

reported an expenditure by the library of \$29,474. A copy of his fiscal report is shown as Table 2.

Construction, furnishing and equipping the new irrigation laboratory was completed during the year. More than \$40,000 was spent by the University for the remodeling and furnishing. In addition, considerable money has been spent for supplies and equipment for student use.

Top administrators of the University, including the President of the University, the Vice President for Research, the Dean of the College of Engineering, and the Director of International Programs have spent considerable amounts of their time in helping to organize the program, advise in the selection of staff and otherwise making decisions pertinent to the 211(d) program.

Administrators of the departments of Agricultural and Irrigation Engineering, Civil Engineering, Economics, Modern Languages, Political Science, and Soils have been particularly concerned in selecting new staff, graduate students and generating financial support for a portion of the salaries of new staff.

The University, through the School of Graduate Studies, has provided funds for the out-of-state portion of the tuition, so the program has paid only the fees assessed resident students.

#### Entrainment

There is no sharp delineation between contributions by the University and the benefits that come to the program through entrainment. It is apparent, however, that as a result of the Grant a number of things are happening. The improvement of laboratory and library facilities mentioned elsewhere, as well as the increased interchange of knowledge between related

Table 2. Library Contribution

1. Library materials purchased from regular library budget		
Serials renewals		\$ 6,635.60
2. Personnel		
Organizing historical collection		
Contractual		2,150.00
Payroll		400.00
Orders processing		
Contractual		2,400.00
Payroll		1,600.00
Fund accounting		
Contractual		1,000.00
Payroll		900.00
Computer Programming		
Contractual		3,200.00
Key punching and verifying (30,000 cards)		
Contractual		1,200.00
Payroll		1,165.00
Cataloging		
Contractual		2,400.00
Payroll		2,000.00
TOTAL PERSONNEL		\$18,415.00
3. Supplies		
IBM Cards (16 cases @ 11.50 per case)		184.00
Ordering forms (BATAB)		121.50
Miscellaneous		87.38
TOTAL SUPPLIES		\$ 392.88
4. Processing Costs		
Binding serials and books		2,931.50
5. Computer time		
Ordering and processing		1,100.00
TOTAL EXPENDED BY LIBRARY		\$29,474.98

departments and an expanded involvement of staff in consulting services have all been brought on by the grant. In addition, the following are specific examples of activities categorized as entrainment.

Dr. D. W. Thorne, Vice President for Research, is writing a textbook on farm management for LDC. The only dollar cost to the program is for some part-time secretarial help.

Dr. Dean F. Peterson prepared a paper entitled "Agricultural Food and Irrigation", which was presented to the Second World Congress of Engineers and Architects, Tel Aviv, Israel, December 15, 1970. A copy is included in Appendix C, section II.

Dr. A. A. Bishop was selected, on the basis of his competence in a technical field, to present the semi-annual Faculty Honor Lecture by the U.S.U. Faculty Association. The paper "Conflicts in Water Management" was published and presented as the 42nd Faculty Honor Lecture.

On April 11 and 12, Dr. Warren Hall, University of California, visited the campus where he consulted with the staff and graduate students and presented a seminar. This was in cooperation with the Institutional Program, but at no cost to the program.

#### Means Developed to Make Information More Available to AID

##### Missions and Others Involved in the Program

The development of brochures and programs for information dissemination are going forward according to guidelines being established by the Publications Committee of CUSUSWASH. As staff members from the cooperating universities go into the various LDC's, they have opportunities to let agencies and individuals know of the competence being generated and made available at the CUSUSWASH institutions.

Involvement of LDC Institutions and Personnel in  
Activities of the University

U.S.U. is directly involved with institutions in Bolivia, Brazil, Chile, Colombia, Ecuador, El Salvador, Venezuela, and Honduras. Details follow:

Brazil

In Brazil, staff partly supported by 211(d) funds have participated in seminars with professionals of the superintendency of the San Francisco River Development Corporation - "Suvalee" dealing with their irrigation program in Northeast Brazil.

Two full time staff members are assisting Suvalee in the design of irrigation experiments under a USU-AID research contract. In the initial development of the contract and in continuing campus support, U.S.U. has been able to release staff for these activities because of the flexibility provided by the 211(d) contract.

The University of Sao Paulo has asked for and received assistance in the selection of a suitable site for an irrigation research farm.

Chile

U.S.U. is working closely with three Chilean institutions, the Agricultural Research Services La Platina Station, the Chilean Extension Services (SAG) and the Catholic University of Valparaiso. The principle activities are the determining of appropriate irrigation-fertilization and row spacing of corn to maximize the economic return from production. U.S.U. is collaborating with the Catholic University in curriculum development.

One of their graduate students is at U.S.U. assisting in the hydrologic analysis of Chilean data in connection with our water management research program.

### Colombia

During 1969 and 1970, three U.S.U. professors spent two years, and a fourth spent a year assisting the Colombian Agrarian Reform Institute (INCORA) set up a training program directly related to their efforts to bring 1,000,000 acres under irrigation. These men received language training, library assistance and campus orientation through the 211(d) program. Their departments were able to release them because of the grant.

A M.S. thesis by an American on water availability in Colombia was partly financed with 211(d) funds. This has been very useful to Colombia's Agricultural Research Agency (ICA).

Utah State has a working agreement with ICA and INCORA to study subsurface drainage problems on Colombia's north coast under Contract AID/csd-2167. The University is also providing guidance in the use of mole plows and lysimeters on the Sabana of Bogota and in the Cauca Valley.

CIDIAT, the Inter-American Agricultural Technology Center at Palmira near Cali, is collaborating in the development of mole drain technology.

### Ecuador

A part of U.S.U.'s water management research in economics involves a graduate student financed with 211(d) funds. The student is working with the National Rice Commission following up and maturing on data generated by another 211(d) graduate student who completed a Master's thesis on "Rice Production in the Guayas River Basin".

The University is collaborating with the Hydrology and Weather Modification Departments of INEHRI. Their chief hydrologist, Engineer Jose Yepes spent three months at U.S.U. performing a computerized study of precipitation data from throughout Ecuador. His work on the U.S.U. campus was directed by professors supported by the grant.

Engineer Guillermo Maggio, who heads Ecuador's Weather Modification Program, visited Logan in the spring of 1971 to become acquainted with the weather modification work being done at the Utah Water Research Laboratory.

#### El Salvador

Three American students, financed by 211(d) funds, spent the summer of 1971 in El Salvador. Two were collecting data on sprinkler irrigation operations. The third, an economics graduate student collected data on market elasticities for crops produced under irrigation. These students all participated in the language training program.

The University is continuing programs of subsurface irrigation, lysimeter data collection, water-fertilizer-crop interactions and extension methods with consulting advice supported by the grant. These programs are carried out in collaboration with the El Salvador Department of Irrigation and Drainage.

The National Meteorologic Service has closely collaborated with U.S.U. in the production, analysis, and interpretation of their hydrometeorological data. Water deficiency maps were prepared, based on their data which was analyzed at U.S.U.

#### Honduras

Engineer, Fabio A. Carias spent three months at U.S.U. performing a computerized study of precipitation data collected in Honduras. Mr. Carias

is employed by the Instituto Geografico Nacional in Honduras and was selected by AID to train for three months in the United States.

#### Venezuela

U.S.U. has had an OAS funded land and water resources training program in Venezuela for the past seven years. This has required the frequent assistance of professors from U.S.U., both at Merida and in other Latin American countries. The 211(d) grant has given the University increased flexibility to release staff for these short term assignments, usually of one month's duration as well as helping in releasing staff to the Merida center for two-year terms. The annual long and short term professional input into this program is about 80 man months. The program trains about 200 men per year, from every country in Latin America except Cuba. Through it, U.S.U. has trained junior, mid-level and top level professionals from about 80 national development agencies.

Training has included programs for increasing the competence of agronomists, engineers, economists, sociologists, and policy makers. The last group has met three times in Logan and focus primarily on program development for the training program and on studying institution building concepts.

#### On-Campus Relationships

Illustrative of the practical use of 211(d) funds on campus is the annual Irrigation Problems and Practices Short Course sponsored by Foreign Agricultural Service of USDA and USAID. The most recent course, held in the summer of 1971, involved 23 students from ten foreign countries. The two course supervisors were supported entirely from this grant.

### FY 1971 Attainments

As a result of the 211(d) grant, all segments of the University have been taking inventory, so to speak, to determine how each division relates to the general area of "on-farm water management" and to develop ways and means to respond to the request for consulting services by USAID and others. Recently, the University, in its Code of Policies and Procedures, has outlined the guidelines for making consulting services available. The policy as stated by the Faculty Code of Policies and Procedures, encourages the staff to engage in consulting activities and to make their expertise available to those seeking such service. The University policy is fairly liberal and in addition, the 211(d) grant has made it possible to provide relief time for those staff members in demand. As a result of this policy and encouragement by the administration, many staff members have been involved in consulting work of various kinds focused on the problems of international water management and development. (See the section on consulting activities for details of staff involvement.) In addition to the stated consulting policies of the University, if considerable off-campus time is required, the staff member may utilize his vacation time or take leave without pay in order to engage in consulting activities. A copy of the section is included in the Appendix C, Section III.

It has been the policy of the CUSUSWASH Consortium Universities to hold two meetings each year. One meeting is devoted to a review of the research activities of the member universities, and the other meeting highlights the consortium aim to improve water management for agriculture, especially in the LDC's. Two such meetings were held during the year. In August of 1970, the Consortium met at Ft. Collins, Colorado, and in

January of 1971 a second meeting was held in Tucson, Arizona. Utah participated in both of these meetings with five staff members participating in the Colorado meetings and twelve staff members engaged in the Tucson, Arizona meetings. In addition to the semi-annual CUSUSWASH meetings, subcommittees of the Consortium have met to develop specific aims or objectives. Among these, the committee on Publications and the committee on Integrated Approaches have been particularly active and Utah has been an active participant.

In addition to the inter-University meetings, a number of intramural meetings have been held with members of several departments being represented in order to sharpen the focus on "on-farm water management" from the interdisciplinary viewpoint. Many more segments of the University are more deeply involved in this important activity as a result of the 211(d) grant.

In the identification and hiring new staff at Utah State University, considerable effort has been devoted toward the development of multiple support for the new staff in order that the gains resulting from staff employment under the 211(d) grant would not be lost at the time of the termination of the grant. As a result, all new staff members at Utah State University have been employed through a multiple support arrangement involving 211(d) funds, University funds, and in some cases funds from the Utah Water Research Laboratory or the Utah Agricultural Experiment Station. Thus, the 211(d) grant has resulted in additions to the staff by entrainment of other resources of the University.

## EXPENDITURES

The expenditures for the second year are shown in Table 3. Further detailed listings of expenditures for staff, students and library expenditures are given in Tables 4,5 and 6.

### Faculty Salaries

The expenditures for staff salaries are shown in Table 4. Some of the salary money shown in Table 4 is also included in the library expenditures because most of the effort of Mr. Palmer was associated with the library improvement program.

### Graduate Research Stipends

The expenses of the graduate students are indicated in Table 5 with the exception of travel expenses which are indicated under the section on travel. The status of the various graduate students is indicated in Table 1.

### Travel

#### U.S.

During the 1970-71 fiscal year, \$2,732.50 was expended for travel within the United States. This travel included Dr. A. A. Bishop's attendance at the following meetings and conferences: American Society of Civil Engineers, Irrigation Speciality Conference; and the National Meeting of the American Society of Agricultural Engineers.

The National Irrigation Symposium at Lincoln, Nebraska, was attended by Drs. Peterson, Olsen and Keller of the AIE staff and several graduate

Table 3. Actual and anticipated expenditures, Utah State University Institutional Grant  
(USU Fiscal Year July 1 to June 30)

	1st Year	2nd Year	3rd Year	4th Year	5th Year
Salaries and Wages Professional Staff, Sub-Professional and Staff Benefits	\$ 16,134.69	\$ 98,862.10	\$120,000	\$ 95,500	\$ 97,500
Stipends, Tuition and Fees	4,814.50	23,310.00	45,500	39,000	40,100
Travel					
Foreign	168.29	1,396.24	25,000	20,532	15,500
Domestic	943.17	3,359.94	3,000	3,000	2,000
Equipment	.00	7,492.67	1,000	-0-	-0-
Supplies and Computer Use	41.35	1,322.15	5,500	11,900	8,650
Library and Publications	1,982.73	5,087.73	10,500	5,900	5,000
CUSUSWASH	.00	.00	10,000	10,000	10,000
<b>TOTALS</b>	<b>\$ 24,084.73</b>	<b>\$140,830.83</b>	<b>\$220,500</b>	<b>\$185,832</b>	<b>\$178,750</b>

Table 4. Salary Support and Percentage of Effort (AID/csd -2459)

Name	Amount Paid	Man Months	Percentage of Support
Alfaro, Jose F.	\$ 5,835.67	4.6	38.8
Bach, Kenneth W.	14,233.33	10.0	83.3
Bishop, Alvin A.	5,000.00	2.5	21.1
Blood, Christine V.	171.47	.5	4.0
Cowan, Peter A.	1,000.00	2.6	21.8
Douglas, Dorothy	1,920.00	5.4	45.7
James, David. W.	9,500.00	6.9	57.5
Johnson, Anne S.	4,000.00	5.3	44.4
Jurinak, Jerome J.	2,000.00	1.2	9.6
Keller, Jack	3,389.00	1.5	12.5
Middlebrooks, Eddie J.	7,267.00	4.6	38.2
Milligan, Cleve	1,000.00	.7	5.8
Palmer, William I.	10,370.00	6.0	50.0
Peterson, Howard B.	11,024.00	5.8	48.2
Shewman, Fred C.	5,000.00	10.0	83.5
Thomas, Dorothy B.	696.69	1.9	16.5
Totals	\$82,407.16	69.5	

Table 5. Graduate Student Expense (Fiscal Year 1970-1)

Name	Stipends	Tuition and Fees
James Elmer Hardoe	\$ 3,000	\$ 326
Mike Moynahan	3,600	580
Herbert Paul	3,600	580
Lanny R. Ptacek	3,600	580
Thomas Lloyd White	3,600	468
Richard Chase	2,700	582
Lee Bailey	300	146
D. Craig Anderson	150	146
Totals	\$20,550	\$3,408

students from the Department. Funds were also used to support a graduate student to present a professional paper in Nevada.

A new staff member, Dr. Jose Alfaro, functioned as Assistant Technical Leader for the Irrigation Problems and Practices Short Course and inspected irrigation project and research institutions in several western states.

Finally, included in the travel expenditures were two separate trips to Washington, D. C. for 211(d) review and reporting purposes. Those attending were Dr. A. A. Bishop, Dr. H. B. Peterson and Dr. Dean F. Peterson.

### International Travel

International travel under the 211(d) grant amounted to \$9,334.54 for the last year. A summary of the individual travel is as follows:

- a. A. Alvin Bishop  
Japan  
August 29 to September 12, 1970  
\$235.55

Enroute to conduct the Eighth NESA Irrigation Seminar in Kabul, Afghanistan, Dr. Bishop stopped for two weeks in Japan under sponsorship of 211(d) funds. The purpose of the trip was to collect information regarding on-farm water management and study the progress of irrigated farming in Japan. (See report of Japan trip. Appendix C, Section IV).

- b. David R. Daines  
El Salvador to Logan, Utah & return  
May 31 to June 18, 1971  
\$193.00

Dr. Daines returned to USU in order to participate in the Water Resources Planning Seminar with Emphasis on Developing Countries, held on campus June 5 through June 19. Dr. Daines was featured as a key speaker during this Seminar in connection with recent developments in water resources in Latin America.

- c. Richard Chase  
San Salvador, El Salvador  
June 25, 1970 - present  
\$2,304.00 (obligated)

Functioning under the graduate trainee program, Mr. Chase traveled to El Salvador in order to conduct research and collect data for completion of his M.S. thesis and program. At the time of this writing, Mr. Chase is still working in El Salvador.

- d. James Hardee  
Bogota, Colombia  
November 17 to December 9, 1970  
\$1,111.79

Mr. Hardee traveled to Colombia under the 211(d) trainee program. He collected data and conducted the research which enabled him to complete his thesis, "Analysis of Colombian Precipitation to Estimate Irrigation Requirements," and subsequently his M.S. program in June of 1971.

- e. Mike Moynahan  
San Salvador, El Salvador  
July 7, 1971 - present  
\$2,700.00 (obligated)

In order to conduct sprinkler irrigation research, Mr. Moynahan and a fellow trainee, Lanny Ptacek, are conducting a series of experiments in El Salvador. This research, when completed, will be incorporated into their M. S. program and thesis. Both Mr. Moynahan and Mr. Ptacek are still located in El Salvador at the time of this writing.

- f. Lanny R. Ptacek  
San Salvador, El Salvador  
July 7, 1971 - present  
\$1,800.00

Mr. Ptacek is currently conducting research in El Salvador with Mike Moynahan, as previously described.

#### Equipment

In the proposal it was indicated that some portable irrigation and drainage equipment would be needed to be used primarily for overseas research and on-campus demonstration purposes. As the trainees began their research, most of the items needed were identified and procured. Of the \$8,500 originally budgeted for equipment, \$7,492 was spent during the current year. Most of the equipment is now being used in the countries where the graduate students are doing their research. Some has been placed in the new irrigation laboratory where it complements the academic program.

Library and Publications

The approximate expenditures for library improvement are itemized in Table 6.

Table 6. Expenditures for Library and Publications  
July 1, 1970, to June 30, 1971

Salaries	\$10,370
Wages	3,336
Staff Benefits	1,244
Computer	796
Publications	5,087
	\$20,833

## WORK PLAN AND BUDGET FORECAST

The rate of implementation of the program was greatly increased during the second year of operation. It is anticipated that these expenditures will likely reach a maximum during the coming year (3rd). This is reflected in estimates for the anticipated budget as shown in Table 2.

### Increased Gains Expected in Tying CUSUSWASH

#### Universities Together

As the programs have been enlarged in the various departments of the University; there has also been an increase in the cooperation among the participating universities. An exchange of staff and students is taking place. Two examples of the cooperation and interchange among the participating universities are as follows:

Dr. H. B. Peterson of the Agricultural and Irrigation Engineering Department will teach a graduate course in the Agricultural Engineering Department of Colorado State University.

Professor Fogel of the University of Arizona will participate in an AID supported seminar in Tehran during September.

### Expectations Regarding Involvement of LDC Institutions and LDC

#### Personnel in the General Activities of the University

Two kinds of direct involvement will continue; visits by the University personnel to the LDC institutions for consulting and training of regular and special students from LDC's will train and study at the U.S.U. campus.



Dorothy Douglas to the professional staff. It is planned to add an additional editor on at least a half-time basis during the third year of the program.

#### New Courses

Rather than add many new courses, most of the old courses are being revised and updated. There is, however, planned a new course in agricultural engineering dealing with irrigation as a means of waste treatment and agricultural waste disposal. An interdepartmental committee has been formed to review the curriculum and may make recommendations for additional changes.

#### Provisions for Graduate Students

There are currently eight graduate students supported by the program. Four additional students have been identified to join the program between July 1, 1971 and January 1, 1972. It is expected that during the year there will be a maximum of twelve active students. The names, departmental affiliation, etc., are shown in Table 1. Upon completion or near completion of the course work and upon gaining sufficient language capability, each will conduct his research in one of the LDC of Latin America.

#### Language Training

The amount of money and effort that goes into the language training varies with the needs of the graduate students and staff. During the coming year, it is anticipated that this activity will be at a minimum because most of the staff and students will have received the necessary training. Mrs. Lynn has been selected by the Language Department to supervise and instruct.

### Library Improvement

The library improvement program has reached the advanced stages. The changes needed in the organization of materials, etc., have been made. New acquisitions have been made and many new publications identified as desirable for acquisition. During the current year, these publications will be purchased and others identified for procurement. Professor W. I. Palmer has been supervisor of the library activities. He now has been selected as Executive Secretary for CUSUSWASH. It is planned to have Professor Kenneth Bach of the Department of Agricultural and Irrigation Engineering assume the responsibilities for the supervision of this portion of the program.

### Seminar Envisioned

Interdepartmental seminars are planned for the year. These will involve staff and graduate students from the cooperating departments.

Several off-campus speakers are being invited to participate. Dr. Henry Caufield from Colorado State University has conducted a series of seminars at his University. He will be invited to participate. It is expected that several of the most outstanding speakers at their seminars will be asked to come to Utah State and repeat the seminar.

Several informal seminars are planned in which the students and staff will exchange ideas of experience in LDC's using Spanish language to communicate.

Dr. Long and/or Ken McDermott of USAID, Washington will be invited to Logan. It is intended they will present a seminar and participate in some group discussions dealing with the problem of relating the research findings and the University competence to the benefit of the LDC's.

Preliminary arrangements have been made with Dr. Warren Hall to organize and conduct a two-week seminar on irrigation science and water management. This would be held during early June, 1972. Professional people from other U. S. universities as well as those from foreign countries would be invited to participate.

Budget for Coming Year

The anticipated expenditures for the third year of the program are shown in column three of Table 3.