

1. PROJECT NO. 931-17-120-489-73
 2. PAR FOR PERIOD 02/20/74 TO 04/30/76
 3. COUNTRY TA BUREAU
 4. PAR SERIAL NO. 9310489 (5)
 PD-ADD-883-A1

ON FARM WATER MANAGEMENT - LA

6. PROJECT DURATION: Begin FY 68 Ends FY 76
 7. DATE LATEST PROG October 1973
 8. DATE LATEST PIP N/A
 9. DATE PRIOR PAR 02/28/74

10. U.S. FUNDING
 a. Cumulative Obligation Thru Prior FY: \$ 3,606,000
 b. Current FY Estimated Budget: \$25,000
 c. Estimated Budget to completion After Current FY: \$ 1,875,000

11. KEY ACTION AGENTS (Contractor, Participating Agency or Voluntary Agency)
 a. NAME Utah State University, Logan, Utah 84322
 b. CONTRACT, PASA OR VOL. AG. NO. AID/ta-C-1103

I. NEW ACTIONS PROPOSED AND REQUESTED AS A RESULT OF THIS EVALUATION

A. ACTION ID		B. LIST OF ACTIONS	C. PROPOSED ACTION COMPLETION DATE
USAID	AID W/ NCSS		
	X	1. Withdraw scientist from Brazil	1 Jan 1977
X		2. Notify Missions of contract termination	1 Oct 1976
	X	3. Orderly turnover of research and withdrawal of contract personnel from all research sites	1 March 1977
X		4. Termination of contract	31 March 1977

D. RE-PLANNING REQUIRED
 REVISOR NEW: PRO PIP PRO AG PRO/T P/C/C PRO/P

E. DATE OF MISSION REVIEW
 PROJECT MANAGER: TYPED NAME, SIGNED INITIALS AND DATE
 Gilbert L. Corey, TA/AGR/SWM
 MISSION DIRECTOR: TYPED NAME, SIGNED INITIALS AND DATE
 Leon F. Hesser, Director, TA/AGR
 10/15/76

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The Utah State University Water Management research project was initiated in June, 1968 with funding under AID/csd-2167. That contract was terminated on March 31, 1974 and the present contract became effective on April 1, 1974. The termination date of June 30, 1976 has been extended to March 31, 1977 in order to complete the comprehensive review upon which this PAR is based.

A review panel consisting of Ernest Smerdon, Team Leader, Howard Haise, and Douglas Caton conducted the field review in Peru, Brazil and El Salvador during the period February 28 - March 22, 1976. Although visits to Ecuador and Guatemala were not made, discussions were held with the field personnel from those sites.

Historical

A proposal for "Research on Agricultural Responses to Water Management in the Wet-Dry Climatic Zone of South and Central America" was submitted by Utah State University, August, 1967. A contract (AID/csd-2167) for \$779,550 initially, was negotiated and signed in June, 1968. The contract was later amended and funding was extended to March 27, 1974. During the period June, 1968 and March, 1974, \$2,328,487 was spent on water management research in Latin America. A subsequent contract (AID/ta-c-1103) was negotiated as a followup covering the period April, 1974 to June, 1976, with a funding level of \$2,380,000. This contract was extended in March, 1976 to March 31, 1977, pending field and on-campus review of progress and future on-farm water management research requirements.

The research has been aimed at water management problems in the semi-arid lands of the Latin American region and applicability to similar conditions in other regions was to be considered. Initial visits were made to Argentina, Brazil, Chile, Colombia, El Salvador, Panama, Peru, and Venezuela during the first 18 months of the contract to discuss the possibility of indigenous country collaboration. Identified water management problems in Brazil, Chile, Colombia, and El Salvador were selected for initial research.

The research emphasis in Brazil was assisting in the development of three irrigation research stations in the San Francisco Valley. This assistance was completed March 1973. A new agreement was then

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negotiated to assist with agreed upon on-farm water management research. TDY consultative assistance is being furnished, and one man is now located at the EMBRAPA branch experiment station in Petrolina.

In Chile, the emphasis was on water conservation practice on farms. In collaboration with host country research and extension personnel, Utah State University set up experimental plots on two private farms and demonstration plots on six communal farms in the Aconcagua Valley. The project was prematurely terminated without conclusive results when AID closed out activities during the Allende regime.

In Colombia, drainage and crop management problems were investigated on the Atlantico 3 irrigation project located between Barranquilla and Cartagena on the Atlantic coast. The work was completed July, 1973. One researcher went to El Salvador in June, 1970 and set up research on drainage, irrigation practices and water-fertilizer-variety experiments. In 1972 he was replaced by two men.

A water law expert who was stationed in Ecuador in 1971, initiated water law research in South America. He assembled water law data from the five Andean Pact countries and has produced a water law digest in Spanish and English. Since January, 1975, one man has been stationed in Ecuador to collect additional data on irrigation district organization and on-farm production from farmers and irrigation district officials.

In November 1974, a man was assigned to Guatemala to collaborate with indigenous researchers in increasing irrigated agricultural production, generally and in February, 1975 one man went to Peru to carry out a program of irrigated land reclamation. In summary, at the present time, there is one man each in Peru, Ecuador, Brazil, Guatemala and 2 men in El Salvador.

The on-campus effort has involved development of a strategy "model" for optimizing research on agricultural systems involving water management. Research plot experiments similar to those being tested in the above Latin America countries have been conducted

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at Utah State University. The Departments of Agricultural and Irrigation Engineering, Soils and Biometeorology, Agronomy, and Agricultural Economics have been utilized rather heavily for TDY assistance in Latin America.

Accomplishments

The research completed under the contract has made significant contribution to better understanding the soil/water/plant relations in some problem soils. Hargreaves collected and analyzed climatic data to evaluate the effects of climate on agricultural production and to quantify the needs and requirements for irrigation. Results were published in several publications related to climatic zoning for agricultural production, rainfall probabilities and evapotranspiration. In addition a central research facility has been established at Petrolina to investigate soil and water management in Northwest Brazil.

Heavy soils on the Malambito Agricultural Experiment Station in Colombia representing more than 40 percent of the soils in the Malambito Irrigation project have been studied. Consumptive use determinations and crop yield functions of soil, water and fertility production inputs were made. However, variability within experimental stands obscured treatment effects and crop yields were far below those required for economic return. Crops included corn, cotton, sesame and sorghum. Rice, however, yielded more than 8000 kg/ha of grain when soil was inundated. The problem of variable crop growth of other crops mentioned was related to excessive soil phosphorous, Fe, Cu and Zn for which no reclamation measures are currently available.

In El Salvador, lysimeters have been installed to measure exapotranspiration of grass to correlate with evaporation from a Class A Pan at 2 sites. Equations to estimate evapotranspiration have been developed from these data that are applicable to the region. Crop response to irrigation and fertility are being developed near San Andres where corn and tomatoes were irrigated by furrow, sprinkler and drip systems. Drip irrigated plots yielded 32 metric tons/ha as compared to 26 and 27 tons/ha for the sprinkler and furrow irrigated plots respectively. The data indicate that soil water

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availability can be controlled using any of the 3 methods and that selection of the best method will depend upon the available water supply and equipment.

In the Zapotitan Valley near San Andres a method to evaluate residual soil nitrogen was developed and can be used as a soil test index and in prediction equations for estimating fertilizer nitrogen requirements. At Atrocoyo, supplemental irrigation investigations using furrow and sprinkler irrigation methods show that corn, beans and soybeans yielded more under furrow irrigation. Pangola grass with proper fertilization gave a 2-fold increase in yield where the growing season was extended to 12 months/year by means of irrigation.

Mole drains have been developed and investigated to alleviate drainage problems in light, fine textured soils in El Salvador and Colombia. Design was based upon the criterion that the plow be pulled with medium sized tractors. Two single mole plow and eight double ones have been designed and tested in Utah.

In the Atlantico--3 project of the north coast of Colombia, leaching studies on extremely saline soils with no vegetation indicated that reclamation can be achieved using soil and water management practices required to produce inundated rice. During the reclamation process, 8 metric tons per hectare of rice were produced and provided income from affected areas during the reclamation process.

In Peru, investigations to reclaim salt affected soils on the La Joya Irrigation project using sprinkler irrigation were initiated. A leaching program was developed which was compatible with the soil conditions, the sprinkler system and the water delivery schedule. Alfalfa was the indicator crop to measure effectiveness of the leaching treatments.

A drainage manual entitled "Drainage and Salinity Problems in Irrigated Areas, How to Avoid and Minimize Them" has been prepared by Utah State University. This publication should be very useful to LDCs when finally published.

Utah State University has accumulated an in-house microfiche library of global water laws. Detailed water laws and regulations for the Andean countries of Bolivia, Chile, Colombia, Ecuador and

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Peru have been collected. A "Water Law Digest" for these Andean countries has been published in Spanish and English.

The materials collected provided the information base from which the Ecuadorian Water Code of 1972 and Regulations of 1973 were prepared. Utah State has also provided consultations to the other Latin America governments on contemplated water code changes.

A rather innovative method of studying water-fertilizer-crop interactions has been introduced in El Salvador and Utah. This involves a single sprinkler nozzle or a line of sprinkler nozzles which supply a point of line source of water respectively. The quantity of water applied varies from a maximum at the source to zero at the edge of the pattern thus providing a continuous water variable. This method has proved quite attractive as a demonstrational tool.

Issues

The comprehensive review addressed several important issues which are herein summarized:

a. Lack of research strategy or focus on a specific problem

The research projects have often been in response to requests from host governments and Missions and as such cooperative development of a research strategy has been difficult.

The major problem is not that the "projects" have not been focused; but, rather, that they have been too narrowly, and perhaps idealistically, focused. They have in general not been formulated on the notion of on-farm systems, and they do not contain assessment of aggregative production and impact effects on a geographic area basis. Further, the indicator crop used (corn or tomatoes) may not generally be a priority crop in the country or region. The work, also, may overemphasize "factorial" designed experiments and, in particular, the line and point source experiments.

A component in the original project which has seemingly had little recent attention in the research, is economic impact assessment of

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irrigation and irrigation research. Economic evaluation objectives were outlined in the original project work, and preliminary studies were started. Among these were costs-returns estimates, institutional factors, and fiscal policy, and a large number of economic inputs on Latin American agriculture were collected. Utah State University then moved into specific studies on the role played by water management institutions, e.g., waterlaw and farmer organizations. The water law dimension was expanded and made a comprehensive undertaking covering a number of South American countries, but nothing further appeared in the reports and work plans on economics.

The specific problems related to small farm irrigation systems have not had the attention that would be desirable. Specifically, systems in which only a handful of farmers may be involved. This is particularly important in the mountain irrigation areas and there is opportunity to do this kind of work effectively in Peru, and also in the Central America area of El Salvador and Guatemala.

b. Training

The project review in 1973 and subsequent RAC recommendations suggested that Utah State University should "concentrate on the preparation of research guides that will enable developing countries in Latin America to delineate their own major problems and design and conduct their own essential experiments."

Utah State University has been involved in several countries and the counterparts with which the Utah State University scientists have worked have often been in their research position for such a brief period of time before moving into other positions. The full impact of their experience on the research in a country is difficult to assess. However, the training they received will undoubtedly be of value in whatever jobs they may currently be doing in the country. There appears to be a need to establish greater longevity in counterpart assignments so that the LDC's do develop capability to design and conduct their own essential experiments.

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c. The value of the Consortium and/or cooperative approach to water management research

There is concern that Utah State University and Colorado State University have not worked together on the technical level to develop research strategies, staff exchanges or coordinated research projects to increase the effectiveness of the total research effort. Many problems in water management, especially on small farms, are common to all areas of the world.

The consortium (CID), was established under AID financing to assist the developing countries on their water management problems. The charter and agreement sets forth six specific objectives of the consortium to seek ways to assist developing countries, to provide information interchange, and to be a mechanism for possible exchange of students, staff, or graduate credits among the members. Both Colorado State University and Utah State University are members of the Consortium.

Difficulties are involved in cooperative work because the contractor has programs in numerous countries and in many cases has been in a country for only a brief period of time prior to being forced to discontinue operations for political reasons. This coupled with the additional problem of inter-university cooperation poses a formidable task when viewing cooperative work.

There are, however, opportunities for improved cooperation in the planning stages as well as in staff exchanges and other coordinated activities. One example of where cooperation might be most effective concerns the institutional, socio-political aspects of the research which is being conducted by Utah State University. Closer cooperation with the research in Pakistan under the Colorado State University contract would be desirable.

d. Extension and utilization of results

Utah State University research on problems related to crop response to multi-factor production inputs (soil-plant-water interactions) in a number of countries under diverse

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climatic conditions has resulted in a number of apparently fragmented research activities. In view of AID's requirement for world-wide application, are there possibilities of reorienting current programs to achieve this goal?

The Utah State University project is not geared directly to extension and utilization of results, except through distribution of publication and annual reports. This circumstance causes concern with USAID's host government with the time lag and the correlation of the research with on-farm practices. Governments (and USAID) are protesting the limited degree of flexibility the Utah State University field people say they have -- they are posted to do research, publish, and more recently to supply data to the model in a fixed evapotranspiration (ET) and water/fertilizer factorial design format. On-farm water management does not appear to have had the highest priority. The concern appears more with perfection of data on a two variable interaction experiment, and also ET measurements.

The key to management is education, demonstration, and incentive. This is exemplified by the early work in Chile. This ordering suggests a two-pronged approach: (1) training more people as water management specialists, and education and organizing farmers into viable water associations, and (2) proceeding on a parallel adaptive research and development course to rehabilitate water systems, establish new systems, and integrate water and crop management.

e. Research sites

AID has reduced its programs and the contractor has apparently met with some difficulty regarding logistical support in Brazil. Would better use of funds and technical assistance result from locating this research elsewhere?

One of the major problems in conducting research in LDC's relates to the question of just how site-specific the research is. Most research which is applied research has some element of being site specific, but that aspect of the research does not have to dominate. The degree to which the research is viewed by LDC governmental officials as being site-specific will depend on how well they under-

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stand the research. If they do not understand the rationale that went into planning the research, they are most likely to view it as quite site-specific and may even believe it is not directed toward problems which are of high priority in their country. This means that joint preplanning for the research is absolutely essential.

Conclusions and Needed Actions

Utah State University with two AID funded research contracts and a 211(d) grant in water management has developed a cadre of scientists who know the agricultural situation in South and Central America. Most are fluent in Spanish and some speak Portuguese. They have developed a great deal of knowledge and information regarding climatic factors, water requirements of specific crops, drainage criteria, water law and institutions, and fertilizer - crop - water interactions.

The University can therefore expect continued heavy utilization in Latin America by the Latin America Bureau, the Missions and others. Continuing the research program in its present form would however, enhance this resource little.

A substantial quantity of data has been collected and further refinement would be difficult to justify in view of higher priority farmer problems and the limitation of funds. There is now need to provide water management technology in farmer fields. This calls for site specific research with a socioeconomic component dealing directly with the farmer.

The following actions are recommended:

1. The present research program in Brazil will be phased out and turned over as soon as possible to counterparts expeditiously and judiciously.
2. The contract will be allowed to terminate as scheduled on 31 March 1977. Orderly withdrawal of personnel and termination of specific projects is expected.
3. Efforts will be made to assist the contractor in placing contract personnel on Mission funded projects where there are TA needs.