STATUS AND RESULTS OF USAID-SPONSORED FIELD SOIL AND WATER MANAGEMENT PROGRAMS

USDI BUREAU OF RECLAMATION ACTIVITIES

by

William B. Peters
Head, Land Utilization Section
Resource Analysis Branch
Division of Planning Coordination
Engineering and Research Center
Bureau of Reclamation
U.S. Department of the Interior
Denver, Colorado

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Introduction

As has been stated by Reclamation Commissioner Gilbert G. Stamm:

> "The opportunity to assist developing nations to improve their economic bases and living standards ranks among the most important and rewarding international undertakings of our day. This complex, multifaceted task should be approached with genuine interest and understanding of development needs, opportunities, and problems." (Stamm, 1969)

Reclamation strives to render assistance in a manner engendering self-respect, and enabling country nationals to proceed confidently to build works to best fit and contribute toward the growth of their own societies.

Nature of Assistance

Reclamation has provided technical assistance in the field of multiple-purpose water resource development to over 108 developing nations. This assistance has been highly varied, encompassing many disciplines, including engineering, economics, geology, hydrology, soil science, agronomy, and environmentalism. It can be reduced to three broad categories: (1) the gratifying task of training foreign nationals in our facilities at home, (2) providing direct consultation on various aspects of water resource developments abroad, and (3) the challenge of water resource planning abroad, accomplished with counterparts from the host nations. The latter primarily involves early reconnaissance-type investigations and preparation of reports to the governments requesting these services. Detailed feasibility studies, design, and construction are usually

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2/ Head, Land Utilization Section, Resource Analysis Branch, Division of Planning Coordination, Engineering and Research Center, U.S. Department of the Interior, Bureau of Reclamation, Denver, Colorado.

carried out under contracts between the governments and private firms. The work is helping through mutual effort to unleash the grip of economic stagnation and the corollaries of poverty, hunger, and substandard living.

Approach to Water and Land Projects

The development of multiple-purpose projects involves substantial capital investments. Assurance that investments will achieve intended goals depends in a large measure upon the availability of technical know-how. Capital is easier to obtain when the borrowing nation can demonstrate it is capable of adequately planning, supervising, and effectively operating proposed developments. The earlier lessons in foreign assistance have clearly taught the need to adapt technology that is realistic and effective for the time and place. Through training, people thoroughly familiar with the social patterns and power structures become available to evaluate development and prepare their own development plans or to effectively evaluate plans prepared through outside assistance. Reclamation uses the interdisciplinary team approach to planning water projects. Formulating a plan is a complex process. There is a tremendous advantage in fielding a team of specialists so the implications of the findings in one discipline may be applied to or questioned by one working in another discipline. Where planning, be it for a single project or for a basin, is involved, the team approach has formed the foundation of our major technical assistance efforts. But even here, Reclamation has followed the practice, when at all possible, of having counterparts from the participating nations assigned to the team to strengthen their effort and to provide essential followup activities.

From the earliest beginnings of this technical assistance program, there has been an increasing awareness of the need to fit water projects into the economic, social, and cultural patterns of the countries in which we have been asked to work. Arthur P. Davis, former Director and Chief Engineer of the Reclamation Service (forerunner of the Bureau of Reclamation) in the preface of this pioneering textbook, "Irrigation Engineering," wrote in 1919 that "* * * social, political, and economic conditions in America are radically different from those in the Orient, and this imposes very different conditions and limitations upon the practice of irrigation engineering." (Davis and Wilson, 1919.) Moreover, that the nonengineering phases of water project planning are not always adequately considered has been repeatedly voiced in conference proceedings, seminars, special reports, task force studies, and other literature (Marr, 1967; United States Panel in the World Food Problem, 1967; Reid, 1962; and United Nations, 1951). Such admonitions are valid echoes of the statement made more than 50 years ago by F. H. Newell, then Commissioner of Reclamation Service, who wrote:

"Irrigation enterprises as a rule have been considered mainly from the physical or engineering side. The promoters, more concerned with the irrigation developments, have approached the subject from the standpoint of the details of building the works * * * it has been a matter of surprise for them to discover, after the works are built, and are in condition for operation that the real elements of success are more dependent upon proper relations with the farmers and with the soil than those upon the works themselves." (Newell, 1916)

More recently, the Asian Agricultural Survey Team (Consultative Committee, 1968) panel assembled by the Asian Development Bank, stated it this way:

"The success of an irrigation project lies not in its structure of canals or drains but in the productivity of the water when applied as an input to crop production. The relation between irrigation and water use is often forgotten in the noise and excitement of constructing monuments to modern man's inventive genius."

Founded upon a base of experience, which in 1973 generated a gross crop value on Reclamation projects of over $3.9 billion ($424 per acre), Reclamation has attempted to develop plans overseas that are realistic for the project setting. This is not an easy task. Much of engineering science as applied to irrigation can be readily quantified, while the social, agricultural, and economic sciences that guide selection of plans are more difficult. The problem is compounded when necessary, reliable statistics and relevant research results are lacking. It is preferred to not use inference and extrapolation on a large scale. Adequate predictions of uncertainties bearing upon a plan require, above all, improved quantitative and qualitative models that can be applied with confidence to project planning in the developing nations.

Environmental and Social Concern

In recent years, Reclamation has been responding to policies and desires of governments for environmental concern in all aspects of planning for water and land use. Protection and enhancement of environmental quality is a priority matter in all investigations. The fostering of efforts to solve problems transcending international boundaries such as that of the Colorado River salinity serves to avoid, diminish, or mitigate similar consequences in other river basins. Environmental specialists have recently performed a very important role on teams in studying water developments in the Senegal River Basin, Africa, and in the Philippines.

Also, social and cultural consciousness has been introduced into water and land resource development in the developing country programs. (Stamm, 1969.) As arranged through USAID, Dr. Jasper Ingersoll was contacted to derive a research model for analyzing human aspects of river basin developments. (Ingersoll, 1968.) The model was proposed to be applied and integrated with parallel engineering and economic studies.

He set forth a set of dimensions, regarded as variable and dynamic, which specify the manner in which people handle various aspects of life. The set includes the ecological dimension: the manner in which a people relate to their environment and resources; a demographic dimension: the manner in which people populate their area; the technological dimension: the manner in which a people apply their knowledge to transform natural resources into goods and services; the economic dimension: the manner in which a people produce, distribute, and consume goods and services; the political administrative dimension: the manner in which a people organize power into patterns and organizations of authority; the social-cultural dimension: the manner in which a people relate to each other as groups and individuals, associated with the manner in which they understand and orient themselves to life; and the psychological dimension: the manner in which individuals define themselves in relation to other people. He then defined a process as a set of shifts through which fairly regular predictable changes occur in a natural phenomenon. In his model, the phenomenon is the capacity of men to make a living within their knowledge and values. The processes within each dimension are then analyzed and identified with regard to the increase in capacity to make a living as a function of the processes of change. Hopefully, the model can be an analytical tool to assist irrgation planners in identifying, evaluating, and selecting the development plan. (USDI Bureau of Reclamation, 1970.)

Land Selection

The selection of lands to be served by water control facilities and measures; i.e., flood alleviation, drainage, and water supply; and formulation of plans for projects have been guided by Reclamation's system of economic land classification. The classification has also been subsequently used to assist in constructing, developing, and operating projects. A rigid or fixed system is not used. Instead, general principles are applied to fit land classification to the environmental, economic, social, physical, and legal patterns existing in a project area.

The physical, soil, topographic, drainage, climatic, and water quality factors and their interrelationship influence the needed crop production inputs and yield outputs. These are in turn controlled by technological levels, economic conditions, social organization, resourcefulness of people, and the goals of the development. Planning is

accomplished by using the land classification survey as a systematic, integrating process for many of these plan determining elements. (Maletic, 1967; and Maletic and Hutchins, 1967.)

Principles

The survey should meet, to the extent practicable, the traditional classification principles. (Maletic, 1962.) These are: (1) the classification must be based upon a single principle - some one aspect of the facts to be classified must be selected and adhered to for the entire classification, (2) the classification should be exhaustive - it should include everything to be classified, (3) the subdivisions should be mutually exclusive - the facts are arranged in discrete and determinate groups.

The first principle is met by selecting an economic factor that is matched to the development goals. For this purpose, single factors such as net farm income or payment capacity are generally used. Mutual exclusiveness is achieved by specifying nonoverlapping ranges in the value of relevant physical characteristics of the land and relating these to selected ranges and economic output expected under irrigation.

In addition to the foregoing, four basic principles are followed in structuring the classification to fit the project's setting. These are as the principles of prediction, economic correlation, arability-irrigability analysis, and permanent-changeable factors.

Under the prediction principle, the classes in the system express the soil-water-crop interactions expected to prevail under the new moisture regimen resulting from the project. This involves identifying and evaluating the changes anticipated to be caused by water control, supply, and drainage formulating plans to assure a successful, permanent agriculture will result.

Examples of changes that may be induced by irrigation are development of shallow water tables causing drainage problems and related salinity, sodic, and aeration conditions which unfavorably influence upland crop growth; modification of slope and microrelief by landforming; and alteration of soil profile characteristics by deep plowing, chiseling, or addition of amendments. The irrigation water may cause favorable changes in the salinity of soils through leaching, or an unfavorable increase in salinity through high water tables or insufficient application of irrigation water. Depending upon water quality, the exchangeable sodium level of the soil may equilibrate at levels favoring water movement through the soil or it may increase the level causing the soil to become impermeable. Calcium carbonate and gypsum may be precipitated or dissolved. Texture may be changed by sediment-laden water. Organic matter levels will change and new biological populations will develop in the soil. Flooding

of soil, as practiced under rice cultivation, sets into motion a series of physical, microbiological, and chemical processes which influence crop growth. (Ponnamperuma, 1965.) These include retardation of gaseous exchange between soil and air, reduction of the soil, and the electrochemical and chemical changes accompanying the reduction. Carbon dioxide and other gases (nitrogen, methane, hydrogen) are produced in the soil and tend to accumulate, build up pressure, and escape as bubbles. There is a decrease in redox potential, increase in pH, and an increase in specific conductance. Also, the flooding causes denitrification; accumulation of ammonia; reduction of manganese, iron, and sulfates; accumulation of the products of anaerobic organisms; and other secondary effects of reduction.

The future drainage conditions in the proposed project area are recognized prime determinants of the permanency of irrigation, particularly with respect to diversified agriculture. The dynamic equilibrium level of ground water and the relation of water input to output are major factors influencing the success of irrigated agriculture. The changes which will occur in salinity, sodicity, acidity, reduction products, and aeration conditions in the root zone are largely controlled by these factors. It is an essential consequence of the prediction principle that the land classification survey must, therefore, deal not only with the soil but the substrata characteristics and conditions as well.

To meet requirements of the prediction principle, land classification survey organizes and synthesizes facts concerning such parameters as (1) drainage requirements, (2) equilibrium salinity levels, (2) equilibrium exchangeable sodium levels, (4) water requirements, (5) soil productivity following landforming and expected soil profile modification practices, (6) crop production inputs and outputs, (7) anticipated land use and management practices, (8) chemical suitability of the water supply, (9) quality of return flow, (10) flood hazard, and (11) soil erosion.

The economic correlation principle involves relating, within a given project setting, the physical factors of soil, topography, and drainage with an economic value. The economic basis for the land classification is usually chosen to contribute toward determining whether irrigation is feasible for increasing net farm income, how the project might be planned to achieve the most benefits, and to evaluate the interrelationships of investment feasibility and optimum water use. In this system, as applied to the United States, the economic value is defined as payment capacity - the residual available to defray the cost of water after all other costs have been met by the farm operator. (USDI Bureau of Reclamation Manual, 1953). Depending upon the purposes to be served by the land classification, other economic values may be chosen to define land class. For initial planning studies in the developing countries, it has generally been the policy to use direct benefits (net farm income), as the economic

parameter in land classification rather than payment capacity. (USDI Bureau of Reclamation, 1967.) This is done to eliminate the immediate resolution of the repayment policies and irrigation subsidies which might be applicable to the projects. With the developing countries, it can be expected that in the early period of project investigation, the development of a repayment capacity is not sufficiently firm to confidently base the land classification on repayment criteria. With land classes defined as economic entities, a set of relevant and mappable land characteristics is chosen for the time and place to provide a physical definition of the land specifications. The land class determining range of these characteristics varies with the economic, ecologic, technological, and institutional factors prevailing or expected to prevail in the area. As a consequence, land classes express the local ranking of land for irrigation use; e.g., best suited, moderately suited, poorly suited, and unsuited for irrigation development.

The permanent-changeable factors principle recognizes that changes in land arising from water and land development impose a need to identify characteristics that will remain without major change and those which will be significantly altered. This identification permits construction of a consistent set of land class determining factors assuring uniform appraisal of land conditions by the various disciplines engaged in making the land classification survey. Usually, the permanent factors include such characteristics as soil texture, depth of soil to gravel, cobble or bedrock, depth to lime zone, claypans, hardpans, and macrorelief. Typical changeable factors include salinity, exchangeable sodium percentage, titratable acidity and exchangeable aluminum, pH, microrelief, water table levels, flood hazard, brush and tree cover, and rock cover. Whether given characteristics will be changed will usually depend upon economic considerations. The land classification survey thus deals with two aspects of this principle. Can the change be accomplished, and what degree of change is economically feasible? This is largely dependent on the climatic and economic setting of the project. For example, a large investment may be made to reclaim a saline, sodic, or acid soil which after improvement will yield a net farm income of $500 per hectare. In another setting, where net income after improvement would only be $75 per hectare, the soil having similar conditions would be regarded as nonirrigable. In the latter case, it may be infeasible to make the change.

The arability-irrigability principle states that the section of lands to be served proceeds through an initial step in which land areas of sufficient productivity to warrant consideration for service are identified and that there is superimposed upon this determination the selection of the lands to be specifically included in the plans of development. The former may be termed "arable" lands, and the latter "irrigable" lands or lands selected for service. The selection of arable lands is guided by the economic value such as payment

capacity or net farm income, as chosen to define the land classes. On the other hand, the irrigable lands are chosen through the plan formulation process. Here, water is allocated to irrigation, hydroelectric power, municipal and industrial water supply, flood control, water salvage and other project purposes. The irrigable area is thus selected in relation to the water allocated to irrigation and to the size and location of the distribution and drainage system. Fundamentally then, the selection of lands for service is a two-step process: (1) selection of an arable area as guided by farm production economics, and (2) selection of an irrigable area is guided by the economics of plan formulation. The steps are interrelated and often complex, requiring close interdisciplinary cooperation.

The application of plan formulation criteria to the classification generally leads to successive elimination of identifiable increments of arable lands from the plan of development. Typical adjustments include (1) elimination of noneconomic increments such as those that are too costly to serve, drain, or provide distribution works; (2) conformance of land area to the available water supply; (3) elimination of tracts located above water service delivery elevations; (4) exclusion of isolated segments, odd-shaped tracts, and severed areas that cannot be efficiently fitted into the farm unit pattern; (5) deletion of proposed public rights-of-way; and (6) elimination of areas unable to meet minimal criteria for economic returns under the plan. Of these factors, it is evident that items (1) and (6) will again be goal-dependent.

Application of Methodology

The system of selecting lands for irrigation is guided by a series of somewhat interrelated stages. These may be identified as the presurvey, survey, and postsurvey stages.

Before the land classification is started, the matter of handling land development costs is determined. Methodology between countries may vary according to whether the Government expects the landowner to pay for all development costs or if the Government does all of the on-farm development with no direct cost to the landowner. The land classification is varied to show a reduced payment capacity in net farm income and lower land class where land development costs are borne by the farmer. When development costs are handled as a Government expense, they do not influence the land class except when the maximum permissible expenditure would be included.

For certain developing countries including Brazil, Afghanistan, Laos, and Thailand, the major development costs involving clearing and leveling were treated as a capital project investment cost rather than a private farm cost. As such, a maximum land development cost

per unit area determined the influence of this factor in separating arable and nonarable land, but did not influence class rank within the arable range as stated above.

The presurvey stage involves study of the land resources, associated productivity, and drainage capability experiences in a fully developed irrigated area having physical and climatic conditions similar to the area of investigation. In developing, fitting, and testing the land classification specifications to project conditions, farm enterprise studies are made to determine the net farm income for the various classes. (Seldon and Walker, 1968.) Establishing these standards for classifying land for net farm income, involves the projection of representative farm enterprise and representative levels of farm management. These, of course, must stem from information of the present day situation, and trends in the development and application of technology in agriculture. In the latter regard, it is recommended adaptive research programs be undertaken to help guide the land classification work by providing answers to questions pertaining to management systems, fertility, amendments, irrigation practices, and other factors.

In the Pa Mong Project, Laos and Thailand, special studies were made of the soil-water yield relationship for both rice and diversified crops. Reclamation gave the initial impetus to a cooperative research program aimed at predicting soil behavior under irrigation and better defining the soil characterization limits to be used to differentiate land and to rank it according to its profit-producing potential. The program was launched in 1967 with the full backing of the Thai Government and with provision for cooperation and coordination among the Thai agencies concerned and the cooperating groups including USAID. This research provided the data that helped define the water service area and, hence, assisted in setting priorities for development of various areas and an improved data base was provided for measuring the economic feasibility and justification of the development. It further assisted in identifying the kinds and amounts of inputs required to build the supporting infrastructure. (USDI Bureau of Reclamation, 1970.)

Data on the water quality are also studied and their potential effect on the soils appraised. Only the soils which will respond favorably to the type of water available for irrigation are selected for development.

The characteristics and qualities of lands that determine suitability for irrigation use vary with each project. The land class determining factors represent selected and correlated ranges for such characteristics as texture, depth to bedrock, hardpan, sand, gravel, caliche or other root-limiting influences; structure; consistence; color and mottling; kinds and amounts of coarse fragments; and kind,

thickness, and sequence of horizon. In addition, the prediction aspect of selecting irrigable lands requires many laboratory measurements. Performance qualities are also either measured or inferred. These would include factors such as fertility, productivity, erodibility, and drainability, as well as such measurable factors as infiltration rate, hydraulic conductivity, moisture characteristics, and moisture-holding capacity.

In the investigation of lands in the tropics, a strong soil characterization program has been conducted. The chemical status of tropical soils was carefully evaluated along with observable characteristics in making sound selections of irrigable land. Instead of salinity and sodicity (there are exceptions), the problems confronted have been usually fertility related chemical characteristics requiring special appraisal. These included status of weathering of the clay minerals; soil acidity; charge status, soluble and exchangeable iron, aluminum, and manganese; base saturation; and nutrient status of the soils. Such characterizations identified infertile soils not suitable for continuous crop production because of high inputs. On other soils they indicated the type and level of production inputs required to attain specified yield levels of particular crops. Of course, other soil characteristics such as texture, structure, depth, water-holding capacity, infiltration rate, permeability, and claypans were evaluated as were water quality, climate, topography, and drainage conditions.

The basic principles of Reclamation land classification; i.e., the principles of prediction, economic analysis, permanent-changeable factors, and arability-irrigability analysis are applicable in selecting land for irrigation development to either diversified or lowland agriculture. The major basis for differentiating physically, chemically, and economically diversified croplands from wetland ricelands is the ability of the soil to attain optimum soil submergence, susceptibility to soil puddling, and control of water table (Grant, 1964). Therefore, the differentiating characteristics of wetland riceland classes are primarily predicated on water control as related to soil characteristics and conditions which will control the moisture regime for wetland rice production. The diversified cropland classes are predicated on conditions of adequate drainage and differentiating soil characteristics that have a strong influence on the yield and cost of producing diversified crops.

Many of the soil parameters, especially with respect to prediction and productivity, are different in classifying lands for the two types of irrigated cropping. In contrast to upland agriculture, the classification of soils for paddy rice production involves the prediction of ultimate soil conditions that will occur from flooding. Some of the conventional soil tests used in surveying soils

for diversified crop production are not applicable to the characterization of soils for paddy rice production because of the drastic changes in soil properties, their dynamic state, and the wide differences among soils produced by flooding.

Topographic characteristics considered consist of the degree of slope, relief, and position. These factors are evaluated as they influence land development needs and costs, method of irrigation, design of on-farm water conveyance systems, erosion hazards, crop adaptability, drainage requirements, water use practices, and selection of management systems. It is necessary to make decisions regarding the extent to which slope and relief will be modified by landforming, and to make estimates regarding the amount, type, and cost of land development.

In the survey stage, appropriate land classification specifications are applied in the performance of the arable classification. This involves field traverse, soil and substrata observation and sampling, laboratory analysis of soil samples, delineation of the land classes and subclasses, informative appraisals, and the related procedures necessary to accomplish the field survey work. Performance of the fieldwork is guided by the type of investigation being performed. These may be of appraisal, feasibility, preconstruction, postconstruction, or postdevelopment grade. If the appraisal studies show promise of achieving the development goals, then more detailed studies are subsequently performed.

The requirement for investigative detail is set not only by the type of investigation being formed but also by the complexity of the landscape being investigated. In accomplishing the field survey, Reclamation generally uses not more than six land classes defined on the basis of their range in payment capacity or net income. In short-growing season areas, fewer land classes are sufficient. Class 1 lands have the highest level of suitability. Class 2 lands have intermediate suitability. Class 3 lands have the lowest suitability for general farming. Class 4 designates land with excessive deficiencies which special engineering or economic studies have shown to be irrigable. Class 5 is used as a temporary designation for lands requiring special studies before a final land class designation can be made. Class 6 is land not suitable for development.

Subclasses are used to indicate the reasons land is placed in classes lower than Class 1. This is shown by appending the letter s for soil deficiency, t for topographic deficiency, and d for drainage deficiency to the land class designation. Subclasses of the land classes 2, 3, 4, and 6 are s, t, d, st, sd, td, and std. The mapping unit symbol also provides for showing the present land use productivity level development cost, water requirement, drainage requirement, and as needed, special appraisals to indicate specific deficiencies.

For drainage evaluation purposes, the fieldwork involves numerous observations and measurements of conditions of the substrata as well as the true solum and surficial parent materials. Some observations to depths of at least 3 meters are used in all investigations, and to greater depth as needed depending upon the particular type of landform encountered.

In the postsurvey stage, the arable land classification may be modified as additional pertinent physical engineering, hydrologic, and economic information is obtained. Arable classification adjustments are needed if the final project plan and costs for water and drainage are significantly different than original estimates. During the postsurvey stage, application is made of tests for the engineering feasibility and project formulation criteria of benefits and costs, repayment, and the operation, maintenance, and replacements costs as needed to select the plan and related irrigable land under the development goals.

Results of the land classification are applied to (1) selection of irrigable lands, (2) determination of water requirements, (3) selection of land use and size of farm, (4) selection of the land development methods, (5) determination of payment capacity, (6) determination of irrigation benefits, and (7) development of layouts for irrigation and drainage system.

Tradeoffs in Agricultural Land Use for Plan Formulation

In investigations for irrigation development in Monsoon Asia, in-depth studies were made and thorough consideration given in both the arability and irrigability determinations to alternatives of land selection for diversified cropping and wetland rice culture. It was generally found on lands susceptible to maintenance of a water regime favorable for rice, that formulating for this cropping use was economically preferred to diversified cropping and planning for the required drainage. The on-farm economic return and project feasibility were much greater when based on rice cropping. Much of the land area comprising the vast Pa Mong Project in Laos and Thailand, because of extremely acid soils, would preclude diversifying to most marketable upland crops if drained. Further, the existing farming experiences and infrastructure favor rice. (USDI Bureau of Reclamation, 1970 and 1971.)

Research and Technology Needs

Constributions to the development effort are conditioned by the constraints operative in project settings. These vary among countries but generally include lack of data, trained personnel, meaningful research, awareness of planning procedures, and policies for water and land development.

There are many ways in which to lay requisite foundations for the improvement of water projects in the developing nations. There is needed a greatly expanded research effort into the production economics of modern technology as applied to specific kinds of soils in the developing nations. The research should be of a pragmatic nature to enable its immediate application to problems involved in selecting land resources for development and for making the related economic analyses.

Considerable improvement is needed in the collection and processing of data required to plan an irrigation project. A large amount of climatic, hydrologic, geologic, topographic, land, agricultural, social, and economic statistics is necessary to evolve sound plans. Overcoming the difficulties imposed by lack of data, unreliable data, and unprocessed raw data should rank high among the development program priorities.

With the food supply and population problem generating increasing pressures to rapidly develop irrigation, more emphasis needs to be given to total basin planning. It is essential the limited capital resources available be invested in projects whose lands are best able to respond to the new technology and where other functions such as hydroelectric power, flood control, and improved fisheries can be developed.

There should also be further development of methods for evaluating impacts of projects on environment and health. As related at the conference on Ecologic Aspects of International Development (Carter, 1969), it has been shown the price of development has, in some instances, included pollution problems, loss of farmlands and habitat (for people as well as wildlife), and the spread of disease. Irrigation planners should be receptive to the development of guidelines for predicting the ecological impacts of irrigation development. There is a continuing need to extend the kind of training described herein, not only in the fields of engineering, agricultural, and economic sciences, but also in the social and ecological fields as well. There is also a need within the developing nations to create a pool of trained workers and project managers who can effectively maintain and operate the constructed irrigation schemes.

Above all, fitting water projects into the pattern of growth necessitates careful specification of the development goals and the strategy to be followed in achieving these goals. These growth patterns will branch in many directions and take on diverse forms as controlled by a genetic code of knowledge, beliefs, and value systems within the society. (Stamm, 1969.)

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