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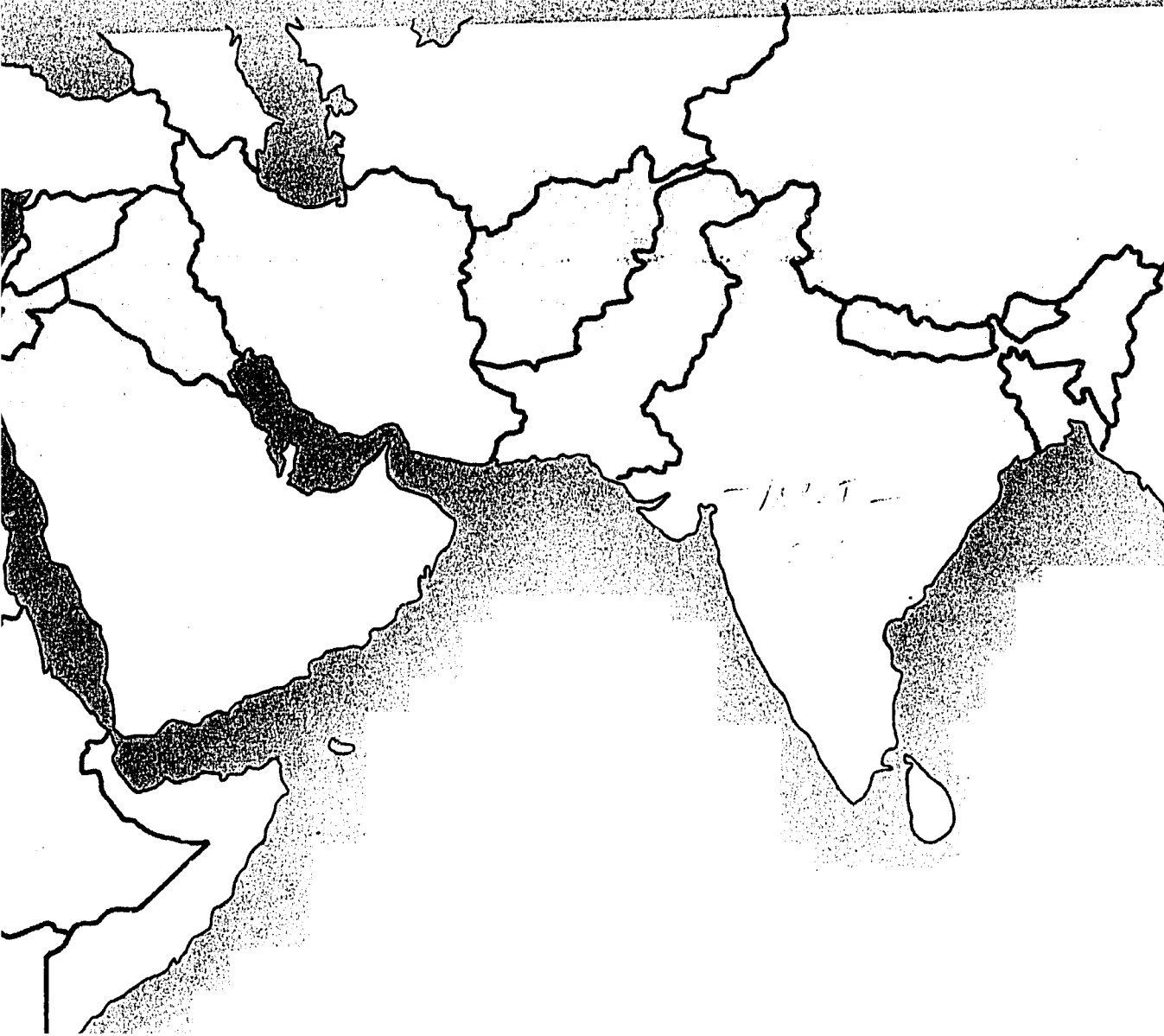
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**IRRIGATION
PRACTICES
SEMINARS
1956-1970**

AN EVALUATION 1973

NESA

**IRRIGATION
PRACTICES
SEMINARS**

1956 – 1970

AN EVALUATION 1973

**BY
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**U.S. AGENCY FOR INTERNATIONAL DEVELOPMENT
ASIA/TECHNICAL/AGRICULTURE**

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MARCH, 1973

FOREWORD

Irrigation has been practiced in the Near East and South Asia for millenia. It has provided means to reclaim desert lands and to insure against drought where rainfall is seasonal or unreliable. Presently, out of about 251 million hectares (616 million acres) of land classified as arable in the NESA region, about 56 million hectares (131 million acres) are irrigated. Especially during the last 25 years, large capital investments involving several billions of dollars in foreign and local currency have been invested in developing irrigation either to irrigate new lands or to improve supplies to lands presently irrigated. Such investments are expected to continue, probably at increased rates, at least for another quarter of a century. During the last one or two decades, the need for improved moisture availability on the farm has been compounded because of the promise of the *Green Revolution*. New inputs yield their full potentials only in an environment of optimal soil moisture.

Changing irrigation practice, either implementing it for the first time or changing tradition, has never been easy. This is true in the Near East and South Asia and there has been disappointment that the large investments have not yielded greater returns at larger rates than has actually occurred. While there are many problems in irrigation development, the most persistent ones occur at the farmer's field. Some of these the farmer may be able to do something about, but most of them are linked to the project or to national policy. As one means of bringing national leadership attention to these difficulties and to possibilities for alleviating them, the U.S. Agency for International Development (AID), joining with various countries in the region in turn, held international biennial irrigation practice seminars during the period 1956 to 1970. The seminars were attended by concerned technical and administrative leaders of the participating countries.

During 1972, I was asked by the Agency for International Development (ASIA/TECH/AGRICULTURE) to make a field evaluation of the effectiveness of the seminar program, and, in response, spent part of July and all of August in the Near East-South Asia region. The ensuing report records my findings. The work was done under Contract No. AID/Asia-597.

I not only had the privilege of making the evaluation visit, but also of participating in planning and holding three of the seminars during the period 1959 to 1964. During these experiences I have incurred a great indebtedness to literally hundreds of people. I should like to name all of these colleagues individually, but to do so here would be impossible. Included are scores of officials from more than a dozen countries who unselfishly extended personal and official hospitality and cooperated technically; scores of American professionals in a dozen AID missions over a dozen years; representatives of international organizations and foundations; and the members of the technical staff of the NESA Bureau (now ASIA) in Washington who provided excellent and appreciated backup support and advice. To all of these I shall be grateful all my life for a rare and valued experience.

Logan, Utah
March 1, 1973

Dean F. Peterson

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SUMMARY

Background

Beginning in 1956, AID jointly with a host country in the Near East and South Asia, staged a series of seminars on irrigation practice. These were held biennially until 1970 at various locations in the region. In his 'Preface' to the first seminar report, Carl M. Forsberg, the seminar leader, stated the seminar's purpose:

...as a means of creating interest and developing a better understanding of the subject of water use...

Forsberg cited the large capital expenditures being committed to irrigation water-supply works and the concurrent difficulty of implementing good irrigation on the farm as reasons for making the effort to hold the seminar. He stated:

... Spending for large-scale works to develop and distribute water for irrigation has reached the magnitude of billions of both local currency and foreign exchange during the past decade. Most countries of the region have large programs, developed by their own engineering forces, or by consulting firms, or both.

Unfortunately, however, very little thought and effort is being placed on the use of irrigation water on the farms. The policy of neglecting the agricultural phase of irrigation can lead only to ruin, both for the farmers in water-logged and eroded soil and poor crops, and to a nation in abandoned structures and investments.

The basic objective of the seminar series remained the same throughout the period of its activity. The very serious problems of ineffectiveness of capital investment and a poor water-use practice still exist. Poor water use is not restricted to new capital-intensive projects, but occurs pervasively on old and new projects whether traditional or modern. It is an obstacle both to gaining economic returns on capital investment for new irrigation works and to effective use of agricultural *inputs* of new varieties, fertilizer and mechanization on traditional systems. Some progress has been made, nevertheless, and the evidence demonstrates that the seminar series was significant in contributing to that progress.

Organization and operation of the seminars was somewhat atypical for international seminars. In each case a senior U.S. expert visited the countries several months in advance and helped develop the program based on problems and accomplishments found in each country and on a consideration of what practically might be stated in a formal paper by country experts and administrators about them. In order to influence policy, an effort was made to include both senior technicians and administrators at the policy level in delegations. During the actual sessions papers and discussions were left to the country delegates. U.S. experts played a secondary resource role as technical advisers and remained in the background of the discussions. The goal was to stimulate discussion of real problems and solutions rather than to instruct. The hoped-for product was policy change and institutional development, but exchange of technical information was an important part of the strategy. Efforts were made to give the seminar as much status in the political hierarchy

of each country as practical. Over the period, the participating countries were encouraged to assume increasing responsibility for organizing and financing the seminars.

The eight seminars were held at the following times and places: Ismir, Turkey, 1956; Tehran, Iran, 1958; Lahore, Pakistan, 1960; Ankara, Turkey, 1962; New Delhi, India, 1964; Amman, Jordan, 1966; Lahore, Pakistan, 1968; Kabul, Afghanistan, 1970. Sixteen countries participated in one or more seminars. These included Afghanistan, Cyprus, Greece, India, Iran, Iraq, Jordan, Lebanon, Nepal, Pakistan, Turkey, Saudi Arabia, Sri Lanka (Ceylon), Sudan, Syria, and UAR. The usual attendance was seven or eight countries, the most was fifteen and the least, six. Average attendance exclusive of U.S. personnel was 45. Attendance by USAID mission and Washington personnel averaged between 16 and 17. The total number of non U.S. participating country attendances was 376. Because some delegates participated in more than one seminar, the total number of different individuals from participating countries total 309. More detailed statistics on attendance are tabulated in Chapter 1.

A ninth (1972) seminar had been planned, tentatively in Turkey; however, this was cancelled because of financing problems in that country. Questions also were raised about the effectiveness and desirability for continuing the seminar series and the writer was asked to make an evaluation of the past and possible future effectiveness of the endeavor. During July and August, 1972, he visited seven of the countries that had been most active in the seminars: Turkey, Iran, Afghanistan, Pakistan, India, Nepal, and Sri Lanka (Ceylon). Former delegates and other agricultural and irrigation officials were interviewed in each country. A total of 247 individuals from the countries visited participated in the seminars. The writer was able to contact 43 of these or 17.4 percent. A substantial number of the participants have retired or are assigned outside of the capital cities visited, so that the sample probably represents a majority of the ex-delegates currently active at the policy level. In addition to ex-delegates, 35 other high-ranking officials concerned with the seminar or its recommendations were interviewed. The approach used in the assessment of effectiveness is outlined in Chapter 2 of this report.

While the countries of the region have much in common that relates to irrigation practice, there are large differences in resource bases, climate, cultural characteristics, and stages of development. Climatic variations range from the semi-arid temperate zones of Anatolia and northwestern Iran, through the temperate and sub-tropical desert areas of Iraq, Iran, Afghanistan, Pakistan and India, to the wet-dry monsoon climate dominating south Asia. Iran has relatively large amounts of foreign exchange available for development in comparison to most of the other countries. In Turkey, development of technical organization and credit to assist farmers in on-farm water management is relatively well advanced. There are signifi-

cart differences in physical as well as institutional infrastructure, also, for example, transportation and education. Size and population also vary greatly: India has a population of 550 million, Cyprus has less than one million. These are only a few examples of variability within the region. After 16 years of development some of the differences appear to have grown increasingly important as far as organizing the seminar is concerned. This is especially true as interest has shifted from the purely technical toward the institutional arena.

Evaluation

Over the period of the seminar, a great increase in awareness of the relative importance of water management at the farm level throughout the NESAs region has been documented. There have also been shifts in relative allocation of resources, priorities and institutional developments that were designed to improve the climate for on-farm water management. The seminar is only one of a number of factors that have brought these changes about, but the evidence indicates that it was a significant one. Results of interviews are compiled by countries beginning in Chapter 3 of this report. The following discussion will attempt to summarize them.

- In Turkey, official assessment by the two most concerned agencies, DSI (State Hydraulic Works) and TOPRAKSU (Soil Conservation and Farm Irrigation) was a cautious endorsement that the seminar "had been useful so far"; however, these bureaucracies were preoccupied with the seminar's future rather than with an evaluation of past effectiveness. Statements by other participants not now employed by DSI and TOPRAKSU were more enthusiastic. The first director of TOPRAKSU felt that "without AID's contribution, and the seminar was an important part of that contribution, TOPRAKSU could not have been formed" and that the seminar helped DSI and TOPRAKSU get together to focus on on-farm water management. Another former director, now a member of Parliament, credited the seminar with influencing government on land consolidation; irrigated farm development especially on irrigation cooperatives; providing a vehicle for exchange of important information; creation of domestic industry in water development and initiation of needed legislation.
- In Iran, the difficulty of evaluating direct effects of the seminar was noted. "It had a 'moral' rather than a direct influence on policy. It doubtless had some influence on the Plan Organization. Planning and regulatory activities were initiated and some of the seminar recommendations were used by the Ministry of Water and Power. There was considerable exchange of information, e.g., knowledge of the importance of drainage was gained from Pakistan. Iran is very much interested in seminars of this type and would attend if held. The seminar has tremendous U.S. public relations value among those interested in water and the U.S. is missing a real public relations opportunity in not continuing the seminar."¹

¹Quotations enclose a composite statement drawn from several sources.

- Afghanistan officials felt that the seminars had been particularly helpful in exchange of ideas helping Afghanistan keep pace in a minimum of time. Some of the more junior officials stated that they received specific irrigation practice information helpful to them on projects or programs within their responsibilities. An official of the Helmand Valley Authority stated that the seminar suggested a variety of new options. Many ideas have been borrowed, e.g., charging for water deliveries. "It was through the seminar that we first became conscious of the necessity to take the farmer into account. You can see changes in the Helmand Valley as a result. Designs have actually been changed as a result of the seminar. For example, the threatening problems of drainage were really brought home." Progress has been made in the Shamalan on such problems as water users organizations, grace periods and longer repayment times on loans, land consolidation, land leveling and selling of water volumetrically. It was stated that "all these ideas came from recommendations of the seminar."

In Agriculture and Irrigation, the Deputy Minister stated that the ideas of the seminar had been reflected, at least subtly, in the Ministry's planning. Only lately has the Ministry become interested in land development as a major activity. One important point is that the seminar has convinced the Afghan Government that something can be done about water rights without becoming in conflict with Islamic laws. Examples in effecting more efficient water use in other countries has made Afghan authorities feel that there are possibilities for success in Afghanistan.

- High Central Government irrigation officials in Pakistan expressed great concern about the watercourse² problem and about the pros and cons of lining watercourses in particular. They felt that the 1968 seminar was a very useful one and that there was a unanimous opinion that it was a success. In Punjab, Provincial Irrigation Department officials felt that while the seminar has made no difference in the overall plans, it has had a positive "qualitative" effect on them. Land reclamation officers in the same province found a more direct benefit emphasizing "...so many problems and assistance is needed. Continuance of the seminar is a must!" Irrigation officials in Sind Province were emphatic on the desirability of the seminar, stating "most seminars have ignored on-farm irrigation, but whatever is done in providing water supply is for the real purpose of growing crops. The field is where they grow, and anything that gives attention to this is invaluable."
- Officials of the Ministry of Agriculture in India recognized a number of direct benefits from the seminars. According to them, they have helped a great deal in generating a climate whereby agricultural irrigation became of interest, identifying a whole field to which much thought had not been given previ-

²"Watercourses" is the term applied to the system of interfarm ditches used to distribute water from a government canal to farm fields.

ously. "The 1964 seminar³ led directly to the Command Area Development Program. While much had been done in developing groundwater supplies, on-farm water management was lacking and state officials are now much more conscious of these problems. The seminar did help in arousing this consciousness and was much worth the effort." Since 1964, there has been good development of soil and water management. The additional Secretary of Agriculture, a high-ranking civil servant who has responsibility for the National Soil Conservation and Water Management Program attended the 1970 Seminar as Chief Delegate from India. He stated that "the seminar had a distinct and significant effect in bringing the present program in Soil Conservation and Water Management about. One benefit is: We learned it could be done."

Irrigation Department officials in the Central Water and Power Commission felt that the seminar was one source of several tending to excite action. but stated that the main burden of implementation was in the Agriculture Ministry.

- Nepal's irrigation potential is relatively undeveloped and its administrative structure quite new. The Ministry of Agriculture is building a capability for on-farm water management service under its Agricultural Engineering Department and delegates attended the sixth and seventh seminars. One felt he had learned a lot but was frustrated about implementation. The other expressed a feeling of diffidence and frustration in that Nepal's efforts had not reached the stage of those of other countries.

Officials in the Irrigation Ministry felt that assessment of the tangible benefits of the seminar would be difficult, but the awareness brought to people had been useful. The Irrigation Department has accepted on-farm water management as part of its task, according to its Chief Engineer, who stated that the sequence of planning had been reversed, now proceeding from the field to the water supply, rather than the reverse.

- While actively participating in most of the seminars, a relatively high proportion of Sri Lanka's (Ceylon's) delegates have retired. One delegate has used seminar material in his university courses. Another senior delegate associated with the large Mahaweli Project felt it was useful to learn how things were done in other countries. The Deputy Director, Ministry of Planning, a delegate in 1962, stated that in Sri Lanka (Ceylon) the seminar did influence those civil engineers who attended to work more closely with agriculture. This need for closer coordination is now realized by the Planning Commission. The Mahaweli Board and the World Bank are now very interested in irrigation practice. For twelve years the Planning Commission has been trying to give "on-farm" orientation to engineers.

³The Indian delegation to the 1964 seminar held in New Delhi included top officials from irrigation and agricultural departments from eleven of the states as well as delegates from the Center Government.

During their history, the seminars issued a number of recommendations dealing with suggested policy and programs. As part of his evaluation, the writer attempted to assess the degree to which these recommendations had been implemented in the various countries visited. Based on study of the recommendations, a list of 13 evaluative topics was developed. This list is contained in Chapter 2 and includes such topics as technical programs, institutional developments and arrangements, educational programs, legal developments and research. A summary of findings will not be attempted here, but may be found under each country in Chapters 3-9. In general, all countries still have a long way to go to implement the recommendations. Some have farther to go than others. Turkey may have reached a "break-through" stage and this stage is probably being approached in India and possibly Iran. Generally, the problems of on-farm water management are not yet being dealt with adequately by civil irrigation engineers responsible for overall project design, nor have the farm-service institutions to provide on-farm technical services and credit been adequately developed. On the other hand, good starts *have* been made and the needs *have* been recognized, not only by the countries themselves, but by international lending agencies, also. That the momentum now exists in most of the countries to carry the movement through is questionable.

Conclusion

Although largely indirect and circumstantial, the evidence is nevertheless quite conclusive that the Irrigation Practice Seminars have played a *significant* and likely a *critical* role in changing national policy and allocation of resources toward solving the problem of inefficient on-farm management of irrigation water in several of the countries of the NESAs region. It has been said that implementation of farm water management requires a substantial cultural change, so the task of achieving full and efficient on-farm management of water is a monumental one. While far from fully achieved, several countries have taken the essential basic steps to develop the institutions and incentives necessary to progress toward that goal. A number of forces have been involved in this evolution, but it appears that the seminars have been an important part of the package.

Possibilities for the Future

Several favorable circumstances contributed to what success the seminar series may have enjoyed. The existence of a network of AID missions with technical water management capability on board was an important factor. This facilitated inter-country communication, expedited efforts in individual participant countries and provided host country support. During the early years, all of the countries faced somewhat the same major problem—little or nothing was being done. Presently, several of the countries have made considerable progress and the commonality of interest may have diverged. The problems in the monsoon-dominated regions are somewhat different from those of the temperate and subtropical arid and semi-arid regions and these differences will need to be considered in planning any future effort. Turkey has officially disclaimed further interest in a future NESAs region irrigation seminar, but is interested in doing something in some other format.

In most countries, officials were interested in continuing the seminar effort in some form and alternatives to AID's organizational role were discussed. Suggestions included organizing the effort under the International Commission for Irrigation and Drainage (ICID) or CENTO. Some felt these alternatives would be desirable; others felt they would not work. There was general agreement that without the catalytic efforts of AID or some international organization, an international seminar would not happen.

There is a strong and rather general feeling that some permanent secretariat should be established which could disseminate information and provide continuous follow through and evaluation. This implies a permanent regional center and this may be desirable, but the writer believes a decision to proceed along these lines should be approached with caution and only after thorough study. The principal function of the seminars was to provide a forum whereby senior technicians and policy-level administrators could communicate both in-country and internationally. This might or might not be achieved by a center, and the cost would be substantially greater. Preparation for participation in the seminar was a major element in improving communications within participating countries. Such a seminar effort can be made on an *ad hoc* basis as needed, but it needs to have *status*.

The need for discussion and exchange of ideas about on-farm water management still exists. Even though some countries have advanced more than others, such countries should be willing to make their experiences and know-how available. The argument that if the seminar was really worthwhile the individual countries would organize and finance it on their own is simply not realistic. Foreign exchange is limited in all of the countries and its allocation is at a political level too far removed from the technical level to deal with the relatively small issue of a seminar. Moreover, an alternate international leadership mechanism is not apparent. Providing the catalytic effort and relatively low financial support needed for international exchanges in the water management field is one of the things that the United States is well qualified to do, and these could have a high cost effectiveness. Certainly on-farm water management has become increasingly

recognized as one of the major constraints to continued agricultural progress in the developing countries.

The writer concludes that some effort to hold some additional Irrigation Practice Seminars in the Middle East over the next few years would be worthwhile. However, some changes in the approach would be desirable. The region might be more limited, say from the Eastern Mediterranean to Pakistan but possibly including India and/or Nepal if those countries are interested. Emphasis might be given to the problems of those countries where modern irrigation development has lagged, drawing on the experiences of the more advanced countries in the region. The features outlined in the third paragraph of this report should be retained. The agenda should be thoroughly restudied and modified, probably to focus in on a more limited number of topics of high priority at this time. Rather than reading papers, a procedure used in the biennial meetings of State Irrigation and Agricultural Ministers sponsored by the Indian Central Government might be adopted. A list of agenda topics is first agreed upon. Position papers on the agenda topics are prepared and circulated in advance. The agenda topics are then simply discussed and conclusions and recommendations formulated.

Consideration might also be given to joining with one or more of the international agencies, e.g., FAO or World Bank as sponsors. A possible host country would be Iran. Efforts should be made to generate as much financial support as practical from the participating countries, but dollar financing should be realistic considering the foreign exchange constraints for travel existing in many of the countries.

One significant point is that every seminar has strongly urged continued U.S. participation as a full partner in future efforts. This desire was invariably expressed by those contacted in the evaluation also. Doubtless the U.S. role in financing and catalyzing the seminars is an important element in this attitude but it is the writer's strong conviction that more important is the honest mutual personal respect and appreciation among professionals in the host countries and the United States who have worked together in one way or another over the past quarter of a century.

CHAPTER 1

INTRODUCTION

Background

In 1956, the Agricultural officers of the AID/NESA region responded to a growing need for emphasis on irrigation water use on the farm by initiating, under the leadership of Carl M. Forsberg, the first of a series of eight biennial regional seminars on irrigation practice. At that time, Forsberg stated:

Spending for large scale works to develop and distribute water for irrigation has reached the magnitude of billions of local currency and foreign exchange during the past decade. Most countries of the region have large programs, developed by their own engineering forces or by consulting firms, or both.

Unfortunately, however, very little thought and effort is being placed on the use of irrigation water on the farms. The policy of neglecting the agricultural phase of irrigation can only lead to ruin, both for the farmers in water-logged and eroded soil and poor crops, and to a nation in abandoned structures and investments.

The large scale investments continue to be made. Irrigation continues to be an essential element in increasing world food supply. FAO's Indicative World Plan (IWP)¹ postulated an investment in water development of \$35 billion between 1962 and 1985. In its IWP report, FAO stated: "Failure to provide institutional services for the support of land and water development has been responsible for reproducing the same traditional semi-subsistence low productivity agriculture as exists in the old areas, and has thus failed to utilize the opportunity to make new settlements serve as the dynamic edge of development." In Asian Agricultural Survey² K. Takase and T. Kano state: "The crucial role of water management has been a major theme of the World Bank for 20 years. About one-half of the \$12 billion lent to 96 countries has been for projects directed toward the efficient use of water resources, including power development. Since 1961, the majority of loans and credits for agricultural development have had irrigation as the central feature." These statements serve to illustrate the level of investment being made in providing irrigation water supply. Many similar ones can be presented.

While some progress has been made on the development of institutions and people so that substantial improvement has been realized, water management on the farm—including irrigation practice—still remains a serious bottleneck, perhaps the most critical one, to increased agricultural production in most developing countries and particularly in the Middle East and South Asia. Improved irrigation practice invariably involves linkages or resources beyond the control of individual farmers so that, even if a farmer were fully trained in irrigation science, his circumstances would seldom permit him to implement his knowledge. He would be constrained by such things as the availability of water when he needed it, often because of inadequate interfarm distribution systems; resources to

¹Provisional Indicative World Plan for Agricultural Development, FAO, Rome, 1970, Ch. 2.

²Asian Development Bank, Asian Agricultural Survey, University of Tokyo Press, 1969. Ch. VII.

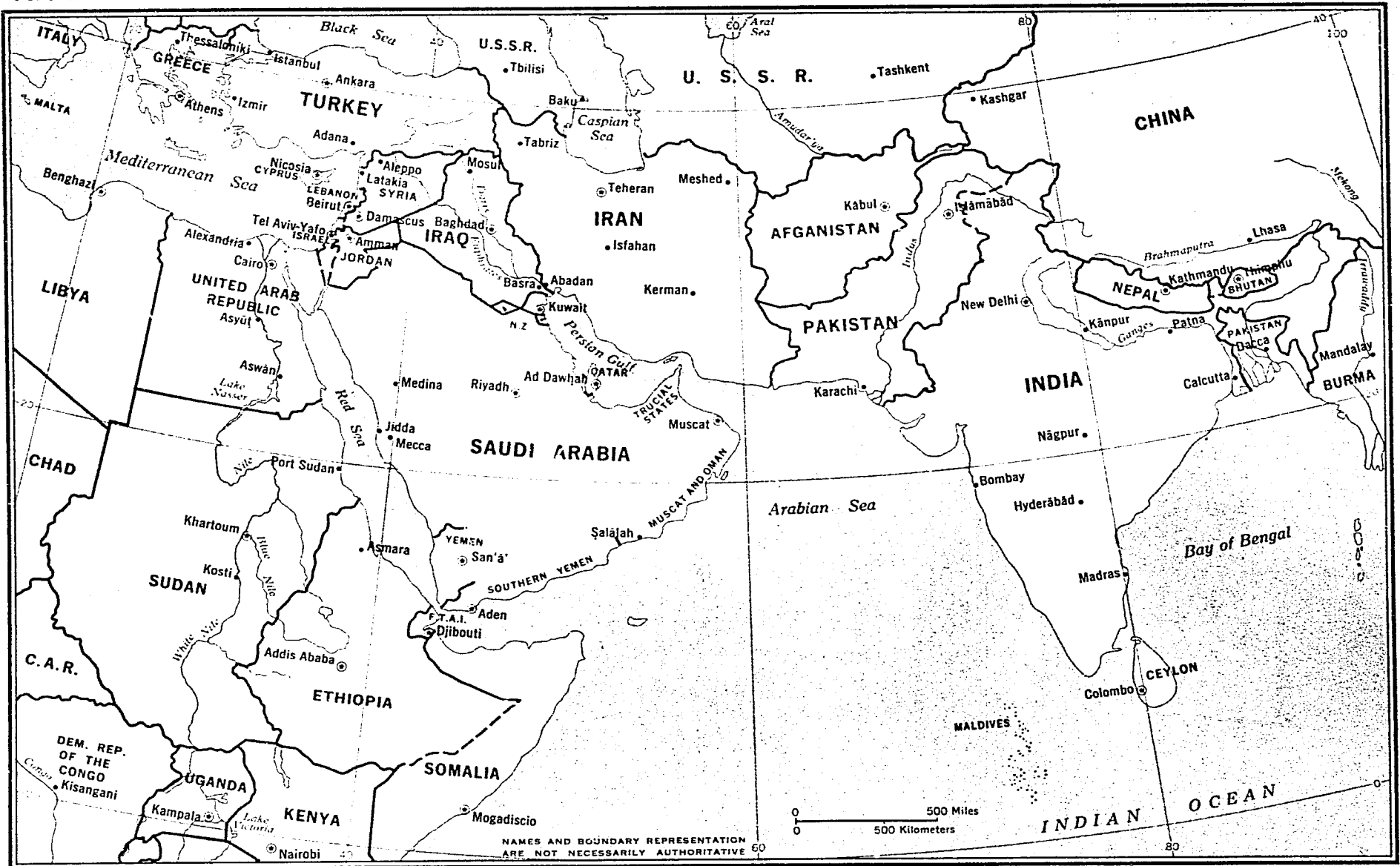
properly prepare his land; size and shape of his field; and lack of surface or internal drainage. He would also be faced with the problem of making better irrigation practice pay. To do this he must introduce a new or modified system of agriculture on his farm which probably will require some or all of the following: new seeds, fertilizer, pest protection and improved harvesting and tillage. There must be a reasonable assurance of a profitable market, he must be permitted to keep for himself some of the increase resulting from the change and he probably will require credit at reasonable rates of interest. Thus the linkages to off-farm considerations—physical, cultural, administrative and political—are numerous and complex.

There are three arenas of action: the farm itself, which is where the production occurs; the project or community which conditions the water supply and drainage environment as well as markets, availability of input, etc., at the farm level; and the national or policy level, which allocates developmental resources, manpower, credit and incentives, develops institutions and fixes project guidelines and requirements. It has been stated that implementation of water control requires a major cultural change. Clearly, considerations ranging from farm husbandry to national policy are involved. While the NESA irrigation seminars began and continued as partly technical in content, they were used as vehicles to explore and exchange information on important institutional and policy considerations also. For this reason, efforts were made to include both high-level technical, and policy-level people in the seminar discussions.

Some other points may be mentioned about the seminar. Two important ones were advance preparation and country participation in presentation of papers and discussions. Several months prior to the seminar a senior United States consultant was employed by AID to visit each country and lay the groundwork for the ensuing seminar. The consultant attempted to identify critical problems particularly those which were under discussion in the country or on which progress was being made and that appeared to present opportunities for country delegates to make contributions in the form of papers. Based on this inventory, the theme and structure of the seminar program were developed and specific program assignments made. Rather than being in the "instructional" mode, the seminars involved presentation of papers and their discussion almost entirely by delegates from the participating countries. While a fairly large number of U.S. experts attended all of the seminars, they served primarily as resource persons, answering questions and contributing to the discussions.

Invitations to seminars were handled at a country to country level with the host country issuing the invitations through appropriate diplomatic channels. Efforts were made to involve high-level political participation in at least the ceremonial aspects of the host country. Usually plenary sessions included participants at the top cabinet level; and, in one instance, the Chief of State. Social

The Middle East and South Asia



functions, primarily receptions, were usually hosted and attended by similar high-level personnel. The normal length of the seminars was two weeks with two or three days devoted to field trips organized to illustrate topics under discussion by the seminar.

AID missions in both the host and participating countries played important roles in assisting in arrangements in the host country, and in expediting communications between countries and preparation of papers and other material.

History of the Seminars and Evaluation

Table 1 lists the time and place of each seminar, the name of the U.S. leader and the number of participating-country, USAID, and other delegates and observers. The latter included personnel from international organizations, such as FAO, Foundations, etc. The total number of individual-participant experiences was 376; however, a number of delegates attended more than once so that the number of individuals involved totalled 309. Several USAID personnel also attended more than once.

Table 2 shows the countries and the number of delegates participating in each seminar. All told, 16 countries have participated in the seminars.

A ninth seminar was tentatively scheduled in Turkey for 1972; however, in-country budgetary problems led to its cancellation. In order to gain some information on the value of the seminar, AID/ASIA Bureau decided to support an evaluation study which would include a field visit to some of the principal participating countries during the summer of 1972. The writer was retained to make these visits and prepare this report. Visits were made as follows:

Schedule of Visits

Turkey, July 17-20, 1972
 Iran, July 23-27, 1972
 Afghanistan, July 29 - August 2, 1972
 Pakistan, August 4-12, 1972
 India, August 14-18, 1972
 Nepal, August 21-22, 1972
 Sri Lanka (Ceylon) August 25-26, 1972

While only 7 of the 16 countries participating at least once were visited, these 7 countries accounted for 301, or 80 percent, of the 376 total country-participant experiences. They also provided 247 of the 309 total country individuals who participated. The writer was able to interview 43 of these, or 17.4 percent. In many cases, participants had retired from government service, or were assigned outside of the capital cities visited. The persons interviewed probably represent a majority of the ex-delegates now active at high technical or policy levels. In addition, 35 high-ranking officials were contacted. These officials had all had experience in planning or arranging seminars or in implementing seminar recommendations.

General Description of the Area

The NESA country area includes Asia Minor, the Eastern Mediterranean countries and the countries skirting the southern edge of the Asian continent including India and Sri Lanka (Ceylon). Generally, the landscape is mountainous, or mountain plateau dominated with coastal belts and some large river plains and deltas occurring where major river systems discharge to the sea, with some closed basins, principally in Iran. The mountain belts—Caucasus (Mt. Ararat 5,185 meters, 16,873 feet); Elburz (Mt. Demavand, 5,780 meters, 18,934 feet) and Himalaya-Hindu Kush (Mt. Everest, 8,850 meters, 29,027 feet)—are among the world's highest. The irrigable lands lie principally in the great river plains and deltas of the Nile, Euphrates-Tigris, Indus and Ganges, the coastal deltas of some smaller rivers, the coastal belts and in the mountain or plateau river valleys.

As a generalization, the region may be divided into two major climatic zones, the Asian-monsoon-dominated zone generally east of about Lahore, Pakistan (Monsoon Asia) and the sub-humid to desert areas of plateaus, mountains, steppes, plains and valleys to the west. Climate varies from continental temperate to sub-tropical and tropical to the west. This zone includes some of the world's great deserts: the Sahara; the Arabian Peninsula; and the deserts of Iran, Afghanistan, Pakistan and northwestern India. To the east, over Pakistan, India, Nepal, Bangladesh and Sri Lanka (Ceylon), the climate is dominated by the Asian monsoon, i.e., wet and humid periods generally during the summer; and extremely dry,

Table 1. Summary of NESA Irrigation Seminars.

Date	Place	U.S. Leader	Country Delegates	U.S. Participants	Other	Total	No. of Countries ^a
1. Sept. 1956	Izmir, Turkey	Carl M. Forsberg	28	16	1	45	7
2. May, 1958	Tehran, Iran	M.R. Lewis	31	17	0	48	8
3. Feb. 1960	Lahore, Pakistan	Dean F. Peterson	34	17	0	5	7
4. Apr. 1962	Ankara, Turkey	Dean F. Peterson	51	17	1	69	8
5. Mar. 1964	New Delhi, India	Dean F. Peterson	73	16	2	91	8
6. Mar. 1966	Amman, Jordan	A. Alvin Bishop	51	16	2 ^b	69	15
7. Sept. 1968	Lahore, Pakistan	A. Alvin Bishop	62	18	1 ^b	81	8
8. Sept. 1970	Kabul, Afghanistan	A. Alvin Bishop	46	17	4	67	6
	Totals		376	134	11	521	67

^aExclusive of U.S.

^bIncluded in observers from United Kingdom.

Table 2. Summary of Participation in NESI Irrigation Practice Seminars.

Year	Number of Country Participants																Total
	Afghanistan	India	Iran	Iraq	Pakistan	Lebanon	Turkey	Sri Lanka	Greece	Sudan	Jordan	UAR	Cyprus	Nepal	Saudi Arabia	Syria	
1956	1	2	4	2	1	2	16										28
1958		3	10	2	1	3	4	4	4								31
1960		2	5		14	3	3	4									34
1962	4	2	4		8	3	21	3		3							51
1964	8	38	4	4			10	1			6						73
1966	3	5	6	1	1	1	8	2	1		8	4	6	1	1	3	51
1968	6	3			34		6	2			5			3	3		62
1970	22	5	6		9		2					2					46
Totals	44	60	39	9	68	12	70	16	5	3	24	9	6	4	4	3	376
Individuals	32	54	30	9	60	8	52	15	5	3	16	8	6	4	4	3	309
Ex-delegates interviewed	10	9	9		11		9	3									53
Other country officials interviewed	2	2	5		14		5	5						2			35

Table 3. Physical, Agricultural and Irrigation Information for Countries Visited.

Country	Population (Millions) (1968)	Gross Area		Arable Area		Irrigated Area		Est. Ann. Runoff		Est. Irrigable Potential	
		Hectares (Millions)	Acres (Millions)	Hectares (Millions)	Acres (Millions)	Hectares (Millions)	Acres (Millions)	Cubic Meters (Billions)	Acre-ft (Millions)	Hectares (Millions)	Acres (Millions)
Turkey ^a	34.00	76.00	189.00	26.00 ^a	63.00 ^a	1.80	4.50	193.00	155.00	8.50	21.00
Iran ^b	27.00	165.00	410.00	19.00 ^b	47.50 ^b	3.15	7.70				
Afghanistan	16.00	63.00	157.00	7.80	13.10	2.90 ^c	7.20 ^c			3.70	9.20
Pakistan	60.00	81.00	201.00	18.90	47.00	12.10	30.00	177.00	142.00 ^d		
India	524.00	328.00	820.00	140.00 ^e	345.00 ^e	27.50 ^f	68.00 ^f	1,680.00 ^g	1,360.00 ^g	190.00	480.00
Nepal	11.00	14.00	35.00	1.80 ^h	4.50 ^h			210.00	170.00		
Sri Lanka (Ceylon)	12.00	6.45	16.20	1.65 ⁱ	4.10 ^j	0.38	1.00				
Total	684.00	733.45	1,828.20	215.15	524.20	47.83	118.40	2,260.00	1,827.00	202.20	510.20

^aOne-third of arable land indicated is left fallow annually. Government investments in irrigation to 1970 totaled U.S. \$900,000,000 or \$2,020 per hectare with annual increase in income \$471 per hectare. Remainder developed privately.

^bOnly 7,100,000 hectares are cultivated in any single year. Public investment in irrigation 1948-1972 totaled \$1,071,000,000. Projected investment 1972-76, \$1,640,000,000. In 1960, ghanats provided 35 percent of irrigation water supply.

^c5,300,000 hectares are equipped for irrigation, about 2,400,000 are fallowed annually.

^dPresent river diversions total 103,000,000 acre-feet annually. Since about 1960, about 8,000 tubewells (approximately 3 cusec capacity) have been installed by the Government. Another 80,000-90,000 (approximately 2 cusec capacity) have been installed privately.

^eBecause of multiple cropping, annual cropped area is 163 million hectares (405 million acres).

^f34 million hectares (85 million acres) is cropped annually.

^gGroundwater potential is estimated at 222 billion CM (178 million acre-feet) annually. There are (1972) 16,000 state-owned and 600,000 privately owned tubewells.

^hTotal crop area is 2 million hectares (5 million acres) annually.

ⁱThere is extensive traditional irrigation. Modern canals command an estimated 220,000 hectares (540,000 acres (1970)).

^jDouble cropping of rice adds about 100,000 hectares (250,000 acres) annually.

Table 4. Population, Physical and Agricultural Information for Countries not Visited.

Country	Population (Millions) (1968)	Gross Area		Arable Area		Irrigated Area	
		Hectares (Millions)	Acres (Millions)	Hectares (Millions)	Acres (Millions)	Hectares (Millions)	Acres (Millions)
Iraq	8.60	45.30	112.00	12.00	30.00	3.30 ^a	8.20
Lebanon	2.60	1.00	2.60	0.31	0.77	0.065	0.16
Jordan	2.00	8.90	22.20	0.80	2.00	0.10	0.25
UAR	31.70	100.00	247.00	4.20	10.40	2.90	7.30
Cyprus	0.60	0.90	2.30	0.39	0.97	0.065	0.16
Saudi Arabia	7.10	173.00	429.00				
Syria	5.70	18.60	46.20	7.00 ^b	17.30	0.52	1.30
Yemen	5.00	19.40	48.00				
Bangladesh	70.00	14.20	35.30	8.10	22.50	0.40	1.00
Greece	8.00	13.10	32.50	3.20	8.00	0.54	1.30
Totals	142.1	394.4	977.3	36.0	91.94	7.89	12.67

^a4.7 million hectares in addition are left fallow each year.

^b3.4 million hectares are in fallow.

hot periods during the autumn, winter and spring.³ Monsoon rains account for from 300 to 5,000 millimeters (12-200 inches) of precipitation annually, increasing generally eastward from the area of Lahore to Assam and Sri Lanka (Ceylon). Even though annual rainfall may be very high, extreme drought is the rule during the dry portion of the year. Serious drought periods also occur during the rainy monsoon season.

Rainfed sedentary agriculture is possible in the temperate sub-humid steppe and plateau regions to the west of Monsoon Asia. Cultivated crops are mostly cereals with some legumes. Indeed, it was on the rainfed steppes of the fertile crescent and on the Anatolian Plateau of Turkey that cereal crops were first developed. In Monsoon Asia, the basic rainfed crop is rice, with some other cereals and legumes grown usually immediately following the wet monsoon. In the western zone, irrigation is generally necessary in order to grow crops where annual rainfall is insufficient to support sedentary agriculture at all. Along the Nile, crops were first grown utilizing the moisture of the receding river flood. In Mesopotamia and in the numerous river valleys, canal diversions, ghanats (horizontal tunnels tapping groundwater) or dug wells watered desert lands. In that portion of the NESAs region within Monsoon Asia, irrigation was initiated primarily to insure against periodic failure of rains during the wet season. The classical "tanks"⁴ of south India and Sri Lanka (Ceylon) dating back some 2,500 years served this purpose and this was the reason for the early canals constructed beginning 136 years ago in the Indo-Gangetic plains of Northern India. In recent years, irrigation in the subcontinent, and

in Nepal, Bangladesh, and Sri Lanka (Ceylon) has been extended to provide water for crops during the dry season. This frequently requires reservoir storage or draft on groundwater because natural river flows in this zone tend to follow the rainfall pattern rather closely.⁵

In many of the countries in the western zone, much of the land under cultivation lies fallow in any given year. This is true not only in rainfed areas but in irrigated areas also. In Afghanistan, about 40 percent of the irrigated area is left in annual fallow. Similar practices are followed in Iraq and Syria. The amount of land irrigated throughout the zone, especially under traditional canal systems, varies widely each year depending on water supply.

Table 3 summarizes population, areal, agricultural and irrigation statistics for the seven countries visited. Table 4 provides some comparable data for the other eight countries, excluding Sudan, that have participated in the seminar series. The seven countries visited represent a population of about 684 million people. They have a gross area of 733 million hectares (1,830 million acres) of which 215 million hectares (524 million acres) are classed as arable. Total land irrigated is 48 million hectares (118 million acres). Considering all of the countries served by the seminar exclusive of Sudan, the total population is 826 million. Gross area is 1,077 million hectares (2,805 million acres) of which 251 million hectares (616 million acres) are classified as arable,⁶ although a substantial portion is in fallow in any given year. Area irrigated totals about 56 million hectares (131 million acres).⁶

³This is the usual pattern; rain occurs during the southwest monsoon. The pattern is reversed in the northern portion of Sri Lanka (Ceylon).

⁴Southeast Asia term for a storage reservoir.

⁵This paragraph and the one preceding it represent extremely broad generalizations. Much of India, for example, enjoys inter-monsoon precipitation and the climate of the south Caspian littoral of Iran resembles Monsoon Asia. There are numerous other exceptions, but the generalization of the two zones seems sound and is quite useful.

⁶Exclusive of Saudi Arabia and Yemen.

CHAPTER 2

PROCEDURE FOR EVALUATION

General Approach

The probability of identifying direct linkages uniquely relating something said or learned at the seminar to a specific significant action taken by some agency or government to improve on-farm irrigation and drainage is apt to be low. This indeed proved to be the case, although there is evidence that some of these incidents have occurred. In all countries, technical assistance personnel have been striving for objectives similar to those of the seminar. All of the seminars' objectives could be deduced from academic study, research and experience. If something good has happened, it almost certainly will be the integrated and subtle result of a number of experiences. This fairly obvious fact presents a major difficulty in arriving at an accurate estimate of the specific value of the seminar series.

Any judgment made will have to be gleaned largely from an assessment of what has happened in furtherance of progress toward the general goals of the seminar and the subjective opinion of participants and other knowledgeable people about the effect the seminar may have had. Instances of direct implementation will be welcome bonuses.

Another aspect is *criticality*. While much of the evidence may be assembled and available to a decision-maker, some incident, consensus, or added evidence may give just the added impulse needed to cause the decision to be taken. There is some evidence, but not clear-cut, that the seminar may have helped or actually provided the critical increment that led to a decision.

The technique used in the evaluation, then, consisted of the following:

1. Identifying significant samples of the major objectives of the seminar and abstracting these to a set of word-described topics.
2. Discussing, as appropriately as practical, progress and status of each of these topics in each country with seminar participants and other knowledgeable people.
3. Trying to identify with these people, specific instances of actions taken as the result of the seminar; or, more usually, exploring how and to what degree the seminar may have been influential in helping to achieve the ends identified under 2.
4. Inviting general comments and criticisms about the value, structure and administration of the seminar, including ideas on what might be done in the future.

Topics for Evaluative Discussion

All of the seminars produced a number of recommendations. In the first seminar these appeared within statements made at the end of the seminar by each chief delegate. In the second seminar, these were contained in a set of final resolutions which contained a general endorse-

ment emphasizing the need for "...improvement of irrigation practice in the Middle East and South Asia countries..." and recommending "...improved effort on the part of both irrigation construction and agricultural farm advisory agencies, either public or private, in securing such improvement." A somewhat stronger resolution recommended that "... each country develop a national training program for agricultural irrigation at least two levels (sic).

1. Local workers ... to teach the farmer better irrigation practices by field demonstrations ... and in many other ways; and
2. Specialists to be available to help train the local workers and assist in special problems."

Beginning with the third seminar, several panels were organized. These met from time to time to discuss their areas of assignment and arrive at recommendations. The areas of panel assignment varied gradually through the course of the remaining seminars. Topics included for the third seminar were:

1. Education and training.
2. Consumptive use and water requirements.
3. Agricultural requirements for irrigation projects.
4. Assistance to farmers for improved irrigated agriculture.
5. Drainage and salinity control.
6. Organization for operation and management of irrigation projects.

By the eighth seminar the list had evolved into:

1. Education and training.
2. Farm management of irrigation practices.
3. Irrigation institutions--farm relationships.
4. Irrigation practices research.
5. Irrigation and drainage systems.

Even though the problem topics were approached through a varying structure of organization, the principal matters of concern did not vary greatly. The recommendations are reasonably detailed, but from an examination of their content the following *evaluative* topics were extracted.

1. Establishment of an irrigation and drainage service to provide technical assistance at the farm level for on-farm water management.
2. Improved program coordination between water supply development agencies and agencies responsible for on-farm water management.
3. Education and training of manpower in irrigation and drainage.
 - a. Irrigation and drainage courses at the university level for engineers and agriculturalists.
 - b. Improved farmer education programs for on-farm water management through extension programs.
 - c. Establishment of institutions for training technicians in irrigation and drainage and related service.
 - d. In-service training programs for technicians in irrigation and drainage and related service.

- e. Use of pilot projects for new developments or for rehabilitation of older developments.
- f. Farmer training courses.
- 4. Development of the elements of the distribution system actually serving the farm units. (Variously termed *tertiaries* or *quarternaries*, water courses, or minors.)
- 5. Improved farm-field management for irrigation and drainage. Consolidation of fragmented holdings, optimal field size and distribution systems, land-leveling (land forming), etc.
- 6. Integrated project planning of water supply and distribution works and farm development.
- 7. Development of farmer organizations, cooperatives, joint companies, private custom, etc., for on-farm management activities requiring joint action.
- 8. Large-scale supervised credit systems or programs for improvement of irrigation on the farm and distributary systems serving the farm units.
- 9. Development of water rights laws and improved water use through administrative procedures.
- 10. Transfer of distributaries or water courses to farmer organizations. Participation of users in operation and management of distribution and water course systems.
- 11. Inclusion of drainage in development plans and implementation of drainage works.
- 12. Intensive cropping and improved rotations practices.
- 13. Research.
 - a. Irrigation practice, i.e., farm use of water, best field layout, measuring and controlling

- water losses, ditch erosion, frequency and amount of irrigation, etc.
- b. Drainage, salinity, reclamation including tube wells, etc.
- c. Water quality problems.
- d. Soil, water, crop, fertilizer relations.
- e. Economic and social research.

Other Factors

In planning the seminars, an effort was made to include people both at a fairly high decision-making level as well as at the technical level. Also, during the course of the seminar series, a number of people who participated at technical levels have risen to offices placing them in positions of increased decision-making responsibility. Many of these actively participated in preparing papers and in formulating the resolutions. Presumably, the ideas expressed and endorsed by them would have influenced their thinking and their decisions.

Reporting

Literal quotations of statements made by people interviewed were, of course, not possible; however, the writer tried to paraphrase what was said as closely to the literal statement as practical. This was done somewhat at the expense of syntax to avoid over-editing and loss of information. These statements are contained in the sections on "General Evaluation" and "Topical Evaluation" in each country chapter.

CHAPTER 3

TURKEY

General Situation

Turkey has a population of about 35 million. Lying mostly between the Mediterranean and the Black Seas, it is a country with a wide variety of landscapes. The central portion, the Anatolian Plateau, ranges in elevation from 900 to 1,500 meters (3,000 to 5,000 ft) and consists of mountains, bench lands, closed basins, and some narrow alluvial plains. It is particularly suited to grain production, but other agriculture flourishes also. The Taurus Mountains range in the south; the Black Sea Mountains in the north; and Istrance Mountains in the northwest. In the east, Mt. Ararat rises 5,185 meters (16,873 ft). Many rivers emerge from Turkey's mountains, including the Tigris and Euphrates. Along the coasts the terrace and bottom lands at the foot of the mountain ranges are narrow except for the several large alluvial deltas formed by rivers. Coastal lands range from zero to 150 meters (500 ft) in elevation. Along the coasts, summers are hot and winters mild and rainy. On the whole, four seasons are distinguishable. In the interior, winters are cold, and in the east, harsh.

Rainfall is highly variable from region to region and is not uniformly distributed throughout the year. In some parts of Central Anatolia, annual mean rainfall may be as low as 300 millimeters (12 inches) while it is as much as 3,000 millimeters (120 inches) in the eastern Black Sea region. Growing season in agricultural areas varies from 128 days to virtually the entire year.

Land Use and Irrigation Development

Turkey's total land area is about 76 million hectares (189 million acres). About 26 million hectares (63 million acres) are cultivated; but, because of lack of rainfall and irrigation, about one-third of the cultivated area is left fallow each year. Turkey estimates that the annual flow of its rivers totals about 193 billion cubic meters (155 million acre-feet) and that about 80 billion cubic meters (65 million acre-feet) from rivers can be utilized for irrigation. Groundwater reserves could produce an estimated 7 billion cubic meters (5.7 million acre-feet). With this potential, 8.5 million hectares (21 million acres) could be irrigated. By 1970, 1.8 million hectares (4.5 million acres) or about 7 percent of the cultivated area, were under irrigation, 800,000 hectares (about 2 million acres) by state irrigation systems, and the rest, privately. Only about 4 percent of the state-owned supply is provided from groundwater. Cotton and cereals are the principal irrigated crops, accounting for 48.5 percent and 19.3 percent respectively. Full development of Turkey's water resources is estimated to cost 159 billion Turkish Lira (TL) (\$27 billion U.S.). Investments by 1970 totaled 5.5 billion TL (\$900 million U.S.) or an average cost of 12,000 TL per hectare (\$2,020 U.S.) with an annual increase in income of 2,800 TL (\$471 U.S.) per hectare.¹

¹Dollar equivalent cost estimates are based on 1970 exchange rates, apparently.

Administrative Structure

Responsibilities for irrigation are shared by the General Directorate of Hydraulic Works, Devlet Su Isliri (DSI) and the General Directorate of Soil Conservation and Farm Irrigation (TOPRAKSU). DSI has responsibility for planning, construction and operation of large scale irrigation projects, flood control, drainage, and navigation. TOPRAKSU handles soil conservation, drainage, land leveling, field irrigation, soil classification standards, small irrigation projects, soil and water research, and cooperates on the supervision of credit for conservation, drainage, and land improvements. Agricultural credit is provided by the Agricultural Bank.

Discussions with Mission Personnel

Discussions with USAID/TURKEY Mission personnel including Mr. Leonard Otto, Food and Agricultural Officer; Mr. John Fisher, Agricultural Economics Officer; and Mr. Warren Leatham, Chief, Land and Water Resources Branch, opened many of the same questions later raised by TOPRAKSU and DSI. They were oriented to the future value of the seminar rather than to its effectiveness up to now. In reporting these discussions, the writer used his notes and attempted to paraphrase as literally as practical.

The Turkish Committee is considering some kind of Mediterranean consortium with a broader focus, probably emphasizing overall project planning which they think is more relevant to their immediate needs. Financing a seminar is a problem, however, and there are legislative limits as to what Turkish officials can spend on participation in international meetings. They would like the United States as a full partner and would like to set up a permanent secretariat or similar arrangement.

In an "off-the-cuff" discussion, a number of questions were explored. These are summarized in what follows. The NESA Irrigation Seminar had been around a long time and, by now, it should have proved itself of sufficient value that it should be taken up by the countries themselves, or if it is not that valuable, perhaps the format should be changed.² It has yet to be shown that (irrigation? the seminar?) has resulted in a change in anyone's income.³ Investment cost and returns should be

^{2,3,4,5}While these points were raised for discussion and should be considered as exploratory only, subsequent study and consideration by the writer caused him to disagree with them generally for Asia.

³Reports prepared by USAID/Turkey later shown to the writer, e.g., Chas. K. Mann's Discussion Paper No. 8, "Formulating a Consistent Strategy Toward On-Farm Land Development in Turkey" cited very substantial gains in net income to cotton farmers in the Ismer and Adana areas resulting from land leveling (a major seminar topic) under irrigated agriculture. In "Monsoon Asia," the author must conclude that vastly improved "on-farm water management" is essential to continued momentum of the "Green Revolution."

looked at. The countries have sufficient sophistication to look at irrigation policy at the macro-level.⁴ Maybe irrigation policies are the ones that should be the subject of a seminar: e.g., investment policy.⁵ The most influential people are IBRD representatives of the recipient countries.

Thought should be given to the audience. Maybe the seminar should cater to sub-ministerial people; ministers change for one thing. Should the horizon for results be 20 years? Maybe the audience should consist of promising young men, or, conversely, maybe there should be a short-term, direct-benefit outlook; in any case, the countries themselves could initiate the seminars. On the other side, the following points were made:

1. The greatest beneficiary is the person who writes the paper. This may not be recognized by him. Presentation of a country paper is particularly valuable. It stimulates thinking and causes the writer to analyze and develop a position.

2. Regional research. Lack of communication leads to stagnation. The countries of the region are indeed isolated. The seminar provides a forum for ideas. If not followed up or replaced, stagnation is engendered.

3. Lack of adequate institutions. "We" have not been much help in changing institutions.

4. Communication. A key problem of a bureaucrat is communicating with his own establishment.

5. Tremendous problems of synthesis are being faced by "these" countries. There are lots of pieces going now. How can they be integrated?

6. There is a need to use the tools available. The seminar method is accepted and indulged in in the NESA countries.

FAO seminars consist of a week of technical lectures by consultants, followed by a second week dealing with policy.

Turkey is giving technical assistance to Afghanistan in several areas and under RCD, Iran, Turkey and Pakistan exchange cooperation in all sectors. Leontieff-type economic models exist in all of the countries except possibly Afghanistan.

Participation in the Seminar and Contacts Made

The first NESA Irrigation Practices Seminar was held in Izmir, Turkey, in 1956. Turkey also played host to the fourth seminar held in Ankara in 1962. DSI and TOPRAKSU cooperated in organizing and putting on the latter seminar which received the attention and participation of the Ministers of Public Works, and of Agriculture who gave opening addresses, as well as the Directors

⁴No amount of macro-policy alone will solve the micro-problem of integrating modern inputs on a small irrigated farm, clearly the number one problem of irrigated agriculture in Asia. Macro-policy may be "necessary," it will not be sufficient.

⁵The seminar, though perhaps subtly, was primarily concerned with "policy," (and its implementation) that would lead to improved "on-farm water management" and its integration with a modern package of agricultural inputs at the farm level. The writer concedes that, from the point of view of Turkey alone, the policy and infrastructure may be sufficiently developed that the subject matter of the past seminars may be passe by now.

General of DSI and TOPRAKSU. Turkey has sent delegations to all eight of the seminars and has made many important contributions in the form of papers and discussions. The country had been scheduled to host the ninth seminar; however, arrangements for this meeting were never completed and the meeting was canceled.

The numbers of Turkish participants in the various seminars were as follows:

Year	Participants	Interviewed
1956	16	3
1958	4	3
1960	3	2
1962	21	8
1964	10	2
1966	8	2
1968	6	1
1970	2	1
Total	70	22

Since nine delegates attended more than one seminar, the total number of individuals attending was 52. Likewise, because most of those interviewed had attended two or more seminars the actual number of participants interviewed was only nine. In addition, five officials who had not been participants but who were involved in planning or policy for the seminars were contacted.

General Evaluation

Positions of State Hydraulic Works (DSI) and the Soil Conservation and Farm Irrigation Directorate were conveyed through their general directors. For this reason, individual interviews with other employees of these agencies who had participated in the seminars were not scheduled. Several officials of other agencies who had been participants were interviewed, however.

TOPRAKSU

Present at the meeting besides Warren Leatham, Branch Chief, Land and Water Resources, USAID/Turkey, and the writer, were Nejat Erkenci, Director General; Nurhan Gurel, Assistant Director General; Kaya Bozkut,⁶ Director, Izmir Region; Ragip Boyaci, Director of Research; Ozdemir Beyce, Research Engineer and Yaldrim Gurgan, Advisor. The consensus was that the seminar had been useful so far. Further definition of usefulness that could make the evaluation more specific could not be drawn from the discussion, which centered on alternative future courses that might be considered.

There was some thought that the seminar should be regrouped to comprise "Near East and Mediterranean" countries, although the group felt "there doesn't appear to be too much to learn within the Mediterranean area." The view was also expressed that AID sponsorship was

⁶Mr. Bozkut is scheduled to go to Pakistan for two months this year to provide technical assistance on land-leveling and on-farm water management under an agreement between the two countries. At the invitation of Agricultural Development Council he participated in their seminar on On-Farm Water Systems at Cornell University, October 16-18, 1972.

needed. "If AID interest reduces, the seminar fails." The International Commission on Irrigation and Drainage (ICID) was mentioned as a possible sponsoring vehicle. Two criteria for continuation were suggested: 1) a single agency, such as AID, should sponsor; 2) each country should have a national committee and there should be a general secretariat. Consultants should give lectures, followed by an open discussion.

With regard to subject matter, there should be more emphasis on on-farm water management, drainage, and land reclamation. There should be *ad hoc* committees with means for "following up." The International Plant Protection Association was cited as an example.

Annual technical meetings should be held to bring in new research information. Equipment manufacturers and UN agencies could participate. Country members and possibly other participants should pay dues.

In summary:

1. A geographical regrouping is desirable;
2. There should be a permanent office and organization;
3. Innovative applications should be reported;
4. The seminar concept is useful, but it should be modified.

DSI

Besides Mr. Leatham and the writer; Sabahatten Sayan, General Director; Fayyaz Ozerman, Foreign Credit and Foreign Relations Advisor; and Orhan Akyurek, Engineer, were present. In response to the writer's question regarding the value of the seminars, Sayan stated that training was an essential part of DSI's mission and that the seminar had been useful in accomplishing that part of its mission. The discussion turned to possible new forms that the seminar might take. This discussion was fully informal and essentially exploratory. The need for training, and exchange of ideas was accepted, but no conclusions were reached. Sayan suggested that DSI consider the matter and state its position in a letter to Mr. Leatham. The letter is included at the end of this chapter.

Other

Mr. Leatham and the writer interviewed Hussein Yegin who has been a regional director (Mersin Region) and Assistant General Director of TOPRAKSU, and who is now General Director, Land and Resettlement Directorate, Ministry of Village Affairs. Mr. Yegin was the principal official responsible for staging the field trip part of the fourth seminar and also participated in the sixth and seventh seminars. Mr. Yegin is a civil engineer with graduate degrees from the United States. During the mid-1960s, he left government service and had a short, but highly successful, career as an agricultural marketing specialist for the Adana area.

Mr. Yegin stated that Turkey benefited from the cross-transfer of knowledge resulting from the seminars. An unrecognized benefit came about through developing papers which crystallized a participant's thinking and "gave him a base from which he had confidence."

Comparing his knowledge and thinking with others added to his confidence. There was a gain in knowledge. For example, Mr. Yegin observed that the links of extension and research were missing in one of the countries visited and probably in at least one of the others. Turkey has attempted to use farmer leaders to supplement extension specialists as a matter of policy.

Seminars have tended to concentrate on research, but there were spin-offs. For example, the Pakistan (seventh) seminar occurred at the time Mexican wheats were being introduced into Pakistan and Turkish linkage to this technology can be traced to this seminar.*

With regard to continuation of the seminar, Mr. Yegin observed that the objective should not be training technicians, but should be aimed at decision-makers and administrators. Over the years the ratio of technicians to administrators attending the seminar has increased. Technicians, administrators, and planning organization representatives should always be included. Possibly other seminars should be held for technicians only.

The problems east of Afghanistan are quite different from those of Turkish interest.

Mr. Adem Karaelmus was primarily responsible for Turkish leadership in the formation and development of TOPRAKSU during the late 1950s and early 1960s. He was that agency's first Director General. He has held a number of important governmental assignments, principally in agriculture, since and is presently Director General, Soil Products Office, Ministry of Agriculture.⁷ Mr. Karaelmus attended the first and second seminars and helped plan the third. His statement is summarized in the following discussion.

At the time of the first seminar (1956) there was little realization or understanding in Turkey of the importance of water use. This subject was entirely new to the Ministry of Agriculture. After DSI was established, large-scale irrigation began to develop but nothing was done for the farmers. DSI did not understand the necessity for considering soil-water-plant relationships, but the seminar helped bring DSI and the Ministry of Agriculture together.

The precursor to TOPRAKSU was only a division under an irrigation engineer in the Ministry of Agriculture. Through the seminars, Turkish officials learned what other countries had done and what their organization was. The seminar discussions helped them to understand the problems and also helped them to develop the technical assistance programs for the farmers. Without AID's contribution, and the seminar was an important part of that contribution, TOPRAKSU could not have been created. TOPRAKSU shifted, however, from a farmer technical assistance concept to more engineering and construction. This was in response to political forces and helped TOPRAKSU to gain more financing. Presently the agency is attempting to shift back.

**Author's Note.* Doubtless the Mexican wheats would have been introduced into Turkey, NESA seminar or no; quite possibly the seventh seminar accelerated their introduction.

⁷The directorate is concerned with substitutions for poppy culture.

Karaelmus attributed establishment of the Anatolian research station to the seminar, and the station is a "good" one.

He feels that more attention needs to be given to Central Anatolia. Here soil moisture is limiting and the land is broken topographically. Turkey doesn't have a moisture or water conservation program for this area which is limited to the production of cereals. Yields are 120-125 kg/decare grossing 120-125 TL but costs are 70-75 TL. Besides tillage conservation, small impoundments are needed. There are thousands of small watersheds and water could be conserved at low cost. About two-thirds of the Turkish farmers are in the plight of the Anatolian farmer. New varieties and fertilizer under irrigation have created a cereal surplus, but Turkey can't compete for export. Policy changes that would protect the Anatolian farmer are needed, possibly a differential wheat support program or possibly wheat should not be grown in the wetter south because of competition with the Anatolian farmer and because of its poorer quality. Wheat is not grown economically in the east, but farmers grow bread wheat for subsistence at a loss. If this supply could be guaranteed, these farmers could shift to more profitable crops—maybe grazing, livestock or barley.

Cemil Kalili has been an agricultural engineer engaged in private practice. He is currently President of the Agricultural Engineering Association of Turkey. He attended the third (1960) seminar representing the Farm Irrigation Division of the Ministry of Agriculture. In 1962, he moved to the State Plan Organization for about two years, planning the southern region. He feels that agriculture policy and planning are deficient in Turkey especially with regard to development decisions made by DSI. Land capability should be taken into account (for example, there are only about 600,000 hectares suitable for producing cotton in Turkey) and its use planned in accordance with projections of need. This was discussed in one of the seminars but has not been implemented. He summarized the benefits of the seminars as follows:

1. Technicians have had an opportunity to exchange ideas.
2. They have had opportunities to see other installations.
3. Turkey (i.e. DSI and TOPRAKSU) honestly tried to do what the seminar recommended.

Compared to other seminars, NESA Irrigation Seminars have been the most helpful. It is the only one for which the agencies seriously tried to carry out the recommendations. It catered to "influential technicians." Seminars in Washington, Paris, etc., get only Directors

General to attend. The NESA seminar got division heads and technicians.

Naki Uner, who attended the first, second and fourth seminars, is a Member of Parliament. He was formerly Director for the Izmir Region of TOPRAKSU and later its Director General. He feels the seminars have been "70 percent successful and 30 percent failure." They should be continued at least two, or better, four more years. The reason is that a number of countries have started new irrigation land reform and land consolidation programs. Especially are group farming institutions (cooperatives, unions, districts, etc.) being emphasized. Benefits of the seminars are as follows:

1. Most important is that they have influenced governments to think of land consolidation, land reform, and irrigated farm development plus irrigation cooperatives. The seminars had an important effect on TOPRAKSU cooperatives, especially groundwater cooperatives.
2. Interchange of ideas. Each country has advanced experience or views on certain aspects of irrigation; e.g., Iran, ghanats;⁸ Pakistan, drainage and salinity control; Turkey, leveling. These interchanges have been quite helpful.
3. They have led to creation of domestic industry in water development.
4. Participating governments have worked out some legislation as the result of recommendations; e.g., land reform and subsidy concepts and water rights have been topics supported by the seminar. The soil and water conservation bill in Turkey was developed, with the help of AID, as the result of the seminar.

Turkey will not suffer if the seminar is closed out, but Turkey has much to offer; for example, district law and land reform laws, and other countries would lose. Turkey also has a large program of cooperatives. The country is approaching the stage of other Mediterranean countries, but should contribute its expertise to the NESA program.

Topical Evaluation

Discussions in Turkey were not structured, nor did time permit examination of the topics outlined in Chapter 2. In general, Turkey has made good progress on all 13 of the topics selected for evaluation and this progress has been quite well covered in recent seminar reports.

⁸Horizontal tunnels driven to intercept the groundwater table and provide a source of water.

List of Persons Interviewed

Delegates

KARAEHMUS, Adem. General Director, Soil Products Office, Ministry of Agriculture. Formerly General Director, TOPRAKSU.¹ 1,2.

UNER, Naki. Member of Parliament. Formerly General Director, and Regional Director, Izmir Region, TOPRAKSU. 1,2,4.

OZGUL, Seref, Head of Drainage Division, DSI.² Recently named General Director, Tea Monopoly. 1,4,5,6,7,8.

GUREL, Nurhan, Assistant General Director TOPRAKSU, 2,4.

KALILI, Cemil, Consulting Agricultural Engineer. Formerly, Agricultural Engineer, TOPRAKSU. 3.

BOYACI, Ragip, Chief, Division of Research, TOPRAKSU. 3,4,5,7.

AKYUREK, Orhan, Engineer, DSI. 4.

BEYCE, Ozdemir, Research Engineer, TOPRAKSU. 4.

BOZKUT, Kaya, Regional Director, Izmir Region. TOPRAKSU. 4.

YEGIN, Hussein, General Director, Land and Resettlement Directorate, Ministry of Village Affairs. Formerly Regional Director, Mersin Region, TOPRAKSU. 4,6,7.

Others

GURGAN, Yildirim, Advisor, TOPRAKSU.

OZERMAN, Feyyaz, Chief Advisor on Foreign Credits and Foreign Relations, DSI.

ERKENCI, Nejat. General Director, TOPRAKSU.

SENTURK, Faut. Director of Laboratories, DSI. Adjunct Professor, Bosphorus University (formerly Robert College).

SAYAN, Sabahattin, General Director, DSI.

¹General Directorate of Soil Conservation and Farm Irrigation.

²Devel Su Isleri, General Directorate of State Hydraulic Works.

TURKEY
ATTACHMENT I

MINISTRY OF ENERGY AND NATURAL RESOURCES

D.S.I.
GENERAL DIRECTORATE

Chief Advisory, Foreign Credits and Foreign Relations

No. 167/555

July 28, 1972

Subject: NESA Seminar

Mr. Warren Leatham
Branch Chief
Agricultural Division
Land and Water Resources
USAID
Vali Dr. Resit Cad. No. 16
Kavaklidere, Ankara

Dear Mr. Leatham:

Following are the views of our General Directorate on NESA Seminar which has been agreed at a mutual conference with Mr. Dean Peterson on 7/19/1972.

1. NESA Seminars are being arranged for about 16 years. These seminars are far from being attractive under the present conditions of Turkey. Due to the other members there is no chance of providing any use for our country. Therefore, either these seminars should be abolished or measures should be taken to make them more attractive. Mean while, Mediterranean countries operating developed Irrigation techniques could be invited for membership.
- 2- It is desirable to create an active position by realizing some activities outside the seminars; so that these seminars and activities might be more fruitful. Such activities may include continuous publications and new courses.
- 3- In order to make activities more fruitful under continuous basis, it is useful to give an international appearance to these attempts. At the same time, it will be necessary that member countries establish a national committee or association.
- 4- USA must be an active member.
- 5- In order to keep going such an International Commission or Community, membership fees must be collected and financial support must be provided from agencies such as AID, FAO, etc.
- 6- If this organization shall be an international organization, we wish that the central office is located in Turkey.
- 7- If it is desired to arrange seminars in Turkey under present conditions, due to budgetary shortages and procedures our General Directorate shall assist in only providing the seminar room and building

Please be informed accordingly.

For General Director, DSI
Mufit Kulen, Asst. Gen. Dir.

CHAPTER 4

IRAN

General Situation

Iran lies between latitudes 25° to 40° N. It is bounded by Turkey and Iraq on the west; Afghanistan and Pakistan on the east; USSR and the Caspian Sea on the north and the Gulfs of Persia and of Oman on the south. About half of the area of the country is an internal desert plateau flanked on the north by the Elburz Mountains and on the south and west by the Zagros. The former rise to heights of over 4,500 meters (15,000 ft), culminating in Mt. Demavand at a height of 5,780 meters (18,934 ft) and slope abruptly north to the Caspian littoral. The Zagros rise to peaks in excess of 4,000 meters (14,000 ft). There are several closed basins; Lake Rezaya in the northwest and certain areas along the Afghanistan border. The climate is generally arid or semi-arid and areas where crops may be grown without irrigation are limited; principally, the northern flanks of the Elburz. On the plateau, annual rainfall ranges to over 200 millimeters (8 inches) in the north to less than 100 millimeters (4 inches) in the south. Seventy-four percent of the country's area receives less than 250 millimeters (10 inches) of precipitation. Summer maximum temperatures vary from 34°C to 50°C (93°F to 122°F) and generally go below freezing during the winter, except along the Persian and Oman Gulfs. Iran's population (1966) was about 26 million with an annual growth rate of about 2.9 percent.

The total area of Iran is 1,650,000 square kilometers (628,000 sq. mi.). Total cultivated area is 19 million hectares (47.5 million acres) of which 7,100,000 hectares (17.6 million acres) are cultivated in any one year. Estimated potentially arable land is 31 million hectares (77 million acres). About 3.15 million hectares (7.7 million acres) are under irrigation. In 1960, about 4.7 million hectares (11.6 million acres) or roughly 75 percent of the agricultural area, was devoted to wheat and barley. Rice was grown on 325,000 hectares (810,000 acres) and cotton on 273,500 hectares (727,000 acres). A wide variety of crops (sugar, oil seeds, fruits, nuts and forage, etc.) complete the list of crops.

Irrigation has flourished in Iran for centuries utilizing ghanats¹ (of which there are about 40,000) and temporary brush and rock diversion dams developed by private groups. In 1960, ghanats were estimated to supply about 35 percent of the total irrigation water used. During the latter 1950s private groups began to install small river pumping plants and centrifugal pumps in shallow hand-dug wells. Deep well drilling started in about 1958. Larger-scale development of irrigation got under way about 1953. Several large dams and reservoirs have been constructed. The annual irrigated area was reported at the third NESA seminar (1960) as 1.5 million hectares (3.8 million acres). At the fourth seminar (1962) this was reported at 2.5 million hectares (6.2 million acres). The

¹Horizontal tunnels driven to intercept the groundwater table thus providing a water supply by gravity flow.

report of the eighth seminar (1970) cited 3.15 million hectares (7.8 million acres) at the beginning of the Fourth Five-Year Plan (1967) with 3.45 million hectares (8.6 million acres) targeted for 1972, the end of the plan. Investments in water development during the Fourth Plan were estimated at U.S. \$708 million, bringing the total since 1948 to \$1.071 billion. At the eighth seminar (1970), \$1.64 billion was mentioned as the amount to be spent during the Fifth Plan (1972-76). During the Fourth Plan, 400,000 hectares (1 million acres) of new land were to be brought under irrigation command and improved irrigation provided for 500,000 hectares (1.25 million acres) additional.²

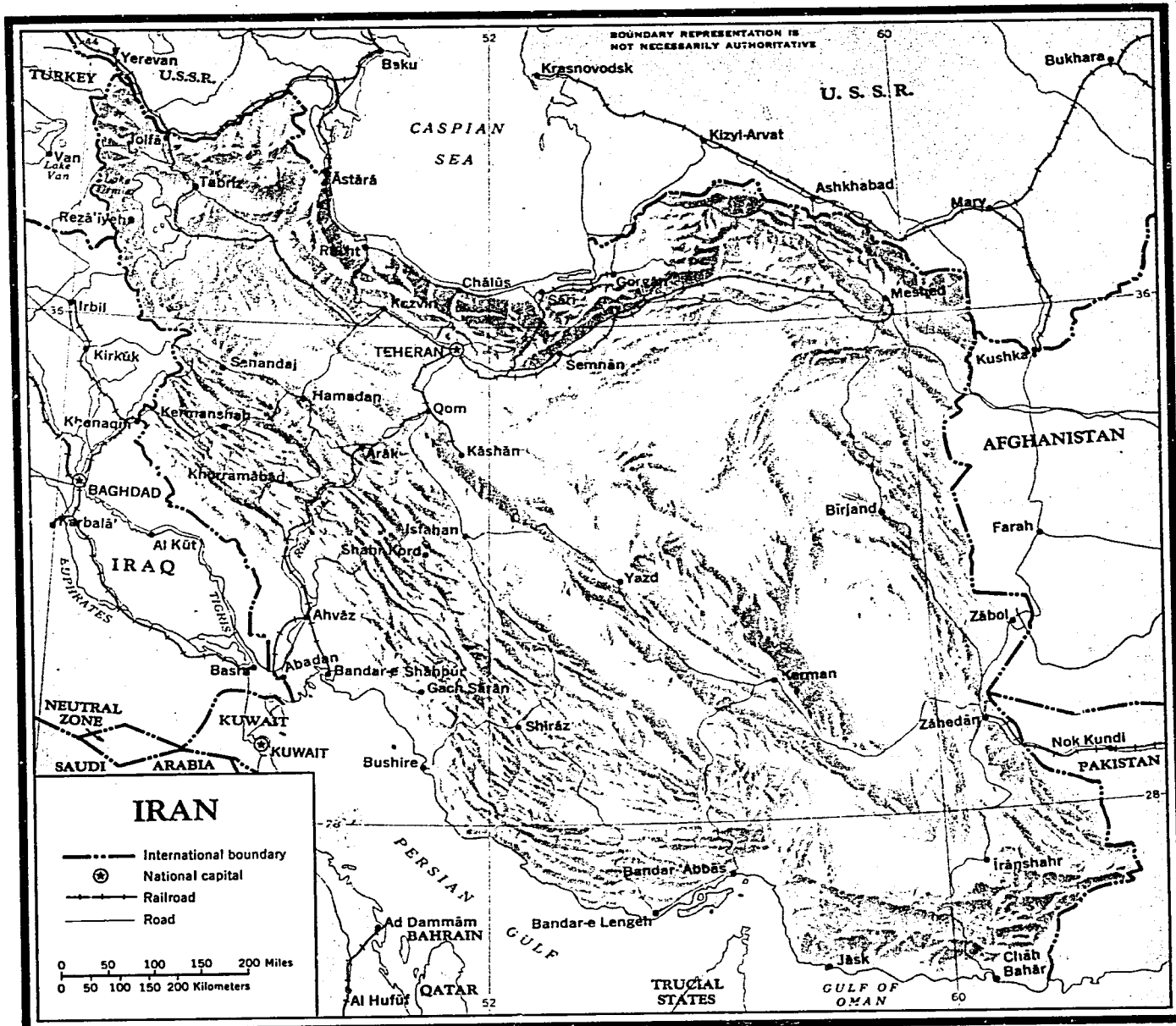
Much of Iran's traditional irrigation developed at village level, and many villages are badly isolated. The new schemes generally bring large blocks of land under irrigation or provide supplementary water to smaller tracts.

Administrative Structure

During the early 1960s, implementation of Iran's Land Reform Law resulted in ownership of agricultural lands passing from generally large land holders operating under a share-cropping system to the farmers occupying the lands. In order to capitalize on the land reform, extension services were developed and a program of cooperatives accelerated to replace services (credit, etc.) provided by previous land owners.

Responsibility for planning and for allocating national developmental resources is centered in the Plan Organization. This organization works with the various ministries in developing programs and budgets. During the late 1950s and early 1960s, surface and groundwater hydrological organizations were developed and several large projects were started drawing in part on foreign technicians and constructors. In 1963, the Ministry of Water and Power was formed replacing the old Irrigation Bongah (Corporation). This Ministry has responsibility for providing the water and power supplies for the country. It is charged with the preparation of plans and designs for water development, the supervision of water use throughout the country including domestic and industrial water disposal, as well as irrigation. The ministry has operating divisions responsible for surface water; groundwater; water control, i.e., administration; and water projects. Supporting activities include the Technical Bureau, and the Research and Hydraulics Investigation Department. A number of field offices are maintained. Operations are decentralized geographically through several regional Water, and Water and Power Authorities directly responsible to the Minister. Traditional concepts of water ownership prevailed until nationalization of the nation's water resources in October 1967. The Water Nation-

²Some projects were started and expenditures made during prior plan periods.



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alization Act declares all waters to be national wealth belonging to the public under the custodianship of the Ministry of Water and Power. Nationalization of water resources became "Point 10 of the Revolution of H.I.M. the Shahanshah and the People of Iran" (The "White Revolution"). The Ministry of Agriculture and Natural Resources has general responsibility for farm management activities and land, water, and forest conservation. The Department of Agricultural Engineering in the Ministry has responsibility for land leveling, drainage and on-farm water management. The Ministry of Land Reform and Cooperatives oversees formation of agricultural cooperatives, societies and other farmer organizations. Supervision of urban water supplies and treatment plants are under the Ministry of Development and Housing.

The Agricultural Engineering Department was established in 1954. The principal activities were farm irrigation, drainage, farm machinery, and irrigation and drainage research. There are several large demonstration farms, larger than 500 acres each. The Minister of Agriculture and Natural Resources, Mr. Rohani, has decided to develop the department and provide services for land leveling, drainage, etc., to farmers. Full costs will not be charged to small farmers.

Under the land reform program, considerable attention has been given to formation of cooperatives. In addition to cooperatives, farmer corporations may be formed. Land titles are transferred to the corporation for unified management and holders share in the profits. Under the Water Nationalization Act, the Ministry of Water and Power may develop large industrialized farms of up to several thousand hectares on lands "under dams." These are managed by Iranian or foreign enterprises or a combination and are intended to be fully modernized.

Participation in the Seminar and Contacts Made

Iran has participated in all of the seminars except the seventh (1968). The second seminar was held in Tehran in 1958. Iranian delegates have contributed their full share of papers and have enthusiastically participated in the activities of the various seminars attended. The numbers of Iranian participants have been as follows:

Year	Participants	Interviewed
1956	4	2
1958	10	1
1960	5	2
1962	4	2
1964	4	3
1966	6	2
1968	0	0
<u>1970</u>	<u>6</u>	<u>3</u>
Total	39	15

Because of multiple attendance the total number of individuals attending was 30 and participants interviewed was nine. In addition, five Iranian officials who had not been participants were interviewed.

General Evaluation

Mr. A. Kakhashan, Undersecretary for Water in the Ministry of Water and Power, stated that the seminar had

been useful in fostering exchange of experiences among technicians from various areas. The seminar has been most useful in focusing attention on tertiary and quaternary distributaries. The Fifth Plan calls for completion of land forming and distributaries for 400,000 to 500,000 hectares during the next five years.

With regard to the future, the countries should be able to take the seminar over. He suggests ICID should develop a Middle East Farm Water Management Committee. Mr. Kakhashan is a vice president of ICID and would be willing to help organize such a committee.

According to Dr. D. Hariri, Director General, Department of Hydraulics and Research, Ministry of Water and Power, people who are planning to attend seminars are given an incentive to start new projects. For those in the field, this provides an opportunity to think things through. The seminar has tremendous U.S. public relations value among those interested in water. It goes into problems of the mass of people—those who deal with agriculture. These are "special" people.

Hariri felt that Iran would like to sponsor a seminar but would need some level of AID support and a U.S. "impetus." The U.S. is missing a real "public relations" opportunity in not continuing the seminar.

Mr. F. Raji, Deputy Director of the Water Resource Department of the Plan Organization, attended the fourth, fifth and sixth seminars. Present also at the interview were Engineer A. Ghaemasabahi, who attended the eighth seminar and Dr. Hariri. Eng. Raji stated that measurement of the influence of the seminar was not possible. It had a "moral" rather than a direct influence on policy. It doubtless had some influence on the Plan Organization. There was considerable exchange of knowledge, e.g., knowledge of the importance of drainage was gained from Pakistan. Iran is very much interested in seminars of this type and would attend if they were held. Perhaps ICID should provide the leadership.

Eng. Ghaemasabahi was satisfied with the seminar. He found the project visits useful as well as the papers. Even though he speaks little English, the intercommunication among the Iranian delegates made up for much of this. In the NESA region, the problems are similar. While the seminar was most educational, papers should have been circulated in advance. It is hard to evaluate whether or not the seminar has been influential directly on Iranian policy. It does have an influence on individuals and upon their technical points of view. Eng. Ghaemasabahi listed the following critical problems in Iran:

1. Obtaining rights-of-way for distributaries.
2. Coordinating different project phases; e.g., agriculture and construction. Could get a more optimal return through better coordination.
3. Educating people in use of modern systems. Education is one of the major problems.
4. Shifting farmers from traditional to modern farming. This is very difficult and Iran should give stronger consideration to this activity.

Considerable progress has been made through new laws and cooperatives.

Dr. A. Jenab, who attended the fifth seminar and who is Professor of Irrigation and Drainage Engineering at Pahlavi University in Shiraz, felt that any future seminars will require a sponsor. He doesn't believe the countries will organize themselves. UN/FAO could possibly sponsor. European problems are different and the present alignment of NESA countries hasn't the same problems. More emphasis should be given to high-level, better quality papers. Repetition should be eliminated and innovation stressed. The delegation should be above the technician level up to and including ministers who can influence policy and also provide information about larger projects. The seminars should be better publicized. Invitations are sent out too late and there needs to be improved dissemination of results.

Engineer A. Rejali, formerly with the Ministry of Water and Power, but presently Director of Master Plan, Ministry of Agriculture, stated that planning and regulatory activities were initiated and some of the seminar recommendations were used by the Ministry of Water and Power. Engineer Rejali attended the fourth, fifth and sixth seminars.

Engineer A. Ayazi formerly headed the Agricultural Engineering Department and attended the first three seminars. He felt that "this kind" of seminar is really useful to the region, but that AID/NESA, CENTO or some such organization should sponsor it. He favors sponsoring under CENTO and urged that the U.S. coordinator stationed in Ankara be contacted. NESA should let CENTO know if it does not intend to sponsor the seminar. Eng. Ayazi had suggested that CENTO schedule an on-farm water management seminar, but this was not considered because of the anticipated NESA seminar. The U.S. should reinforce CENTO and try to give it technical assistance.

Eng. H. Vessal, who is Undersecretary for Water and Power Planning Studies in the Ministry for Water and Power and who attended the first seminar stated that the Khuzestan water project was designed without much attention to tertiary and quaternaries and the Ministry has concluded that standards and guidelines for these need to be developed.

Eng. H. Sohaie, who attended the eighth seminar was visited concurrently with his chief, Dr. A. Borhan, Director General for Agricultural Engineering. Eng. Sohaie is head of the Irrigation Research Section. He commented that the seminar was useful and that it was helpful to him to have to prepare his paper. "Water Requirements in Iran." Research underway covers quality and quantity of water, furrow spacing, drainage depth and spacing, and management of affected soil after leaching. The department operates ten field stations. He learned new techniques that helped him with his job and stated that the seminar was very good for those participating. Dr. Borhan suggested that the seminar might be held outside of the region since there is no longer American or Australian input and new ideas are needed. He feels there is no similarity in the regional problems to Europe.

Dr. M.B. Gholezadeh, Director General of the Technical Bureau, Ministry of Water and Power, has not

attended any of the seminars, but has received the publications and found them useful for exchange of ideas, publications, and knowledge of others with interests similar to his. He felt Iran could provide some assistance to seminar funding problems. He feels that it is important to invite both technicians and higher authorities rather than technical people only. It is important to expose the problems.

Dr. I. Vahedi, Minister for Water and Power, has not attended any seminars but suggested they might be placed under ICID. He felt that their continuation was important especially because they develop people. People working in the same fields get to know each other and correspond. The proceedings should be designed to provide a good set of references.

Topical Evaluation

1. *Establishment of an irrigation and drainage service.*

Capability for extension and farmer services has increased and the seminar has had some effect. University professors lecture to extension personnel. Early in the history of the seminar, the seminar was useful in introducing new irrigation methods through the Agricultural Engineering Department. Under USAID sponsorship an Agricultural Engineering Department was evolved in Iran. When AID left, this "collapsed," but Iran is now realizing the importance of this service and is trying to revitalize it. This seminar helped indirectly in the organization of this department. A practical approach is needed. The service is presently very small and needs to be increased 100 times. The Fifth Plan has greatly enlarged the target with the budget approximately doubling. This has not yet been finalized, but it is planned to render some services to farmers at reduced cost for farms up to 200 hectares.

Land development for farming has not paralleled dam development. Water use is still at a preliminary stage. Iran needs to be more serious in soil conservation, especially irrigation and drainage.

According to Dr. A. Borhan, the present Director General, the Agricultural Engineering Department is trying to establish a base for the agricultural engineering services to design, layout, and supervise soil and water engineering works. Research is being pushed. Attempts are being made to interest private contractors and the department is working with the bank on credit. One hundred thousand hectares (250,000 acres) total in various parts of the country has been designed.

2. *Improved coordination between water supply development agencies and agencies responsible for on-farm water management.*

This topic came in for only limited discussion. One observer thought coordination was inadequate and still needs improvement. The seminar has been quite effective in bringing this about, however. Plan Organization has participated in the seminars and has tried to improve coordination working largely with the Ministries of Water and Power, and Agriculture. Another observer felt that the need for better coordination is recognized much more than formerly, but that the seminar was not directly

responsible for this. Coordination between agricultural and engineering phases is very difficult.

3. *Education and training of manpower for irrigation and drainage.*

a. *At the university level.*

There is little or no cooperation between civil and agricultural engineering. The civils have no agricultural background and the agriculturals cannot handle the scientific and engineering problems. Little progress has been made on this point.

The agricultural engineering curriculum has been strengthened, but there has been little effect on the civil engineering curriculum as far as irrigation and drainage are concerned. The seminar is one of many impacts that has led to strengthening of agricultural engineering curricula.

Manpower, not money, is the problem. CENTO established a training course at Karaj. Thirty students are trained at the M.S. level each year. This now has been taken over by the Agricultural Engineering Department.

b. *Improved farmer education programs.*

There are some in the Extension Service. Farm leaders are trained "across the board." The seminar program was not thought to be greatly influential in this.

All farmer education programs have grown and improved. Extension, and especially banking service, are very important at the villages.

c. *Establishment of institutions for training technicians*

Iran has a one-year course for training leaders of cooperatives, but doubt that seminar had much influence on this.

There have been some institutions developed, but training is mostly "in-service."

There is some technician training but "not satisfied with it." There are some centers in the regions. Entrance requires nine years of general schooling and the program is two years in length. There are about six of these institutions in the Ministry of Agriculture. There should be a special course for farm irrigation and drainage and it needs to be more practical.

There is a one-year, post high school technician course on land and water engineering at Karaj. Twenty technicians are trained. The Department (Agricultural Engineering) is working hard on mechanization and is training at three levels. This course has been underway for two years.

Village reform is having problems because there is little knowledge of machinery. More "opportunity" programs are needed. CENTO courses have helped with operators, but the shortage is greatest between the operator and the engineer. Repairs are the main difficulty. Companies providing equipment should be required to provide parts. Plan Organization is working on this.

d. *In-service training programs for technicians.*

Reference was made to some of these. See 3c. Further specific information was not obtained.

e. *Use of pilot projects.*

Pilot projects, according to one observer, are standard practice on new irrigation projects. Results often can be applied to traditional irrigation.

f. *Farmer training courses.*

This is handled under Rural Affairs. Further specific information was not reported.

4. *Development and improvement of distributaries to farmers.*

Development of minor irrigation distribution systems has long been neglected, but is now given priority beginning with the Fourth Plan starting about three and one-half years ago. Twelve consultants are working on studies of this problem mostly under storage dams. It is not being done yet for traditional farms.

The main difficulty as far as irrigation practices and design of distribution systems are concerned is the need for involvement of large numbers of local people.

Improvement of distribution systems is moving fast. Both Water and Power and Agricultural Ministries are pushing this. Much is being done in the private sector. The seminar has had a strong effect on this development. The Water and Power Ministry is concerned about the level at which its responsibility should stop. Formerly this was set at 200 hectares; however, there is some thinking that the Ministry should finish the task. The Khuzestan project was designed without much attention to tertiaries and quarternaries. The Ministry for Water and Power has concluded that some standards or guidelines should be developed and has retained a consultant to suggest this.

5. *Consolidation of fragmented land holdings, optimal field size and farm distribution systems, land leveling and other on-farm irrigation and drainage improvements.*

Attention to land preparation has received emphasis and practice is being greatly improved. The seminar has had a good effect in bringing this about. Land consolidation is part of the program of developing tertiary canals. Without this, development of distribution systems is impossible. Under the farm corporation and agro-industry approaches, consolidation is automatic. It is voluntary under farm cooperatives.

6. *Integrated planning at project level for water supply, distribution works and farm layout and development*

Soil surveys and land classification have been included in project planning for a long time but is taken much more seriously and is done better. Recently, provision was made to require drainage in plans from the beginning. Some projects, e.g., Karkuk, have suffered because drainage was not included. The seminar has had a strong effect on bringing about the inclusion of land classification and drainage in plans and construction.

7. *Development of farmer organizations, cooperatives, joint companies, private custom services, etc., for on-farm water management improvement.*

The cooperative movement began about 40 years ago. There are 8700 cooperatives now and a total of about 15,000 are needed. An effective way of forming cooperatives is to expand existing ones, so the number needed is unknown. Thirty-two farm corporations have been developed also. The Land Reform program accelerated the development of cooperatives.

8. *Large-scale supervised credit systems for improvement of irrigation and drainage.*

Iran has had a substantial IBRD-supported "Agricultural Development Fund" for larger farmers for loans exceeding one million rials (about \$14,000). The Agricultural Bank provides credit for cooperatives. Loans are given directly to the cooperatives and corporations rather than directly to the farmers. Some credit is also available for infrastructure development. Plenty of credit is available, but credit supervision is very difficult on small farms and probably much money is spent other than as agreed upon.

Seminar recommendations on credit have been implemented to some extent. The Agricultural Bank can lend up to one million rials (about \$14,000) but there must be an approved plan. Credit is not so much of a problem as is coordination.

9. *Development of water rights laws, improved use of water by legal or administrative procedures.*

Water nationalization (1967) means that water is not privately owned, but its use may be acquired. It cannot be sold, but is allocated. The seminars have had some influence in this development.

Water, including groundwater, is granted for a particular use and the right reverts if not used for that purpose. The law permits most of this to be handled administratively, and a Division has been established in the Ministry of Water and Power for this purpose. Appeals can be made to an Appeal Board.

10. *Transfer of distribution systems to farmer organizations. Participants of users in operation and management of systems.*

Transfer to a cooperative or a corporation may occur. There is no fixed policy, but it is evolving along the foregoing lines.

11. *Inclusion of drainage in development plans and implementation of drainage plans.*

Covered under Item 6

12. *Intensive cropping and improved rotation practices.*

Only in the south can multiple crops be grown.

13. *Research.*

a. *Irrigation practices, i.e., farm use of water, best field layout, measuring and controlling water losses, ditch erosion, frequency and amount of irrigation, etc.*

This is moving rapidly and the seminar has influenced the program. There have been more than 30 studies in the form of pilot-type projects.

b. *Drainage, salinity and reclamation.*

Drainage research is behind but is coming along. The seminar definitely had an influence. Work is being done at Shiraz and at Karaj.

c. *Water quality, mixing well and surface waters, etc.*

No comments.

d. *Soil, water, crop, fertilizer studies.*

One observer reported that this was moving fast primarily because of new fertilizer plants, but the seminar had a strong influence in this area. Another observer felt that little research was yet being undertaken. The Agricultural Engineering Department has started research for some crops; rice, cotton, wheat, alfalfa and deciduous fruit. These programs have been going on for about six years.

List of Persons Interviewed

Delegates

- AYAZI, M., Consultant, Ministry of Agriculture. Formerly Director General, Department of Agricultural Engineering. 1,2,3.
- VESSAL, H., Undersecretary for Water and Power Planning Studies, Ministry of Water and Power. 1.
- AHI, S.M., Private consultant on underground water development. Formerly Director, Agricultural Department, Plan Organization. 3.
- REJALI, A., Director for Master Plan, Ministry of Agriculture and Natural Resources. Formerly Engineer with Ministry of Water and Power. 4,5,6.
- RAJI, F., Deputy Director, Water Resources Department, Plan Organization, 4,5,6.
- JENAB, A., Professor of Irrigation and Drainage Engineering, Pahlevi University. Shiraz. 5.
- ESFENDIARI, F., Engineer, Department of Hydraulics and Research, Ministry of Water and Power. 8.
- SOHAIE, H., Head, Irrigation Research Section. Department of Agricultural Engineering. Ministry of Agriculture and Natural Resources. 8.
- GHAEMOSABAHI, A., Engineer, Water Resource Department. Plan Organization. 8.

Others

- VAHIDI, A., Minister for Water and Power.
- KAKHASHAN, A., Undersecretary for Water Ministry for Water and Power.
- HARIRI, D., Director General, Hydraulics and Research Department, Ministry for Water and Power.
- BORHAN, A., Director General for Agricultural Engineering, Ministry of Agriculture and Natural Resources.
- GHOLEZADEH, M. B., Director General Technical Department, Ministry for Water and Power.

CHAPTER 5

AFGHANISTAN

General Situation

Afghanistan is a mountainous plateau country bisected southwesterly and northeasterly by the Hindu Kush range which rises to heights of 7,000 meters (23,000 feet) in the east and from 3,000 to 4,000 meters (10,000 to 13,000 feet) in the west. It is land-locked, bounded by Iran on the west, USSR and China on the north and east and Pakistan on the south. Arable lands are located in the many river valleys carved from the mountainous uplift, the steppe lands fronting the mountains on the north along the USSR border, and the desert basin to the southwest served by the Helmand River and its tributaries. The total land area of the country is about 63 million hectares (245,000 square miles- 157 million acres). About 7.8 million hectares (19.4 million acres) are cultivated; 5.3 million hectares (13.1 million acres) are equipped for irrigation, but only about 2.9 million hectares (7.2 million acres) are irrigated in any single year because of water shortages. Another 1.3 million hectares (3.2 million acres) are dry-farmed, primarily wheat and barley. Afghanistan's 1970 population was estimated at about 16 million.

Afghanistan's continental climate, with high mountain ranges and streams, has led to the development of traditional irrigation systems that are on a level unsurpassed by any other country; however, precipitation varies widely from year to year and many diversion structures are unable to withstand high water flow and must be repaired or rebuilt annually. A large portion of the cultivated land (most of the dry-farmed area plus 1.2 million hectares (3 million acres) of that irrigated) is devoted to production of wheat and barley although corn, rice, cotton and fruits and vegetables are important crops also. Grazing is an important industry and there are more than 20 million sheep and 3.5 million cattle in the country.

The origin of Afghanistan's canals is lost in history. Some are quite large, having capacities of 25 to 50 cubic meters (900 to 1800 cubic feet) per second. At high river flows, uncontrolled intakes admit so much water that the canal banks may be overtopped and washed away or the canals filled with debris. This, along with washouts of primitive diversion dams, washouts of canals from summer storms where canals cross wadis and the natural variance in precipitation, makes traditional irrigation farming hazardous in many areas. Only improved modern structures and management can change this situation. Besides rehabilitation of old canals, there is the potential to bring additional lands under irrigation by extending existing canals, developing reservoirs for these, or by entirely new projects. Afghanistan also has many khariz,¹ (called ghanats in Iran) but the relative contribution to total irrigation water supply is unknown to the writer.

¹Horizontal tunnels driven to intercept the groundwater table thus providing a water supply by gravity flow.

Large irrigation projects underway include the Helmand Valley, Nangarhar Valley, Parwan, Sardah, Sharwan Canal and Kalagai. From all sources apparently about 110,000 hectares of new land are at one stage or another of development; these are being completed or settled at the rate of about 10,000 hectares (25,000 acres) per year. Afghanistan's report to the seventh NEISA seminar (1968) listed seven small irrigation projects underway or completed serving about 42,000 hectares. Total "new-land" potential for larger projects appears to be of the order of 300,000 hectares (750,000 acres). In addition there is some unknown potential of new and supplementary service from rehabilitation of traditional canal systems totaling perhaps as much as 500,000 hectares (1,250,000 acres) of which 200,000 hectares (500,000 acres) might be new land. These add to an estimated potential of 500,000 hectares (1,250,000 acres) of new land.² Estimated costs for new lands, based on the report of the Soil and Water Survey Authority in 1965 ranged from \$800 to \$2500 per hectare (\$320 to \$1,000 per acre).^{3,4} Costs of service to new or fallow lands by extending and improving existing canals has been estimated to average about \$300 per hectare (\$120 per acre). Extensive additional groundwater development using tube wells does not presently appear promising and costs of new or maintaining old khariz are now prohibitive, and khariz are wasteful of water. Shallow wells are now foreseen as the best practical groundwater source⁵ and efforts are being made to improve technology for dug wells to depths of 30 meters (100 feet) or more. By drilling head shafts deeper on some khariz, flow has been increased.

Afghanistan's largest irrigation project, the Helmand-Argbandab Project serves a total of about 150,000 hectares (370,000 acres). Kajakai Reservoir provides service to 101,500 hectares (250,000 acres) of which 45,800 hectares had not been previously irrigated, plus 45,000 hectares (113,000 acres) under the Arghandab Reservoir. An additional 40,000 hectares (100,000 acres) of new land eventually may be available under the Arghandab and Chakhansur divisions.

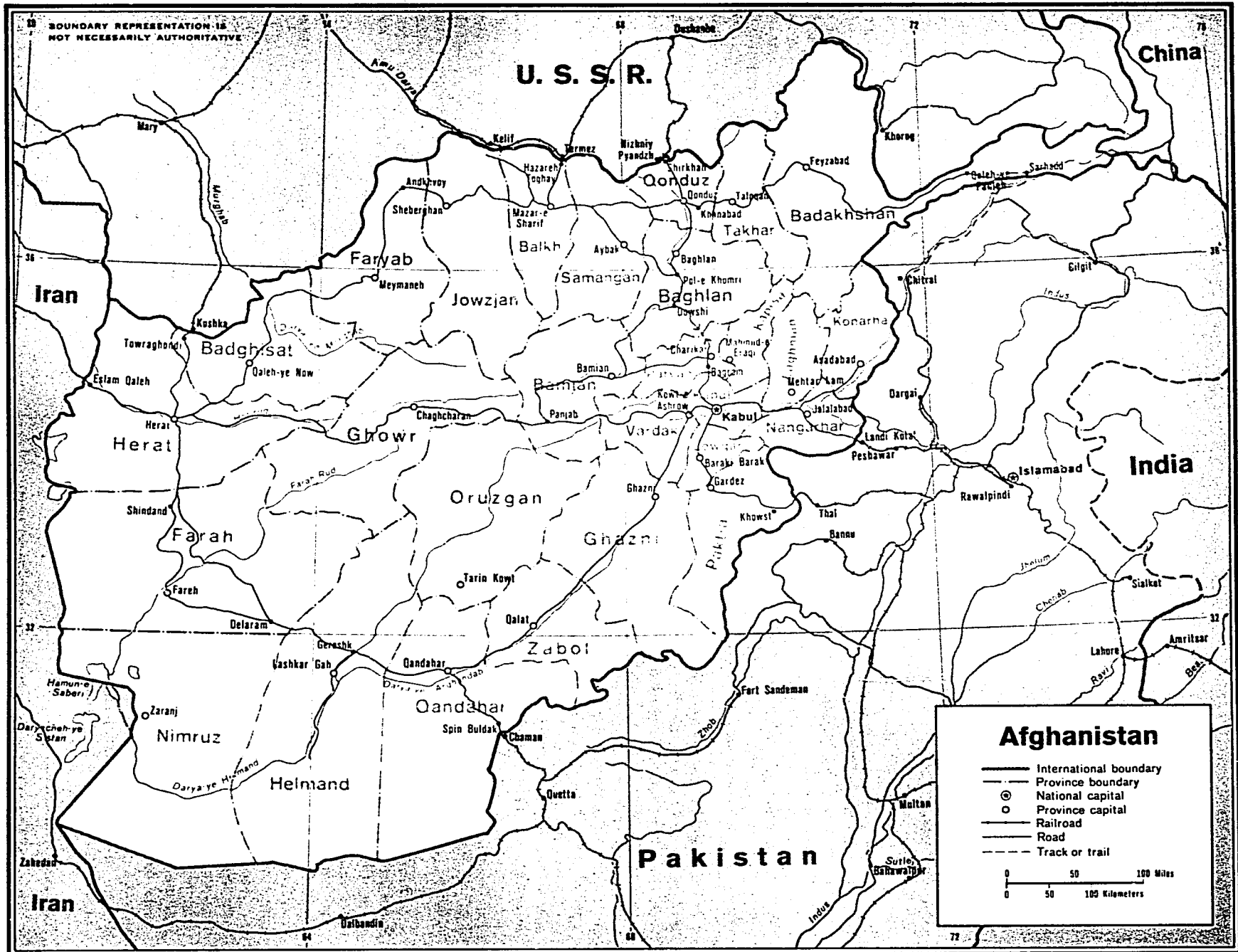
In Afghanistan the average farm unit is 22 jaribs or about 4.5 hectares. There are larger holdings, but these ordinarily are leased out into smaller units.

²United States Agricultural Review Team. Agricultural Development in Afghanistan with Special Emphasis on Wheat. A Report to the Royal Government of Afghanistan. USAID. Kabul. 1967. 106 pp.

³USAID/Afghanistan. 1967.

⁴Costs of land development in the Nangarhar project may be double this maximum including cost supplied by Afghanistan.

⁵Due to economics and financing difficulties, individual farmers cannot ordinarily finance the cost, about \$15 to \$20 thousand, and credit policy requires a 50 percent down payment on deep-well loans.



Problems of Irrigation Farming

Difficulties with canal diversions and maintenance have already been mentioned. As in many other countries, those farmers nearest the diversions usually enjoy the most reliable supplies. There are no organized cooperative systems of canal management but there are informal ones that draw on labor for operation and maintenance of the system. A *mirab* or water master is elected by the water users. In any event, a major problem of the traditional canal irrigator is reliability of his supply, both due to climatic variations and physical facilities. In some areas, there are problems of drainage and salinity. Access to inputs of seeds, fertilizer and machinery is difficult also and is aggravated by distance from supplies and markets. All fertilizer still has to be imported; a urea plant being built near Mazar i Sharif by USSR has been under construction since about 1966, but has not yet been finished.

Basically, there is no water law, which makes private water development hazardous. Parliament so far has not dealt with this problem. One of the problems of placing new lands under development is definition of land ownership. Lands are held largely by tradition. Deeds await completion of cadastral surveys which are going very slowly. For example, on the Nangarhar project this led to development and operation of about 6,000 hectares (15,000 acres) under a government farm, but it was not clear how the land tenure on the additional 24,000 hectares (60,000 acres) in the project would be defined. This same land tenure problem seems to apply to new lands under extensions of traditional canals. Water rights and land ownership problems were cited as the principal handicaps to introduction of credit.

On the Khoustan rehabilitation project, as an example, improved diversion works, canal structures, etc., were supposed to provide about twice the present water supply. This was to be utilized by extending the present canal and irrigating new lands. The project was completed in 1970. So far, the extension has not been utilized. Apparently land ownership and water right problems are such that land cannot be disposed of practically or else farmers are not interested.

Traditionally, institutionalized credit has not been available, nor has its use been well understood; however, significant progress in this regard appears to have been made in the last two or three years. Afghanistan still lacks basic legislation on cooperatives. Lack of land leveling capability adds to problems of efficiently applying water to land.

Certain areas of the Helmand Valley project were plagued with problems of drainage and salinity and heavy soils as well as with problems of settlement. Existing facilities were inadequate for lands provided additional service. An intensive effort is being made in the Shamalan area to consolidate and level lands, provide improved canal and farm delivery service, roads, and other infrastructure. In the Shamalan area one person may have as many as 12 to 15 fragments of land. There are no deeds. Lands are held by tradition and common agreement. Under a new law which applies only to the Shamalan area,

optimal consolidation can be effected and eventually a deed can be given. Special evaluation committees and a mobile court which can sit in the field are to be established; however, no judges have yet been appointed. At present 13,200 hectares (31,500 acres) out of a possible irrigable area of 18,500 hectares (43,800 acres) are being irrigated.⁶

A general problem in Afghanistan is that a farmer cannot afford to cultivate intensively for wheat, but must go to higher cash crops. The Helmand Valley, with double cropping, and the dry farming areas could produce the country's needed wheat.

Administrative Structure

Irrigation is administered generally under the Ministry of Agriculture and Irrigation. Some of the larger projects, like the Helmand-Arghandab and the Nangarhar, are administered by relatively autonomous organizations or projects. These are now under the Ministry of Agriculture but not under the Irrigation Division of the Ministry. The Irrigation Division has the function of serving small projects. The Provincial Development Department (PDD) also does irrigation development.

The Water Survey and Irrigation Department is headed by a President who supervises the following sections: Irrigation Design, Surface Water, Water Management (UNDP Water Management Project), Survey and Topographical, and Underground Water. A Minor Irrigation Team (FAO) and USAID's U.S. Bureau of Reclamation Advisory Team are associated in an advisory role. The Department works through the Directors of Agriculture and Extension in the provinces, and is mainly concerned with rehabilitation and water right controversies.

The *Water Management Project* is a UNDP project which has been underway for about two years. It is concerned with collecting hydrological and related legal data, examining projects for technical and economic soundness, and reviewing the nature of water rights. Minor irrigation under an IBRD loan is attempting to introduce credit to farmers and also operates a tubewell program. The project was initiated in early 1971.

The Irrigation Construction Unit is a separate division under the Ministry of Agriculture and Irrigation. It provides construction services either using its own forces or through contracts with private constructors. Engineering services are free. Construction is paid for by farmers who usually can get credit. The unit also does government projects, often extending traditional canals serving government land. A Program for Agricultural Credit (PACCA) was formed under the Ministry in 1965 and started its activities in 1969 working with FAO.

Recently the Extension and Agricultural Development Office has been transferred from the Prime Minister's Office to the Ministry of Agriculture and Irrigation.

⁶See Assifi, A. T. Helmand Valley Shamalan Land Development Project Plans in Report "8th NESA Irrigation Practices Seminar." Kabul, Afghanistan. 1970.

Participation in the Seminar and Contacts Made

Afghanistan sent one representative to the first seminar in 1956. The country did not participate in the second and third seminars, but has done so since, making significant contributions of papers and discussions and sending strong delegations. The country played host to the eighth, and latest, of the seminars which was held in Kabul in 1970. The Minister of Agriculture and Irrigation, H.E. Abdul Karim, the President of the Irrigation Department, Mr. Jomma Mohammedi and the Country Director for AID, Dr. Bartlett Harvey, made opening addresses.

The number of seminar delegates from Afghanistan (not including American personnel stationed in Afghanistan) attending and the number contacted by the writer are summarized in the following table:

Year	Participants	Contacted
1956	1	0
1958	0	0
1960	0	0
1962	4	1
1964	8	2
1966	3	1
1968	6	3
1970	22*	8
Total	44	15

*Seminar held in Afghanistan.

Because of multiple attendance, the actual number of different individuals attending the seminar was 32 and the number interviewed was 10. Discussion with Mr. A.F. Issaq, President of Irrigation in the Ministry of Agriculture and Irrigation revealed that at least 8 of the 32 participants were known to be stationed at locations other than in Kabul; most of the remainder who were not contacted were unknown to Mr. Issaq. On advice of the Mission, the writer did not visit the Helmand Valley as he had originally planned. Two other government officials and six expatriate heads of multi-lateral or bi-lateral assistance programs were also contacted.

In addition, Mr. M.A. Rahman, Project Manager, Water Management Project for the United Nations, who attended parts of the eighth seminar, was visited. Mr. Rahman was a member of the Indian delegation attending the fifth seminar (New Delhi, 1964). At that time, he was Chief Engineer, Public Works Department, Andhra Pradesh State. Later he became a member of India's Central Water and Power Commission.

General Evaluation by Participants

Mr. John Wilson, Agricultural Officer, accompanied the writer in interviewing Mr. A.F. Issaq who has succeeded Mr. Jomma Mohammedi as President of Irrigation in the Ministry of Agriculture and Irrigation. Mr. Issaq attended the eighth seminar. He stated that the seminar had been quite useful. For one reason because it raised the question of land consolidation. The government is working on land lease and land selling laws and regional reports on land and water are being prepared.

A joint meeting was held with Mr. Abdul Tarrir, who attended the fifth seminar, Mr. Saleh Popolzeh and Mr. R. Shinwari. Popolzeh and Shinwari both attended the seventh and eighth seminars and are, respectively, Directors General for Groundwater and for Design in the Water Survey and Irrigation Department. Mr. Tarrir has been field engineer for the Khouestan and the Kalaqui projects and had recently returned from a six-month's tour in the United States with the Bureau of Reclamation. These officials felt that the usefulness of the seminar came primarily from the exchange of ideas. Afghanistan needs to keep pace and such exchanges save time. The Irrigation Presidency has discussed extensively the problems of implementing the seminar recommendations. They would strongly like a regional follow-up and would be very much interested in some future seminars. They have had some very good experiences with exchanges on training methods, but do not think that the NESEA countries alone could finance the seminar.

Mr. A.H. Azizi who heads the Water Management Project⁷ and who attended the eighth seminar, felt that training is one of the most important factors needed by his agency especially since the number of projects is increasing. At the time of the seminar, he was construction engineer on the Parwan project being developed with Chinese assistance. The emphasis on irrigation practice was most helpful to him, providing practical information. He asked many questions and got answers to them. The seminar was appreciated by the Afghanistan Government.

With regard to the operation of the seminar, Mr. Azizi felt that it should require reports from the participants on what they have done about the recommendations and what the benefits have been. He objected to having the seminars simply repeat recommendations of previous ones and felt that the recommendations of the eighth seminar did not reflect the discussions. Each seminar should re-evaluate the material; there is too much similarity between the reports. He suggested that the seminar title be changed to "Problems of Irrigation of the Region."

Mr. Azizi graduated in engineering from the University of Kabul in 1964 and has done post-graduate work at Southampton, England.

Mr. M. N. Azimi is Director General of Minor Irrigation Projects. He is a 1966 graduate in engineering from Kabul University and attended the eighth seminar. He stated that he had tried to follow the seminar recommendations but was not always successful in implementing them. He felt that he does not know how to get needed information and would like to see establishment of a secretariat and exchange of publications. He also stated that the seminar is very important to Afghanistan.

Mr. Tawab Assifi is Vice President of the Helmand Valley Authority and has attended the fourth, seventh, and eighth seminars. He was graduated in civil engineering from Cornell in 1955 and gained an M.S. degree at

⁷He is co-project manager of this UNDP project with Mr. M.A. Rahman, United Nations representative.

Colorado State University in 1966. He expressed the opinion that the seminar was very good. Benefits came not only from what others said, but because preparation of papers forced participants to think about their problems. He felt the seminar suggested a wide variety of new options. Many ideas have already been borrowed, e.g., charging for water deliveries. "It was through the seminar that we first became conscious of the necessity to take the farmer into account. You can see the changes in the approach to the Helmand Valley as a result. Designs have actually been changed as a result of the seminar. For example, the threatening problems of drainage were really brought home." Mr. Assifi believes that the seminar actually caused an acceleration of drainage after the participants saw the results elsewhere. AID has now provided an on-farm adviser. The seminar influenced AID in this decision.

Mr. Assifi reviewed progress in the Shamalan project on such problems as water users organizations to be developed into general cooperatives; the 10-year grace period followed by a 50-year amortization period on development loan repayments; land consolidation features; land leveling; selling of water by land served or volumetrically. He stated "all of these ideas came from the recommendations of the seminar. In the past, all HVA did was build dams and canals."

According to Mr. Assifi there is a communication gap between the technical and the administrative people. Technical people do not get much encouragement from the administrative people and it was a tremendous boost to their egos to be appreciated by other technicians. He does not believe the NESAs can organize an international seminar. They can do this internally, but they have no real way to get involved internationally. AID has this capability. Maybe efforts could be organized worldwide. Some other aid donor might sponsor. Perhaps the Germans and French might make some contributions. An attempt should be made to get USSR involved. They have considerable experience. Mr. Assifi would like to see a seminar held in Iran.

The seminar was generally found to be useful according to the statement made by Jomma Mohammedi, now Deputy Minister of Agriculture and Irrigation. Mr. Mohammedi is a 1961 civil engineering graduate from the University of Kabul and received an M.S. degree from the University of Colorado in 1963. He was formerly President of Irrigation in the Ministry and was co-chairman of the eighth seminar. He also attended the sixth seminar. He stated that he did not know how far the information was spread, but that the seminar played a considerable role as far as leaders were concerned. Collection of information to prepare a paper often caused a change of views. The exchange of views was useful also. The ideas of the seminar have been reflected, at least subtly, in the Ministry's planning. He would like to see the seminar continued, but financing would be very difficult for Afghanistan because of lack of foreign exchange.

The Ministry has not had a deep commitment specifically to irrigation at the farm level, but more to major works. Only lately has the Ministry become interested in land development as a major activity. Previously it was interested primarily in diversions, etc.

Mr. Ebrahim Pearose, who attended the eighth seminar, was formerly Director of Design in the Agricultural and Irrigation Ministry. He is a University of Kabul graduate and a Bureau of Reclamation trainee. He is now with the Irrigation Construction Unit. He introduced the President of the Unit, Mr. Abdul Hai Abaucy and Mr. Khalyar, an engineer. Mr. Abaucy graduated from the old Afghan Institute of Technology and went to the United States in 1953. He has a Bachelor's degree in mechanical engineering from the University of Wyoming, an M.S. degree from Illinois and has worked on his doctorate at Stevens Institute of Technology. Until two years ago, he was on the staff of the University of Kabul. While not a delegate, he attended some of the sessions of the eighth seminar. He reported that he found the seminar useful. There was an opportunity for exchange of information.

Mr. Pearose inquired about action being taken toward establishing a secretariat for exchange of information. This was included in the resolutions. He would like to see AID take the responsibility for information transfer.

Mr. A.S. Zia, formerly Head of Agriculture for the Helmand Valley Authority, attended the fifth (1964) and the eighth seminars (1970). Mr. Zia is undergoing transfer to the Extension and Agricultural Office. Mr. Zia holds a B.S. degree in agronomy from Iowa State and an M.S. degree in agricultural economics from Wisconsin. He was in the United States from 1953 to 1959 and has been back for two short training periods since, most recent in 1968. He stated that as long as there is no central office where information on new developments can be obtained, the seminar serves a very useful purpose. Unless some substitute can be developed, it should be continued. Participants from the Helmand Valley Authority held key positions in that agency. He believes that *different decisions have been made by HVA authorities because of seminar discussions*. Seminar discussions saved time. It was unnecessary to repeat experiments. HVA was particularly benefited, but needs lots more information about irrigation and drainage. This would be especially beneficial to the Shamalan project.

Part of the eighth seminar was attended by Mr. M.A. Rahman, who heads the UNDP Water Management Project that is making a water rights study. As mentioned previously, Mr. Rahman attended the fifth NESAs seminar in India as a delegate from Andhra Pradesh State. He stated that he had a good opinion of the seminar. He was particularly impressed with the Iranian papers in the eighth seminar and had a very good discussion about water rights legislation with the Iranians and this has been useful for his program. One important point was that it helped convince the Afghan Government that something can be done without becoming in conflict with Islamic laws.

The Afghans who attended had a chance to know in what fields research is being done in neighboring countries, especially on consumptive use and water requirements. This has made it possible to convince responsible people in Afghanistan that certain aspects of the UNDP program are feasible. An Indian-Afghan bi-lateral team will begin research on crop water requirements. Mr. Rahman stressed that examples in other countries dis-

cussed in the seminar have made Afghan authorities feel there are some possibilities for success in Afghanistan.

Professor Snelling, plant scientist and head of the University of Wyoming team at the University of Kabul stated that, while he was not personally involved in the eighth seminar, one of his colleagues, Professor Salim, gave a report. He attended some sessions and heard some of the reports. He was greatly impressed with the Iranian paper on water use and hopes the Afghans will take this to heart. The ability of the Afghans to attend international meetings is minimal. The Wyoming contract does not provide any international travel funds. Dr. L.C. Saboe, Field Crops Advisor, stated that he was highly impressed with the seminar papers. Professor Salim's paper created a rather good discussion.

According to John Wilson, USAID/Afghanistan Agricultural Officer, the seminar program has been influential in turning the point-of-view toward the land. Interest in agricultural drainage is still insufficient and Afghanistan needs greatly improved use of water. There is little or no night irrigation in Afghanistan.

Water rights laws are needed. Because traditional rights exist it is difficult to secure rights for new land even though water is available. In many cases farmers do not apply sufficient water to keep the salts down. There is a need to develop new crops that can be sold in other parts of the world and this should be possible because of favorable climate and irrigation. For example, Afghanistan's climate is well adapted to the production of vegetable and field crop seed.

As alternatives to the seminar, Mr. Wilson mentioned considerable interest in rainfed crops. Possibly there should be a seminar on other inputs for irrigation.

Often people feel that no one else has similar problems. Seminars bring home the similarity and demonstrate that frequently other people's solutions will work. Another advantage is that such seminars demonstrate how professionals work after they leave academia; this is especially true in regard to preparation of papers

Topical Evaluation

1. *Establishment of an irrigation and drainage service to provide technical assistance at the farm level for on-farm water management.*

This has been done to a small extent but is not yet generally successful. The Helmand Valley is getting some of this done.

2. *Improved program coordination between water supply development and agencies responsible for on-farm water management.*

The Agricultural Ministry is not in a position to construct large dams. The Irrigation Division has a relationship with the Irrigation Construction Unit and with hydrology, hydrogeology, meteorology, etc., for small projects and can get information on the large ones. Both the Helmand Valley Authority and Nangarhar Project do their own farm development work.

The Helmand Valley Project is an integrated operation and engineers have based their designs on recommendations of agriculturists. These have determined the sizes of blocks and land classification. The Extension Service has consulted with farmers and information has been passed on to the Technical Department in the Ministry, although this Department does not now consult with agriculturists. The Ministry of Agriculture, however, does not have a land settlement project and extension services are lacking.

3. *Education and training of manpower in irrigation and drainage.*

- a. *Irrigation and drainage courses at the university level for engineers and agriculturists.*

Agricultural Engineers are under the College of Engineering at the University of Kabul. They take two courses in soil and water. These courses are also taken by plant scientists. Because of the "strike" there have been no engineering graduates for two years. The shortage has been further aggravated because the program has been extended to five years. The Russian-operated Polytechnic Institute requires five years, but its graduates are more specialized than those of the University of Kabul. Junior college level training is needed in Afghanistan. Emphasis is placed on training by the UNDP water management team. They are sending some counterparts abroad.

- b. *Improved farmer education programs for on-farm water management through extension services.*

The Irrigation Department has not done much training, but through the Extension Service has trained farmers. All departments cooperate with the Extension Service in the training of farmers. HVA also has set up some farm demonstrations and the Extension Service has demonstration farms in all of the provinces, but training needs to be extended to farmers and government officials.

- c. *Establishment of institutions for training technicians in irrigation and drainage and related service.*

The Program in Agricultural Credit and Cooperatives in Agriculture (PACCA) has trained 130 people at its central facility at Bodm Bagh near Kabul. It has two sub-centers in other provinces. Some trainees are college graduates, others are at the 12th grade level. PACCA also has a literacy program. Operators and mechanics are generally available as the result of the heavy construction projects that have been finished.

- d. *In-service training programs for technicians in irrigation and drainage.*

Land-leveling technicians are trained by the topographic department. HVA is training some water masters. There are some other training programs, but not as many as needed.

- e. *Use of pilot projects for new developments and for rehabilitation of older developments.*

There is a pilot project being developed near Mazar i Sharif with assistance from the Asian Development Bank. The Extension Service has field stations in all of the provinces.

f. Farmer training courses.

Groups of farmers from the Helmand Valley are being sent to Turkey for training and observation of irrigation practices there.

4. Development of the elements of the distribution system actually serving farmers.

Some pertinent comments are included under some of the other topics. This is being done primarily on the Shamalan project.

5. Improved farm field management for irrigation and drainage. Consolidation of fragmented holdings, optimal field size and distribution systems, land-leveling (land-forming) etc.

In the Khouestan project (canal rehabilitation and extension) the distributaries are in place but no land-leveling has been done. The problems are lack of manpower and equipment.

Generally in Afghanistan, existing irrigated lands are already leveled because the basin method of irrigation is widely practiced. The government is responsible for leveling⁸ (on Irrigation Department projects) and can give some help to farmers.

Optimal size of fields, consolidation of holdings, etc., are still insoluble problems because of the lack of cadastral surveys which are progressing slowly. Locating government-owned and farmer-owned land boundaries is still a long process. Land consolidation is being given consideration and is actually being done on the large projects.

Activity in land-leveling is nil so far. The Extension Service should advise farmers on this and they have received some ideas from Turkey and India, but there is lack of a trained Afghan staff for design and expert service.

Under the Shamalan project in the Helmand Valley, a special law has been passed since the 1970 seminar which provides for optimal land consolidation and eventually a deed. This law applies only to the Shamalan project. Land consolidation was one of the strong points in "selling" the project to the farmers. Usually under land consolidation schemes, some land is taken away from the farmer. In this case, no land is taken by the government. Land-leveling will be done by HVA and, with the consolidation, will take into account farmsteads and orchards. Only a limited amount of leveling is anticipated.

USAID emphasis in the Helmand Valley is water management. A realistic water pricing schedule will be sought and double cropping encouraged. Since land in the Shamalan will be out of production during leveling, reimbursement to farmers will be necessary.

⁸The writer interprets this to mean jurisdictional responsibility for the program.

6. Improved project planning of water supply and distribution works and farm development.⁹

On the large projects such as Helmand Valley, some of this is being done. It is the principal thrust of the Shamalan project.

7. Development of farmer organizations, cooperatives, joint companies, private custom, etc., for on-farm management activities requiring joint action.

There is no organized cooperative water-users system; but there are invariably informal ones that draw on labor for operation and maintenance. Traditionally water users simply get together and elect a "mirab" or water-master.

The Minor Irrigation Section is trying to establish cooperatives and farmers societies. There are some agricultural cooperatives, but none for irrigation. The Program for Agricultural Credit and Cooperatives (PACCA) sponsored by FAO, has trained some people for organization and management of cooperatives.

In order to reach agreements on supervised credit schemes where there is joint interest, protocol requires going through a court procedure and all parties assume responsibility for repayment. One project had 100 interested parties. There is no district or equivalent law.

8. Large-scale supervised credit systems or programs for improvement of irrigation on the farm and distributary systems serving the farm units.

This was accelerated last year largely because of the drought. Pumps were sold and assistance was given to cleaning khariz, etc., over and above the Agricultural Bank's regular program, under a drought relief program pushed by the Minister of Agriculture. The Agricultural Bank is the only institutional source of credit and will provide this if its rules and regulations are met. Loans have increased by four times in one year. Bank rules are quite rigid and make loans difficult to process. Technical people should provide studies for the Bank. Some

⁹This seems an appropriate place to record observations on the Nangarhar project near Jallalibad. The project was started 8 years ago (about 1964) and was developed under a 65 million ruble loan from Russia. Area served was targeted at about 75,000 acres. Generally, the land was quite rocky, about 60 percent very poor. Rocks were removed and new soil hauled in. As of August 1972, about 56 million rubles of the loan had been spent. Project includes a storage reservoir and diversion canal 20.25 kilometers long. About 15,000 acres is government-owned and operation of this has started. It is not yet clear how the remainder will be settled, especially considering the capital indebtedness against it. Citrus plantings were made five years ago and a small amount of citrus and some vegetables and olives were produced last year. USSR takes the produce against the loan. The project is about 1,000 (3,300 ft) meters lower than Kabul, 800 meters (2,500 ft) above sea level and the climate is essentially frost-free. Capital ruble cost is about \$1,000/acre, but total cost is about double that amount. One problem is that Pakistan can put citrus in Kabul at 2 Afs/kg. A large amount of military work corps effort has gone into the project; about 6,000 military personnel have been assigned to the project. There is considerable effort in dairying on the government farm; holstein-friesian, brown swiss and jersey bulls are being crossed with local cows. Some f4 crosses are just now coming into production and a modern dairy has been set up to serve 2,000 cows. Only about 95 cows have come into milk production at this time.

concessional terms may be desirable to stimulate irrigation development.

Credit is handled through the Minor Irrigation Section in collaboration with the Agricultural Bank under an IBRD (World Bank) loan. This section is trying to introduce credit to farmers, but is finding it quite difficult. A feasibility report with designs and cost estimates is prepared for each loan application. Pumps are popular and pumping of both surface water and ground-water may be financed under the program. Eleven tube well schemes have been studied but only two were able to raise the down payment (50 percent on tube wells). It is proving very difficult to introduce a full-repayment system for irrigation development.

The Afghan Finance Agency is partly Helmand Valley Authority and partly Agricultural Bank. It now accepts a joint note from a group of farmers whereas previously a real property mortgage was required.

Farmers are not now too interested in obtaining credit to develop water, which they feel the government should supply. In the Kundus project, farmers refused to repay loans. During the last three years, which have been deficient in rainfall, there was a rush into shallow well development and 450 pump sets were sold. Credit risk with shallow wells is very high. Farmers cannot afford to grow wheat using pumped water, but must shift to cash crops, although they will probably persist in growing their own household wheat. Wells are inadequately designed. They are not deep enough, and because they are not tested, pumps are improperly selected; capacities were often far too high. Deep wells cost around 1,200,000 afghanis, which is too much for a single farmer to finance. The Ag Bank requires a 50-percent down payment on deep wells and is concerned about control over ground-water pumping to avoid depletion and interference. Engineers had planned deep wells to serve a livestock feeding and development project near Herat, but have shifted to 1,000 shallow wells and are asking for an IBRD loan. Cost of shallow wells is about 200,000 afghanis. While many ancient dug wells (500 years old) are well lined and in good repair, the art has been lost. The Bank is emphasizing well lining technology. Wells must be 50 meters removed from other wells or khariz in order to insure against interference.

In its first year, 1348, (1960) the Bank loaned 2.6 million afghanis to 200 people. During 1971, 138 million afghanis were disbursed. This should reach 200-250 million in 1972 and 2.5 to 3.0 million by 1975. About one-third of the development loans are going for irrigation, one-third for mechanization and one-third for agro-business, new crops, maintenance, etc. The Bank maintains an import section which provides required foreign-made commodities.

Collections are difficult. Farmers are being trained to act as Bank agents and this may turn out to be a useful innovation. Commissions will be based on loans collected rather than loans made. The Bank is strict in that only loans for projects deemed economically sound are made. It hopes to achieve about 75 percent recovery.

In the past, there has been difficulty in collecting on credits. The present method of joint security is believed viable. Small farmers have the best repayment record, the large farms are the poorest risks. While there have been some loan losses, repayment has been, relatively, very good. On fertilizer in 1970, repayment was more than 90 percent.

9. *Development of water rights laws and improved water use through administrative procedures.*

Reference has already been made to the UNDP Water Management Program that is compiling data on water rights, water use, etc. There is now no general water law nor has Parliament discussed one, except for some specific legislation applying to the Helmand Valley.

Land ownership and water rights are still not settled and there is a serious problem of water distribution. For supplemental water, farmers were supposed to return part of their land holdings to the government in repayment of investment cost. This was a progressive tax depending on farm size. Parliamentary opposition, however, has prevented implementation of this. Everyone who discussed it emphasized the need for water-rights legislation.

Throughout much of Afghanistan, lands are held only by tradition and common agreement, without deeds. There is a national cadastral survey which is working at setting land boundaries to the end that deeds will be given, but the work is going slowly.

There is no legislation providing for district or equivalent organization in Afghanistan. There is no legal way to proceed in joint enterprises except through unanimous concurrence. Where joint responsibility is required for credit, there is a court procedure which binds all participants once unanimous concurrence is achieved.

A special law providing for optimal land consolidation and a deed has recently been passed, but this law applies only to the Shamalan project and provides for special evaluation committees and a mobile court. (See Item 5.)

In the Shamalan project, water will be sold presently on the basis of land served, but the Authority plans to shift to a volumetric basis.

10. *Transfer of distributaries or water courses to farmer organizations. Participation of users in operation and management of distribution and water course systems.*

The informal traditional canal organization has already been mentioned. This has experienced difficulties because of domination of the rivers and the canals by the most powerful farmers. One expert has concluded that the government should control the river and drainage structures at general tax expense with the other system elements owned by the farmers and financed by credit.

In the Shamalan project, the government will manage canals and laterals at first. In the meantime, HVA will try to form water users associations. The associations will be used, not only for water distribution but for credits, seeds, etc. HVA plans to assess both an amortization, and operation and maintenance charge. Contracts provide for

a 10-year grace period followed by a 50-year amortization period.

11. *Inclusion of drainage in development plans and implementation of drainage works.*

Where drainage is a problem, the policy now is to construct drains concurrently with canal construction. The Helmand Valley has started drainage work. Generally, however, interest in agricultural drainage is still insufficient. Afghanistan needs greatly improved efficiency of water. Irrigation water is frequently turned loose at night, often on someone else's fields.

12. *Intensive cropping and improved rotations practice.*

Improved cropping practice is being pushed by the Extension Service. Helmand Valley is unique in that farm sizes permit mechanization and double cropping. In this area farmers have made windfall profits from wheat during the recent drought (past two years).

13. *Research.*

- a. *Irrigation practice, i.e., farm use of water, best field layout, measuring and controlling water losses, ditch erosion, frequency and amount of irrigation, etc.*

The Ministry has a research program which does work on varieties, fertilizers, etc. Researchers are keeping records of water application (both timing and amount). HVA has operated coordinated research on variety trials and fertilizer for several years and this program is now moving to include irrigation.

- b. *Drainage, salinity, reclamation using tube wells, etc.*

There is research on drainage and soils on both the Helmand and Nangarhar projects. A study of the effect of canal operation on groundwater has been done in HVA.

List of Persons Interviewed

Delegates

- ASIFI, Tawab, Vice President, Helmand Valley Authority. 4,7,8.
TARRIR, Abdul. Engineer, Water Survey and Irrigation Department. Ministry of Agriculture. 5.
ZIA, Abdul Sattar, formerly Head of Agriculture, Helmand Valley Authority. Extension and Development Office, Ministry of Agriculture. 5,8.
MOHAMMEDI, Jomma, Deputy Minister of Agriculture, formerly President Water Survey and Irrigation Department, Co-chairman eighth NESA Seminar. 6,8.
POPOLZEH, Salah, Director General, Groundwater Section, Water Survey and Irrigation Department, Ministry of Agriculture. 7,8.
SHINWARI, A., Director General, Design Section, Water Survey and Irrigation Department, Ministry of Agriculture. 7,8.
ISSAQ, A.F., President, Water Survey and Irrigation Department, Ministry of Agriculture. 8.
PEAROSE, M., Ebrahim. Irrigation Construction Unit. Ministry of Agriculture. 8.
AZIZI, A.H., Director General, Water Management Project, Ministry of Agriculture. 8.
AZIMI, M.N., Director General, Minor Irrigation Projects, Ministry of Agriculture. 8.

Others

- ABAUCY, Abdul Hai, President, Irrigation Construction Unit. Ministry of Agriculture.
BROWN, P.A., Project Manager, Minor Irrigation Section. Ministry of Agriculture and Irrigation. Sir M. MacDonald & Partners.
GHUFRAN, Mhd., President, Nangarhar Valley Project.
KREICHHAMMER, K.H. Credit Manager. Agricultural Development Bank.
LEVINTON, David, Assistant Director, Helmand-Arghandab Valley Region. USAID/Afghanistan.
RAHMAN, M.A., Project Manager. Water Management. United Nations.
SNELLING, Kenneth W., Soil Science Advisor, University of Wyoming Team, University of Kabul.
WILSON, John. Agricultural Officer, USAID/Afghanistan.

CHAPTER 6

PAKISTAN

General Situation

Pakistan has basically a desert climate modified by the winter and summer monsoons. The summer monsoon is the most important in terms of precipitation with rainfall greatest in the north and east ranging from 101.6 millimeters (4 inches) to 1,116 millimeters (40 inches). The average at Lahore is 482.6 millimeters (19 inches). In the south and west, precipitation is low, only about 406.4 millimeters (16 inches) in the Sind. Crops can be grown the year around. During the spring and autumn the climate is very hot and dry. It is hot and humid during the summer monsoon. The area of Pakistan is 805,000 sq. km. (310,400 square miles) or 80.5 million hectares (200 million acres). About 19 million hectares (47 million acres) are cultivated, more than 12 million hectares (30 million acres) using irrigation, mostly from canals. Potentially cultivable land in the Indus Basin is estimated at 73 million acres, but most of the remaining not now cultivated would need irrigation. A very large share of Pakistan's irrigated land lies in the great, flat deltaic plain of the Indus River. The average slope of the lower 1,100 kilometers (700 miles) of this river is about 0.0002 (one foot per mile). In its lower reaches, slopes may be as low as 0.00006 to 0.00005 (one foot in 3 or 4 miles). The population of Pakistan is approaching 60 million.

Irrigation in Pakistan

Much could be written about the fascinating history of irrigation in Pakistan. The large canal systems, started a century ago, have been expanded almost continuously. Because of the high sediment load and low slope these canals, some having capacities as great as 1,100 CM/sec (40,000 cusecs), were designed to transport their sediment loads without deposition or erosion. Research, beginning in the late nineteenth century, made Lahore the center for development of the branch of engineering science dealing with canals transporting heavy loads of sediment. Irrigation systems were not designed to provide a full water supply for intensive cultivation. With extensive land resources and the constraints of animal power, much of the land lies fallow at any given time. Indeed, with the low land slopes, intensive irrigation would have resulted in even more extensive waterlogging than now occurs. Even so, waterlogging became widespread by the 1950s, probably largely from canal leakage, and amounts to about 50 percent of diversions. The low application of water, necessitated by lack of drainage, led to increasing salinity problems. Presently about 128 billion cubic meters (103 million acre-feet) of irrigation water is diverted annually from the river, but, considering canal losses, only an average of about 52 centimeters (1.7 acre-feet per acre) is delivered to the fields against an estimated consumptive use and leaching need of 93 centimeters (3.2 acre-feet). Average application efficiency is believed by some to be only about 50 percent; therefore, only about one-fourth of the water diverted actually is available to crops. Crop yields, on the average, are very low. By 1960, about 2 million hectares (5 million acres) of land were subjected

to serious waterlogging and salinity problems and this was increasing at the rate of 120,000 to 160,000 hectares (300,000 to 400,000 acres) per year. Development of tubewells and more intensive irrigation in affected areas appears to have checked the spread of waterlogging and salinity.

The average yield of the three western tributaries of the Indus, which was made available to Pakistan under the Indus Basin Treaty of 1960, is 177 billion cubic meters (142 million acre-feet). One large dam, Mangla, has been completed and a second, Tarbela (the largest earth and rock-fill dam in the world) is scheduled for completion in 1975. These will provide surface reservoir storage to increase the availability of river water.

During the 1950s, studies began of the use of tubewells primarily for relieving waterlogging problems; but also with the idea of adding to the usable water supply. These studies showed that generally salty water was overlain by fresh water with the depth and quality of the overlying fresh water usually decreasing with distance from the rivers and large canals. Groundwater grows increasingly saline toward the south also. Evidently the fresh water results largely from river and canal seepage and overlies the salty fossil groundwater.

The groundwater studies led to the implementation of the large Salinity Control and Reclamation Projects (SCARPS) utilizing electrified tubewells and development of an electrical generation and distribution system based on the exploitation of natural gas produced by the Sui fields of the southwest. Four SCARP projects have been completed and involve about 8,000 tubewells. The success of public tubewells triggered a remarkable development of private tubewells for irrigation water supplies. Somewhere between 80,000 and 90,000 of these have been installed. During the two-year period, 1967-1969, nearly 27,000 were constructed, about 60 percent powered by diesel engines. Investment in private tubewells is estimated to be approaching one billion rupees.¹ Public tubewells are larger and deeper, 16-18 inch casing, producing an average of 85 liters per second (3 cusecs); private wells are 6-8 inch, producing up to about 50 liters per second (2 cusecs).

A significant problem of management of the SCARP tubewells for water supply is groundwater salinity. Some wells produce water that is quite salty. If not too salty, this is blended with canal water. The river water is of high quality, 200 to 300 ppm total dissolved solids, and use of the saline groundwater has caused some problems. Some SCARP wells have actually been shut down. Based on studies made by the Land Reclamation Directorate, limits

¹In 1972, the rupee was devaluated to 11 per dollar. Previously the official rate was 4.7. The cost estimate was made by Sayid Hamid, formerly Chief Engineer, Reclamation, Water and Power Development Authority, in conversation with the writer in 1972.



of quality have been placed such that blended water supplies shall not exceed 1,000 ppm total dissolved solids, Sodium Absorption Ratio (SAR) shall be less than 10 and Residual Sodium Carbonate less than 2.5 m.e./liter.² Even with the difficulties of salinity and the problems of blending and distributing well and canal water, agricultural production in SCARP I supplying about 1.25 billion cubic meters (one million acre-feet) per year to some 400,000 hectares (one million acres) on Rechna Doab, between the Ravi and Chenab tributaries of the Indus, has increased spectacularly. In 1959-60 this was reported as 93.4 million rupees. The year the first wells were placed in production, 1961-62, this amounted to 123.4 million rupees. By 1965-66, when the wells were completed, production reached 267.3 million rupees. After leveling off to 304.2 million rupees in 1967-68, production increased to 378.6 million rupees in 1968-69. Approximately 250 wells in SCARP I have been shut down because the water is too salty. There are also some worrisome decreases in discharge (specific capacity at some of the wells). The reasons for this apparently have not yet been explained satisfactorily. Exhaustive data on well production, salinity and groundwater have been collected and are being analyzed. A U.S. Geological Survey team of four hydrologists is assisting in this effort.

Because of much lower cost (particularly in foreign exchange component), and increased ease of financing and of replacement, the smaller, shallower tubewells are being favored, especially for water supply. From the point-of-view of comprehensive drainage, Pakistan officials recognize the eventual need somehow to dispose of the salts now being added and recirculated in the SCARPS without damage to agriculture downstream. This is a long-range problem which apparently does not need immediate solution.

The idea of increased intensity of cultivation and improved production with optimal use of varieties, fertilizer, pest control, tillage, harvesting and water is widely accepted. Water supply is also widely recognized as the limiting resource constraining this objective for the large acreage under irrigation.

Distribution to Farm Units and Land-Leveling

Under the canal system, the main canals and laterals are operated by the Irrigation Department which delivers water to the inlet of a "watercourse" system serving a "chak" of up to several hundred acres. The farmers within a chak are responsible for building and operating the watercourses, but the writer was told that the Irrigation Department designated location of the watercourses, insuring that an outlet is provided to each field and that the farmer receives the stream of water for the correct amount of time. There is widespread difference of opinion about the efficacy of the watercourse system. Some people strongly felt that the present watercourses are an important obstacle to efficient water use due to lack of an

²Ch. Mohammed Hussain. Water Quality in Relation to On-Farm Water Management in West Pakistan. Report of Eighth NESA Irrigation Practices Seminar. Kabul, Afgh., 1970. p. 305-320.

adequate level of technical management and design, seepage losses and water wastage; others felt that, under the stress of need for water, each farmer takes steps to insure that the watercourse is kept clear and functions adequately. Water is delivered to each watercourse inlet on a scheduled basis; one obvious problem is that the schedule of availability of water frequently doesn't coincide with optimal timing or is too long between turns for crop requirements.

Conjunctive use of well water can largely solve the problem of timing as well as provide an increased water supply; however, the well must be linked to the watercourse system (unless it is located alongside a canal); capacities need to be increased and, if the water is saline, a workable blending arrangement devised. These pervasive problems are remarkably hard to solve.

While there most certainly is a great potential to be realized from improving the operation of watercourses, just what should be done and how to do it still remain to be resolved by actual field experiment and demonstration.

While the country appears flat and level, the effect of micro relief in farm fields on both field irrigation efficiency and waterlogging and salinity is not generally appreciated.³ While farmers work hard to smooth their fields using an oxen-powered smoothing board, this does not do the job, nor do bulldozers. Success requires grading designs based on surveys and scraper and land planning operation.

G.N. Jones and R.L. Anderson⁴ have shown that farmers consistently under-irrigate. The writer agrees with these authors that with short water supply, high risks (and lack of other highly profitable inputs), this is the rational thing for the farmer to do. The writer thinks he will continue to do so unless there are radical changes based on a much better water supply. Indeed, under these conditions, this may be the best use of the resource.⁵ Except for groundwater, which is limited, further improvement of the water supply (after Tarbela Dam comes into operation) can come only through conserving surface water. The physical-demographic pattern, based on the canals, will not be changed readily. There are also narrow physical limits within which the canal system can even operate hydraulically; a fact too frequently overlooked. While efforts could and should be made to improve canal service, these limits are, nevertheless, very real. Increased farm irrigation efficiency and prevention of canal and distributary leakage constitute the remaining ways to increase water supply; however, stopping these losses—especially from the canals—will eventually reduce fresh groundwater supplies.

³*Ibid.*, p. 310.

⁴Jones, G.N., and R.L. Anderson. The Problem of Under-Irrigation in West Pakistan: Research Studies and Needs. I.D. 70-71-GNJ-RLA-19, June, 1971.

⁵This illustrates what may become the classic dilemma of irrigation policy on the sub-continent. High population, chronic underemployment and excess of land in contrast to water argue for *extensive* rather than *intensive* irrigation practice, yet high production requires *intensive* irrigation practice with a full package of "inputs."

These complex problems can only be worked out using fairly large scale field experiments and comprehensive basin modeling taking into account economic and social factors. On the face of it, land-leveling looks extremely important, but it is expensive and will not pay unless it is possible to shift to intensive cultivation, which means a full water supply and drainage. Fortunately, Pakistan and USAID are now drawing up plans to tackle land-leveling and watercourse problems on a pilot-project level.

Pakistan has few natural resources beyond its agricultural ones and these are severely limited by water supply. Such being the case, it is hard to understand why that part of irrigation engineering dealing with management of water on the cropped land and with drainage has been so slow to develop in contrast to the advanced development of hydraulic engineering relating to diversion and storage works, and canal systems. As set forth under the Canal Act of 1873, agricultural irrigation engineering has not been within the responsibility of the Irrigation Department, where a large share of the engineering talent resides. On the agricultural side, the institutional framework has been much less strong and the essential engineering training has been lacking in the agricultural curricula. It now appears, though, that these difficulties are beginning to be resolved.

Quoting some of the officials interviewed, "in 1958-59, a new era began in Pakistan irrigation development," (the Indus Basin Treaty, waterlogging and salinity alleviation and the potential for groundwater). Another official said that 1965-66 was a "watershed" in Pakistan's agriculture. (By then the impacts of fertilizer, new varieties and groundwater development were beginning to be realized.) Perhaps the 1970s will produce a turning point in *on-farm water management*.

Administrative Structure

Two years ago, West Pakistan, then administered as a single wing or province, was subdivided into the four provinces of Northwest Frontier, Punjab, Sind, and Baluchistan. These are administered under the Central Government seated at Islamabad. The first three provinces mentioned are riparian to the course of the Indus as it flows from north to south. Presently apportionment of the Indus waters among the provinces is being negotiated. Completion will be an important step toward further progress of irrigation development in Pakistan.

Various departments are organized under the provincial governments and various ministries have been continued in the Central Government. Of greatest interest to on-farm water management are the Departments of Irrigation and Power, and of Agriculture. Initiation of provincial governments would appear to be helpful in increasing the resolution and scope of understanding, insuring more comprehensive planning and in bringing administration closer to the people concerned. This seems to be especially true from the point of view of irrigated agriculture development.

With the culmination of the Indus Basin treaty (which spawned development of the large link canals to replace

water in the eastern tributaries now diverted to new lands in India, the large storage reservoirs and the development of groundwater), the Water and Power Development Authority (WAPDA) was developed during the 1950s. This large and capable engineering and construction entity continues at a national level, but under the reorganization responds to the plans and programs authorized and financed by the provinces.

In general, then, WAPDA plans and constructs the major water and power works, the Irrigation Departments operate the distribution systems and the SCARPS and the Agricultural Departments are generally responsible for agricultural aspects of production. Payment for canal water for irrigation is made on the basis of crops harvested and is assessed and collected by the Revenue Department.

With the advent of serious waterlogging and salinity in the 1950s, a Directorate of Land Reclamation was set up within the provincial (then West Pakistan) Irrigation Department. This Directorate could allocate extra water for leaching affected lands. It also has taken a major responsibility in drainage and salinity research. During the decade of the 1960s, coordination of agricultural efforts was effected primarily through the autonomous Agricultural Development Corporation (ADC), but this organization has been discontinued now in favor of the Integrated Rural Development Program presently under implementation.

Since 1949 the Agricultural Engineering Directorate in the Agricultural Department has developed a capability for designing and constructing the smaller tubewells. These are installed under the technical supervision and advising services of a district engineer and are financed from private sources or through Agricultural Bank credit. The Directorate now constructs about 3,000 wells annually using its own equipment on a reimbursement basis. This Directorate also does rough land-leveling designed to bring scattered "uncultivable lands" into a condition where final leveling or "land forming" and irrigation can be accomplished by the farmers. About 900 bulldozers are used in this effort. Farmers are charged an hourly rate for the work, which is subsidized 35 percent by the Government.⁶

The new integrated Rural Development Program is under the Agricultural Department and, as explained for Punjab, has the following responsibilities:

- It will integrate the work of a number of specialized governmental and other agencies engaged in various aspects of agriculture.
- All agencies concerned will be coordinated at a rural "center." Demonstration centers are being implemented in each district of the country (19 in Punjab) as a first step. The approach is stepwise on an experimental basis. A center in the Punjab, for example, will comprise 50 to 60 villages, i.e., 50,000

⁶Information on the Agricultural Engineering Directorate and the new Integrated Rural Development Program was supplied by Majid Hassan Khan, Joint Secretary, Agriculture, Government of Punjab.

to 60,000 acres, more or less. The approach is to involve the people themselves in the development and operation of the centers. There will be a small government nucleus at the centers; a director, a couple of technical assistants and clerical help plus the representatives of the various services, including irrigation. Each village will have a cooperative society and will elect a member to the center "Board" which will govern the operation of the center and lay down policies for the manager.

- Inputs including credit will be made available at the centers, where there will be depots and godowns. Credit is being emphasized and will be jointly supervised involving all of the technical expertise represented at the Center. Emphasis will first be placed on increasing production; then marketing will be tackled. Storage warehouses will be set up.

Participation in the Seminar and Contacts Made

Pakistan has been an enthusiastic participant in the Irrigation Practices Seminars since their inception. The country was host to two of the seminars; the third, held in 1960, and the seventh, held in 1968. The third seminar attracted attention at high government levels. President Ayub Khan opened the seminar and discussed flooding and drainage problems at some length. Governor Akhtar Hussein of West Pakistan; Minister of Agriculture and Irrigation for Pakistan, M. Azam Khan; Mr. Kenneth Vernon, Chief, Public Works Division of the U.S. Mission and U.S. Country Director, James S. Killen, also made major addresses dealing in some detail with problems of irrigated agriculture. Within a few months of the seminar, President Ayub appealed to President John F. Kennedy for assistance in solving the waterlogging and salinity problems. This appeal led to the significant study made by a special White House Panel headed by Dr. Roger Revelle. It is not beyond the realm of possibility that the efforts of the third seminar contributed to President Ayub's decision. The seventh seminar was inaugurated by Acting Governor of West Pakistan, S.I. Haque.

The number of seminar participants from Pakistan, not including American personnel stationed in Pakistan, have been as follows:

Year	Participants	Interviewed
1956	1	0
1958	1	1
1960	14*	3
1962	8	1
1964	0	0
1966	1	0
1968	34*	7
1970	9	3
Total	68	15

*Seminar held in Pakistan.

Two of the delegates attended three seminars and four attended two, thus a total of 60 officials were involved. Four of the delegates were identified as repre-

senting East Pakistan⁷ (one attended twice) leaving, presumably, 56 separate individuals from Pakistan. The number of delegate interviews made by the writer totals 15 in the table, however, one interviewee attended three seminars, and two attended two, making the number of attendees contacted 11. In addition, 14 other officials, many who had participated in planning of the seminars, were interviewed. One USAID representative who had attended seminars was interviewed, bringing the total number of persons interviewed to 27.

Contacting of delegates was restricted due to retirements or assignment to stations outside of Islamabad, Lahore or Karachi, the three places visited. A special, but unsuccessful, effort was made to contact Muhammad Hussain Chaudry, recently retired Chief of Land Reclamation, who attended the last three seminars.

General Evaluation

Mr. A.H. Kazi, Chief Engineering Advisor, Department of Natural Resources, Government of Pakistan and his associate, Mr. Mohiuddin Khan, formerly Engineering Advisor to the Government of Pakistan and Chief of the Pakistan delegation to the eighth seminar both stated emphatically that the seminar helps Pakistan. Both expressed the feeling that they were really worried about the watercourse problem in general and were concerned about the problem of watercourse lining in particular.

Mr. Sarfraz Malik Khan, who received an M.S. degree from Colorado State University in 1953, has spent 16 years with the Irrigation Department and, since 1969, has been Chief, Water and Power of the Planning Commission, Government of Pakistan, attended much of the 1968 seminar. He stated that the 1968 seminar was a useful one and the unanimous opinion was that it was a success. His principal criticism was that there had been no follow-up.⁸ This, and financial support to implement recommendations or to support some of the recommended programs seems essential. He suggested that there should be an international group or panel comprising three members from each country. He does not see how the participating countries, however, could assume the leadership for the seminar and asked the question: If AID doesn't take this leadership, who will?

The group at West Pakistan University of Engineering and Technology, Lahore; Professor and Head, Dr. Nazir Ahmed, Assistant Professor Iqbal Ali, Dean A. H. Qureshi and Registrar Ikramul Haq stated that they had found the seminar useful. For example, some of the techniques implemented in Iran were adopted by the Land Reclamation Directorate. They believed knowledge transfer through the seminar has been significant.

Mr. Sayed Hamid, formerly Chief Engineer, Reclamation for WAPDA and who was responsible professionally as *principal* for the engineering and construction of the SCARPS felt that the greatest benefits of the seminars had been in the preparation of papers, but that the format

⁷Complete information on affiliation was not included for the 1968 seminar, so there could have been others.

⁸The writer's interpretation is "by AID and Pakistan."

should be changed to cover only discussion of two or three topics on which a team of consultants would prepare comments and criticisms in advance. The greatest weakness is in implementation of recommendations, which should be conveyed to the governments by the sponsor and should be reported on at the next seminar. The seminar should meet in the field and discuss the projects examined by the consultants on the spot. Projects should be inspected in at least three countries.

After considerable discussion, the group representing the Irrigation Department, Punjab: Mr. Khablur Rehman, Secretary; Mr. Abdul Latif Mirza, Deputy Secretary; Mr. Saadat Ali, Director Indus Negotiations, Treaty and Regulations, Mr. M.S. Minhas, Chief Engineer and Mr. S.M. Ayoob, Director of Irrigation Research, felt that while the seminar has made no difference in the overall plans, it has had a positive qualitative effect on them. They felt that many more copies of the reports should be printed and circulated. In criticism, they felt that papers should be prepared, circulated, and read in advance and only briefly presented in order to allow more time for discussion, that the seminar should be limited to two or three topics, and that governments should feel responsible to see that recommendations are implemented.

The Land Reclamation Directorate group, Director M. Sadiq Ali Chaudry, Deputy Director Khalid Mahmoud Mian, Soils Research Officer Nur-a-din Chaudry, Economist Fazal Haq Chaudry and Land Reclamation Officer Mahmoudul-Hassan Chaudry stated that there are "...so many problems and assistance is needed. Continuation of the seminar is a must! The country needs both technical and financial assistance."

Dr. A.G. Asghar, formerly Director of Land Reclamation and later Vice Chancellor of the West Pakistan University for Engineering and Technology and co-chairman of the third seminar felt that the seminars give a platform where one can have an opportunity to talk in a scientific way, but in general felt not enough progress has been made on the seminar's recommendations.

Majid Hassan Khan, Joint Secretary for Agriculture, Punjab, who has an M.S. in Agricultural Engineering from the University of Wisconsin, attended the 1968 seminar as an observer, but did not comment on the value of the meeting.

In Karachi, Mr. A. Wahab F. Shaikh, Secretary, Irrigation and Power, Government of Sind and the Deputy Secretary, Mr. A.N.G. Abbas, were joined by Mr. S.A. Aryne, Deputy Chief Engineer Project Planning - South Zone, WAPDA. None had attended the seminar, but were familiar with it and requested copies of all reports. Mr. Shaikh was emphatic on the desirability of the seminar. Most seminars have ignored on-farm irrigation, but whatever is done in providing irrigation water supply is for the real purpose of producing crops. The field is where they grow, and anything that gives attention to this is invaluable. It is of direct benefit where production occurs. While earlier, land and water resources were plentiful, population increase has changed this. "These factors have lead us to focusing attention on on-farm irrigation." In the Sind, the Irrigation Department has implemented

"thousands" of plots where they have persuaded farmers to place a portion of their fields under cultivation using advice of experts and compare results with those obtained on the rest of the farm so farmers then can see the benefits for themselves under their own management and economic constraints.

Mr. Leland Anderson, USAID Pakistan, who has also served in Turkey and in the NESA Bureau in Washington and who attended the seventh seminar held in Lahore as a representative of the NESA Bureau, AID Washington, in trying to evaluate the seminar asked the questions: What would have occurred had there not been a seminar program? What opportunity for international exchange would there be? In Turkey, it was a good educational exercise; in fact DSI (Devlet Su Isleri--Water Resource Development Agency) became equally or more concerned about water management than TOPRAKSU (Soil and Water Conservation Agency).

Topical Evaluation

1. *Establishment of an irrigation and drainage service.*

The Center and the provinces are becoming more aware of this deficiency, which is well understood by the secretaries and joint secretaries. The Agricultural Development Corporation, started in about 1960, included this responsibility in its assignment. With dissolution of this agency, the present government has initiated its Integrated Rural Development Service (described in some detail under section on Administrative Structure). This agency could impact the seminar recommendations. *USAID should provide more copies of the seminar recommendations for study by the Ministry of Agriculture.*

The Integrated Rural Development Service is complemented by the People's Works Program and these two agencies will be created with the help of the local people. One official viewed the Provincial Irrigation Department as the agency having technical responsibility to the Integrated Rural Development Service for on-farm irrigation and drainage service under this arrangement; however, in most cases, officials of the Irrigation Departments viewed this as being the responsibility of the Agricultural Department, although in some areas, the Irrigation Department appears to have assumed this responsibility. Some Irrigation Department officials feel that the irrigator himself is quite effective in handling this matter since water is his main constraining input; improvement is possible in some areas, but in other large areas there is not much room for improvement.

One group felt that education of farmers is the basic problem, but also felt that engineers who understand agriculture are very badly needed. The farmers basic troubles are: 1) Lack of water; this is inherent in the basic design of the canals and the water allowance cannot easily be changed. 2) Distribution troubles in the chak. Water is not distributed as designed and some agency should influence improvement. The outlets are bad also. 3) Farmers need assistance on how best to use water. They need to avoid salinity.

Such an agency needs to be created. When it comes right down to it, "agriculture is a new subject in Pakistan."⁹

2. *Improved coordination between water supply development agencies and agencies responsible for on-farm water management.*

At top level this is done through the departments and heads in the regions and provinces under the coordination of the Planning Commission in the Central Government. It was done for the SCARP projects. At the Central Government level there is a Water and Land Management Board which includes the Irrigation and Agricultural Departments. Formerly at least three agencies were involved, the Agricultural Development Corporation (ADC), WAPDA, and the Irrigation Department. The ADC has been discontinued, but it was in an ideal position to effect coordination. The Irrigation Department regards coordination as a continuing exercise between themselves and the Agricultural Department, but "since the Agricultural Department does little there is little coordination to be done."

Planning is always "done in a hurry." The development of the four provinces requires coordination between national and provincial programs and there should be a coordination committee for this purpose. Coordination between the Irrigation Department and WAPDA is clear cut on the basis of policy. Coordination between these two agencies and agriculture is less so.

At the farm level, the Integrated Rural Development Program is designed to effect coordination at the village and union level. See discussion of this earlier.¹⁰

⁹Writer's comment. Clearly there is a wide range of opinion on the need for increased service under this topic. The Integrated Rural Development Program is recognized as being a major element, but, since it relies on technical agencies, its formation will not create the technical service capability. There is probably considerable validity to the argument that the farmer is doing about the best he can if he receives only the traditional canal water allotment. But where there are new water supply opportunities and drainage infrastructure is provided, there would appear to be a real need for specialized technical service. This is recognized by Pakistan authorities, but the ultimate concept of form and responsibility has not emerged. Very likely this form will vary among the provinces.

¹⁰Writer's comment. Perhaps the intent of Topic 2 has not been too clearly defined. There are several levels of coordination. Allocation of Central Government resources among the programs is done through the Planning Commission. There is also coordination of programs between provinces. The largest gap appears to be between the Irrigation Departments and the Agricultural Departments. In a sense, this appears almost a linguistic one involving the word *irrigation*. On-farm water management is not an Irrigation Department responsibility; conversely, "irrigation" at whatever level is an Irrigation Department responsibility. It is almost as though the word irrigation includes only providing irrigation water supplies. However, in the WAPDA schemes, the Irrigation Department has, in some instances, apparently, taken initiative in on-farm water management. The Integrated Rural Development Program certainly has been conceived to provide not only coordination, but an actual integration at the local level. In conclusion, it appears that there has been improved coordination in top planning, and that successful implementation of the Integrated Rural Development Program, which will require a tremendous effort, could lead to this at the farm level. Little appears to have been done to close the gap between Irrigation and Agriculture.

3. *Education and training of manpower for irrigation and drainage.*

a. *At the university level.*

Agricultural engineering lacks prestige and the curriculum is short on basic irrigation engineering, although it has been lengthened to five years and both irrigation and engineering are now included in the curriculum at West Pakistan Agricultural University. There is a full course in irrigation engineering in the five-year Civil Engineering curriculum at West Pakistan University of Engineering and Technology which includes irrigation practice as well as dam and canal design. A post-graduate course includes additional irrigation practice and drainage and salinity. There has been some university collaboration in short courses for WAPDA. In the opinion of some government officials these courses are just getting started and coordination is lacking between agricultural engineering and other engineering programs. Actually there is widespread unemployment among engineers in West Pakistan and there is a dispute over whether or not the new five-year agricultural engineering graduates qualify for employment in the Irrigation Department.

b. *Improved farmer education programs.*

This is regarded as generally the responsibility of the Agricultural Extension Services at Village and Union Council level and comes under a provincial agricultural officer. It will now come under the Rural Works Program. There is an awakening in the rural areas resulting from commercial advertising on radios, but basic education, including agriculture in the secondary schools, is needed. There are some model reclamation farms and some model farms for rice growers. In the Sind, the Irrigation Department has induced many farmers to try out new techniques on portions of their own farms in order to compare results under "real" farming conditions. Officials of the Department report good results.

c. *Establishment of institutions for training technicians.*

There are a number of polytechnics, but "overseer" graduates are having difficulty finding employment at the present time. These programs range from six months to three years. It is not clear whether or not courses relating to on-farm irrigation and drainage are included. There was some opinion that since the land was level, there was no need to train technicians for land-leveling, but equipment operators were the principal need. This view is not universally held, however. The Dean of the Faculty at West Agricultural Pakistan University has requested that the faculty be trained in land-leveling.

d. *In-service training programs for technicians.*

WAPDA offers some but there are apparently no others. The need is great and efforts should be increased. Officials of the Land Reclamation Directorate particularly emphasized the need for in-service training.

e. *Use of pilot projects.*

A number have been considered; e.g., Mona, which is working on the disposal of saline water. There is a tile drainage project in the Sind. The Land Reclamation Directorate regards these as essential. Chuharkana¹¹ was a

¹¹See report of third seminar, p. 105.

pilot project on land reclamation; but, with implementation of SCARP I it has lost its identity.

f. Farmer training courses.

The Peoples Work Program is replacing the Basic Democracies concept which was concerned with farmers' training courses. The program is dormant now, but the new program will pick it up. Some farmer's courses are going on at Lyallpur (West Pakistan Agricultural University).

4. Development and improvement of distributaries to farms.

There was considerable discussion and confusion about what "ditches" this question related to. In Pakistan, these are the "watercourses" within the "chaks" as discussed earlier.

According to Mr. Kazi, formerly Chief Engineer, WAPDA, the SCARPs have had troubles with the distributaries. One problem is to provide the link from the well to the distributaries, often because of right-of-way difficulties. He stated that "watercourses are the main bottleneck in the SCARPs." Officials of the Punjab Land Reclamation Directorate reiterated this point. On new projects, distributaries are being engineered by the Irrigation Departments. Mr. Sarfraz Malik Khan stated that the mechanism for making improvements would be through the new People's Work Program. Generally, the Irrigation Department felt that operation and maintenance was not a problem because of the incentive of the farmer to insure getting all the water he can. The watercourses are laid out by the Irrigation Department so that all lands are commanded and timing is on the basis of area of land held. The department can condemn rights-of-way for this purpose. WAPDA and USAID are developing a research-demonstration program to see what might be done about improving watercourses. The study will include seepage control as well as other design and operation considerations.

5. Consolidation of fragmented land holdings, optimal field size and farm distribution systems, land-leveling and other on-farm irrigation and drainage improvements.

Pakistan has been doing some land consolidation, but opinion varies on the effectiveness of the program. The Board of Revenue can do this through mutual consent of concerned landholders.

There is considerable rough leveling going on using bulldozers, but landforming is still largely left to the oxen-drawn smoothing board which does not eliminate micro-relief. The need for the fine-type of land-leveling or landforming, using scrapers and land planes to bring to a desired engineered grade is not too widely accepted. The cost is relatively high and would be prohibitive where full water supplies are unavailable. Some experiments by the Punjab Land Reclamation Directorate showed field irrigation efficiency for 1/8-acre plots was 70 percent, decreasing to 50 percent for one-acre plots. Differences were attributed to micro-relief.

WAPDA and USAID are emphasizing a research-demonstration program on land-leveling. One major prob-

lem is the lack of trained personnel to design land-leveling plans.

6. Integrated planning at project level for water supply, distribution works, and farm layout and development.

This has been done under the SCARP projects to some extent. With the formation of the provincial governments this will be the responsibility of WAPDA and the provincial irrigation departments. Water supplies and canal design were said by the representatives of the Engineering University to be based on land classification.¹²

7. Development of farmer organizations, cooperatives, joint companies, private custom services, etc., for on-farm water management improvement.

"Cooperatives have been a complete failure. They are trying the 'Comilla' approach here now ... and the Integrated Rural Development Program may put new life into the cooperative movement. There are informal arrangements within the chak under the canal system and this is probably the best approach here."

"These (arrangements) are badly needed. Cooperatives are not working and their number is small."

"Cooperatives usually are a failure."

"A legal basis is needed and a law is under consideration. The need is recognized, especially if there are to be 'joint ventures' with the government as is now contemplated under the Integrated Rural Development program. This program now visualizes that a cooperative will be formed in each village."¹³

8. Large-scale supervised credit systems for improvement of irrigation and drainage.

The Agricultural Development Bank of Pakistan provides loans for tubewells, tractors, etc., but the degree of supervision given was not clear. There is no credit available for land-leveling. This is done by the government and the cost is recovered. (Presumably the last statement refers to the bulldozer program of the Agricultural Engineering Directorate.) Farmers complain that it is too hard to get loans. Some commentators stated that the procedure was "too complex." On the other hand, a large number of farmers, maybe most, do not understand the use of credit. There is need for a study of the credit program to make it function more realistically, and for farmer education in its use.

Under the Integrated Rural Development Program, credit will be made available, along with other inputs, at the Centers. Availability, according to Majid Hassan Khan, Joint Secretary for Agriculture, Punjab, will be based on

¹²Writer's comment. No real information regarding the way and extent to which agricultural evaluations are integrated into project plans was obtained. This does not mean it is not being done.

¹³Writer's comment. Some minor liberties may have been taken with the quotation marks. The statements are taken as nearly verbatim as possible. Formation of cooperatives has not been highly successful in most developing countries.

technical plans agreed to by the technical experts available at the Centers.

9. *Development of water rights laws; improved use of water by legal or administrative procedures.*

Some of the small canal systems have water rights. Basic legislation is the Water and Drainage Act of 1873 and the Water Development Act of 1963-64. Canal water rights are proportional to the land and the government tubewell rights seem to follow this pattern. Private tubewells can be drilled in SCARP areas only with permission, but none are now being drilled in these areas. Eventually there will probably be legislation on private groundwater development, probably involving licensing. Rights under "civil" canals are recorded in the Revenue Department under the supervision of the Development Commission.

Presently water is delivered on the basis of areas of land holdings. Some consideration is being given to changing this to permit charges on a volumetric basis. An expert from Australia has been making a study of water rights, but his name could not be recalled.

There is, at present, concern about inter-provincial water right allocations. This is a Central Government subject to be decided by the President through the National Assembly (apparently on the basis of studies and recommendations made by representative commissions). Allocation of Indus waters among the interested provinces is a fairly urgent matter. Much needed development, including groundwater and drainage, will await these decisions.

10. *Transfer of distribution systems to farmer organizations. Participation of users in operation and management of systems.*

The water courses are maintained by the farmers. The government comes in if rights of a shareholder are affected or water is wasted due to lack of proper maintenance. Transfer to farmer organizations is not deemed possible in Pakistan, the government owns the canals and the farmer organization is informal and cooperation is mutual. This topic is not considered to be a problem.¹⁴

11. *Inclusion of drainage in development plans and implementation of drainage plans.*

Drainage was originally neglected. Drainage problems in the Sind are extremely difficult. The soils are very heavy and drainage there is difficult. While plans have been made, implementation has been lagging. The general drainage problem hasn't really been solved. A major problem is disposal of drainage water. Some kind of large national system eventually will be needed. While most development plans include drainage, indeed all new projects do, financial resources are a serious constraint to implementation, however. Betterment levies have been used, but yield relatively little revenues. There is a proper drainage "circle" using natural "nullahs" (drainage or

stream channels). Most well projects on the Sind are for drainage purposes. The Sind is salty and water from wells cannot ordinarily be used for leaching and rainfall is much lower than in the north.¹⁵

12. *Intensive cropping and improved rotation practices.*

Intensive cropping has not been as much of a success so far as was hoped. The design intensity for the SCARPS was 150 percent, but only about 110 percent has been achieved so far because of salty water and failure to build the well link channels due to right-of-way problems. Intensive cropping, nevertheless, is being pressed everywhere subject to water availability. Water is the scarce resource now. Where water is available intensity may go as high as 180 percent and there is continuing improvement in Pakistan. This does need to be improved and there should be an agency to advise farmers. The cultivator is always anxious to put more land under crop; the limiting factor is availability of water and this deficiency cannot be made up by increased fertilizer use. Greater intensity is implicit in the plans for the Integrated Rural Development program.

13. *Research.*

a. *Irrigation practices, i.e., farm use of water, best field layout, measuring and controlling water losses, ditch erosion, frequency and amount of irrigation, etc.*

An Irrigation, Drainage and Flood Control Council has been formed. Mr. Kazi is chairman. Malik Sarfaraz Khan is a member. (See appended list of persons visited.) Private sector, Irrigation Departments and the universities are represented. The Council allocates funds, for example, to the Lahore stations (i.e., at the Reclamation Directorate and the Irrigation Department, Punjab). The Agricultural Department has responsibility for crops research, the Irrigation Department does crop water requirements.

Concern was expressed about how best to proceed on water quality and watercourse lining programs. Research is lacking except on the Mona project where there is five years experience. Colorado State University is working on mixing-water problems. West Pakistan Agricultural University and Punjab Land Reclamation Directorate are initiating some irrigation practice research at Lyallpur, and the need for more to be done is recognized. There is a special interest in measuring and controlling losses in water courses. More desirable and less expensive linings need to be developed for all canals. The opinion was expressed that emphasis should be placed on main canals since this is where most of the seepage occurs.

The Land Reclamation Directorate claims a leading role in the research effort in irrigation and drainage.

b. *Drainage, salinity and reclamation.*

This is being done by Land Reclamation which has nine research stations. More is needed especially on tubewells.

¹⁴Writer's comment. This recommendation probably is pretty well in effect under the canal system. It would certainly seem impractical for a farmer organization to operate the canal system and they already have responsibility for maintaining and operating the watercourses.

¹⁵Writer's comment. Certainly drainage problems are well recognized in Pakistan. In fact, the SCARPS were implemented in order to achieve better drainage as well as to increase water supply.

Water quality mixing well and surface waters, etc

Colorado State University is cooperating on research in mixing well and surface waters as is the Land Reclamation Directorate, Punjab. There are some hydraulics problems including the problem of distributing the large streams and bifurcation of streams in the water courses. Availability of hydraulic head is extremely limiting. A report on the economic use of groundwater will soon be completed.

d Soil, water, crop, fertilizer studies.

This is being done at West Pakistan Agricultural University and at centers supported by the Agricultural Research Council. There need to be many more field test sites. The Land Reclamation Directorate is doing some research in this area, but regards it as still in its infancy. It is a new subject to them and help is needed

List of Persons Interviewed

Delegates

- ASGHAR, A.G., retired, formerly Director of Land Reclamation, West Pakistan, later Vice-Chancellor, West Pakistan University of Engineering and Technology, Lahore. 2,3,4.
- HAMID, Sayid, retired, formerly Chief Engineer, Reclamation, Water and Power Development Authority (WAPDA), West Pakistan. 3,7
- MINHAS, M.S., Chief Engineer, Department of Irrigation, Government of Punjab, 3,7.
- REHMAN, Khalilur, Secretary, Irrigation Department, Government of Punjab, 7.
- KHAN, Sarfaraz Malik, Chief, Water and Power, Planning Commission, Government of Pakistan, 7
- ALI, M. Sa'adat, Director, Indus Negotiations, Treaty and Regulations, Irrigation Department, Government of Punjab, 7.
- MIRZA, Abdul Latif, Deputy Secretary for Water and Power, Government of Punjab, 7.
- KHAN, Majid Hassan, Joint Secretary, Agriculture, Government of Punjab, 7.
- KHAN, Mohiuddin, Department of Natural Resources, Government of Pakistan, formerly Engineering Advisor, Government of Pakistan. 8.
- ALI, Iqbal, Associate Professor of Civil Engineering, West Pakistan University of Engineering and Technology, Lahore, 8.
- AHMAD, S. Nazir, Professor and Head of Civil Engineering, West Pakistan University of Engineering and Technology, Lahore, 8.

Others

- ABBASI, A.N.G., Deputy Secretary, Irrigation and Power, Government of Sind.
- ABDULLAH, M., Agricultural Development Commissioner, Department of Agriculture, Government of Pakistan.
- AHMED, Barkat, International Affairs Officer, Department of Agriculture, Government of Pakistan.
- ANDERSON, Leland, Agriculture, USAID, Islamabad.
- ARYNE, S.A., Deputy Chief Engineer, Project Planning South Zone, WAPDA.
- AYOOB, S.M., Director of Irrigation Research, Department of Water and Power, Punjab.
- CHAUDRY, Fazal Haq, Agricultural Economist, Directorate of Land Reclamation, Punjab.
- CHAUDRY, Mahmud-ul-Hassan, Land Reclamation Officer, Directorate of Land Reclamation, Punjab.
- CHAUDRY, M. Sadiq Ali, Director of Land Reclamation, Punjab.
- CHAUDRY, Nur-a-din, Research Officer, Soils, Directorate of Land Reclamation, Punjab.
- HAQ, Ikramul, Registrar, West Pakistan University of Engineering and Technology, Lahore, formerly Engineer, Department of Irrigation, West Pakistan.
- KAZI, A.R., Chief Engineering Advisor, Department of Natural Resources, Government of Pakistan, formerly Chief Engineer WAPDA.
- MIAN, Khalid Mahmud, Deputy Director of Land Reclamation, Punjab.
- QURESHI, A.H., Dean, Faculty of Engineering, West Pakistan University of Engineering and Technology, Lahore.
- SHAIKH, A. Wahab F., Secretary, Irrigation and Power, Government of Sind.
- SHEIKH, Rifat Pasha, Secretary for Agriculture, Government of Pakistan.

CHAPTER 7

INDIA

General Situation

India is a large and complex country and only a brief description can be included here. Population in 1971 reached 547 million in the 19 states that make up the country.

Physiographically, the ancient rock, plateaus, and valleys of the subcontinent itself are separated from the northern Himalayan range (which in itself is complex) by the extensive Indo-Gangetic plains at the foot of the Himalayas. These plains have been built up from the Himalayan sediments filling the enormous trench formed where the subcontinental plate impinged and under-rode the continental Asian plate. Three great river systems, the Indus, the Ganges, and the Brahmaputra, drain from the Himalayas into the plain. In the west, the five major tributaries of the Indus converge in Pakistan, but are shared with India. In Bengal, the Brahmaputra from the east and the Ganges from the west enter Bangladesh where they converge on the deltaic plains of that country. In India, the areal extent of the great plains totals 625,000 sq. kilometers (62.5 million hectares or more than 150 million acres). South of the Great Plains, between the Deccan plateaus and the Great Plains, lie the Central Highlands, a compact block of mountains, hills, plateaus and valleys accounting for one-sixth of the area of the country. The Deccan or peninsular plateaus, form a rough triangle extending 1600 km (1000 miles) north and south and 1400 km (900 miles) east and west with the Arabian Sea on the west and the Bay of Bengal on the east. Along the peninsula's eastern edge are the Western Ghats which average 550 meters (1800 ft) in height. In the south, peaks rise to 2,500 meters (8,000 ft). The main rivers of the peninsula (the Godavari, Krishna, Mahamadi and the Cauvery, principally) rise in the western ghats within 100 kilometers (60 miles) of the Arabian Sea and transect the plateaus flowing eastward to discharge into the Bay of Bengal. The East Coast Belt extends 1000 km (600 miles) along the Bay of Bengal shore with an average width of 100-130 km (60-80 miles). The western coastal belt is much narrower, from 10-25 km (6-15 miles) in width.

The climate of India is likewise variable. The major wind pattern is the monsoon which flows from the northeast generally during the winter months, to be dramatically reversed to the southwest during the summer months. These patterns are modified, largely by the topography, to give wide variations locally. Most, but not all, of the rainfall occurs during the southwest monsoon, (June to September) exceeding 100 cm (40 in.) in the eastern part and extending to 250 cm (100 in.) on the west coast, western ghats, Assam, and parts of West Bengal. Rainfall diminishes rapidly from 50 cm (20 in.) at Delhi to less than 15 cm (6 in.) in the extreme west.

Cultivated Land and Irrigation in India

India's total area is 328 million hectares (about 820 million acres). Estimated cultivable area is about 190

million hectares (480 million acres), 140 million hectares (345 million acres) of which are presently cultivated to provide 163 million hectares (405 million acres) of crops. About 20 percent of the cropped area or 27.5 million hectares (68 million acres) net, received irrigation water by 1968, part of it for two or more crops, making 34 million hectares (85 million acres) gross. About 10 million hectares (25 million acres) (net) were served from government canals. Another 9.2 million hectares (23 million acres) were served from wells, public and private, and the remainder from private canals, tanks and other sources.

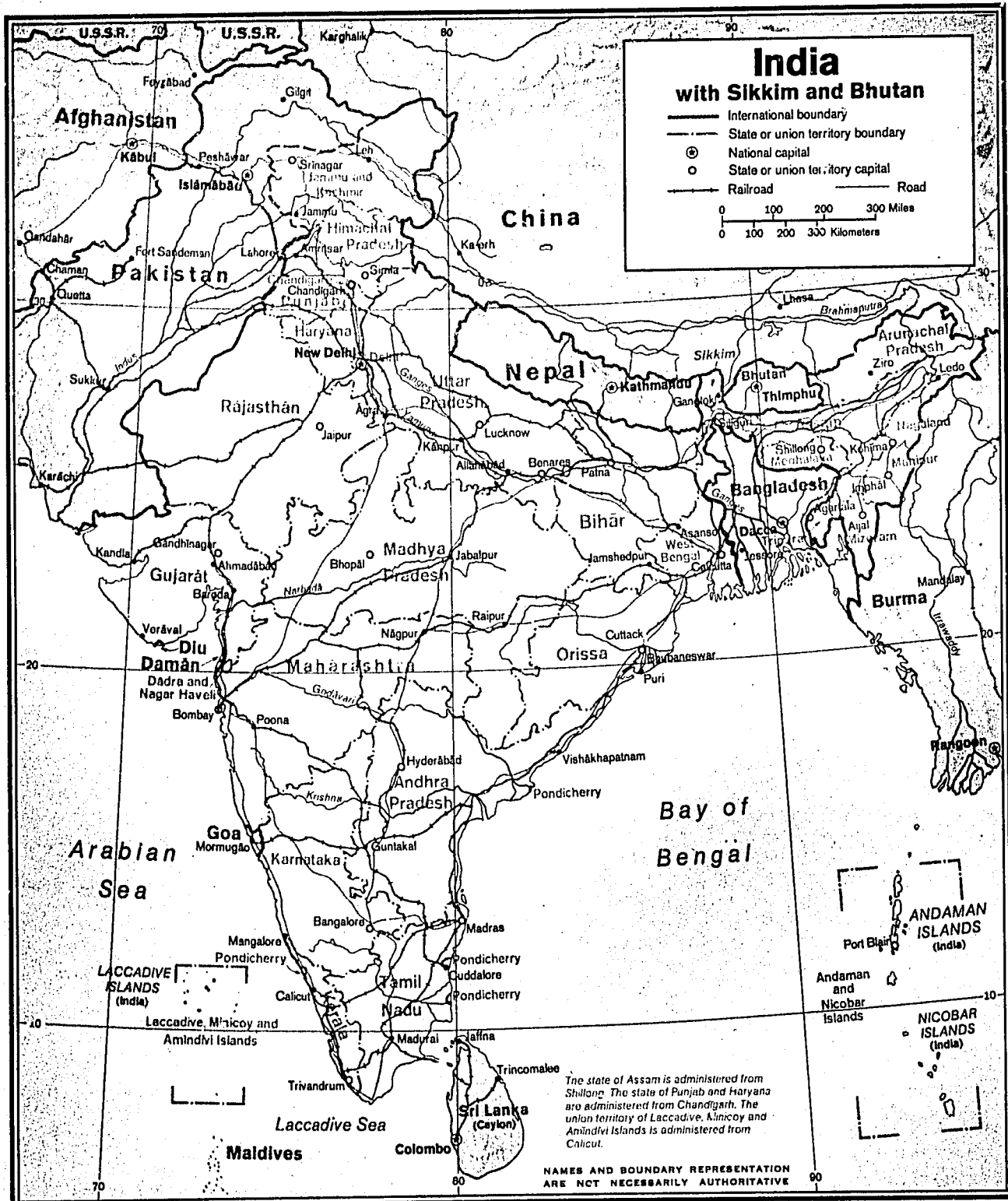
Irrigation has been practiced in India for centuries. Under British rule, public investment in irrigation started in 1836 and accounted for about 7.7 million hectares (19 million acres) out of a total of about 14 million hectares (34 million acres) total irrigated in undivided India by the turn of the century. Of the total, about 35 percent was irrigated by wells. At partition, India retained about 20 million hectares (49 million acres) (net) of irrigated land. At the end of the Fourth Plan (1974), India projects about 43 million crop-hectares (108 million crop-acres) (gross) of irrigation.¹

India estimates its average annual surface water supply as 1680 billion cubic meters (1360 million acre-feet) of which 561 billion cubic meters (454 million acre-feet) can be used for irrigation. About 208 billion cubic meters (168 million acre-feet) were utilized for irrigation by 1969. Total gross area potentially irrigable from surface water is estimated at 61 million hectares (150 million acres). Groundwater potential is estimated at 222 billion cubic meters (178 million acre-feet) annually, which could serve an additional 22 million hectares (55 million acres) (gross).² About half of the estimated groundwater potential is located in the Indo-Gangetic plains.

Use of dug wells for irrigation in India is as old as history. Tubewells have been installed by some states during the past three or four decades and these now total 16,000. Privately-owned tubewells are being installed at the rate of about 100,000 per year, and there are about 600,000 such wells now (1972) in India. By the end of 1969 there were only 266,000. Private tubewells are smaller and shallower than the state-operated wells.

¹Following Indian practice, "gross" irrigated area refers to the total number of crop areas or hectares; i.e., some lands (an increasing proportion) produce two or more irrigated crops per year. References for this and the previous section include: Fourth Plan, Government of India; Eighth NESA Irrigation Practices Seminar, Report; and Report of the Irrigation Commission, Vol. I, Ministry of Irrigation and Power, G.O.I., New Delhi, 1972. 430 pp.

²These are best estimates. The Report of the Irrigation Commission states: "No systematic study of the irrigation potential of the country has so far been made. The few estimates that have been prepared suffer from all the limitations imposed by lack of full information."



Public expenditure for irrigation in India during the late 19th century was, in large part, to insure against recurring droughts and prevention of famine; projects were regarded as either "protective" or "productive" depending on the purpose. Emphasis under the various plans beginning in 1950 has been on "productive" schemes. Much of the land irrigated produces crops under rainfed conditions. Irrigation increases the yield and also the number of crops that can be grown by making water available during the dry season. Principal irrigated crops are wheat and rice. Some pulses, oilseeds and cotton are irrigated. Nearly three-fourths of the sugar cane receives irrigation.

Canal irrigation systems in India, designed many years ago, are often inadequate for supplying the water needs of high-yielding crop varieties. Difficulties stem from a number of factors, not the least important of which is the highly variable flow in the rivers, which is not concurrent with needs, and lack of storage reservoirs. These difficulties were recognized by the Irrigation Commission and steps were recommended for correction by providing reservoir storage where feasible, modernizing diversion and distributary works, and supplementing surface water with groundwater supplies. These revisions are generally difficult, not only because they may be costly, but because of physical considerations as well. While frustrating to agriculturists, the realities and immensity of the task of improvement of the basic water supply are frequently overlooked.

Field channels and distributaries often present problems also. Normally, the government will construct distributaries from canal outlets to blocks of land of perhaps 40 hectares (100 acres) size. Farmers then construct field channels to distribute water to the fields. In many instances construction of field channels has not been satisfactory and lack of channels has been an important factor in contributing to inefficient utilization of canal water supplies. In rice areas, separate field ditches rather than field-to-field distribution has been shown to increase yields significantly. In some cases state governments have taken on construction of field channels at their expense in order to expedite irrigation.

The need for land-shaping is widely recognized in India. If excavation is not excessive, this may be accomplished with resources directly at the farmers disposal. In other cases, varying project by project, credit for obtaining services of tractor-drawn equipment is necessary. In the Nagajunasagar project, the Reserve Bank estimates that credit will have to be made available for shaping 50 percent of the land. Land-leveling may be done with head baskets for about the same cost as with machinery, but takes longer and fields may have to be out of production longer. On "black-cotton," (heavy clay) soils cost is 1.75 to 2.00 Res/cubic meter. Sand dune leveling in Punjab costs 1.00 to 1.50 Res/cubic meter.*

*July, 1972 exchange rate, 7.60 rupees per U.S. dollar.

Administrative Structure

Development of water resources in India is a State function. The Central Government develops policy, integrates planning and shares financing. On some large developments, special authorities may be created. At the Central level the Ministries having primary responsibility are Agriculture, and Irrigation and Power. In the Ministry of Agriculture the functions of water management, soil conservation, minor irrigation, and groundwater development have been brought together under a single Joint Secretary directly under an Additional Secretary for Agriculture. Minor Irrigation and the Central Groundwater Board are organized under a Deputy Secretary. The Joint Commissioner for Minor Irrigation is a member of the Central Groundwater Board. Water Management and Soil Conservation are set up under a single technical head responsible to the Joint Secretary.

The Central Water and Power Commission (CWPC) is organized under the Ministry for Irrigation and Power and has central planning and engineering responsibility for evaluating water resources and for irrigation and power development. The international aspects of the Indus and the Ganges are handled by the Ministry as is the Central Board of Irrigation and Power. State organizations may vary, but are similar in that there are generally secretariats for agriculture and for irrigation although details may vary. It is the Irrigation Departments' responsibility to deliver canal water to the "block." Agriculture Departments have responsibility for agricultural inputs and, except in one state where it is under the Irrigation Department, groundwater development. As mentioned previously, some states also have developed tubewell programs using deep wells.

Irrigation developments are classified as major and medium works, and minor programs. Major and medium schemes are under the Irrigation Departments and are developed jointly by the states and CWPC. Minor works are under the Agriculture Ministry in the Central Government and include groundwater development. Small projects, 40-80 hectares (100-200 acres), are carried out by State Departments of Agriculture. Minor works are defined as those costing less than Res 1.5 million. In 1969 about 53 percent of India's irrigation was accounted for by minor programs. Fourth Plan (1970 through 1974) targets run close to 1.4 million hectares (3.5 million acres) gross of additional irrigation to be added annually, a little less than half under minor irrigation. In the summer of 1972, there was a sustained period of drought during the wet monsoon season. This has led to consideration of accelerated efforts in the development of small irrigation projects. While credits are supplied for minor irrigation, these are fully repaid by the beneficiaries.

In about 1965, India initiated a program known as the "Command Area Development Program." This program was set up in order to increase or accelerate the utilization of land under irrigation canal commands. In 1963 a Joint Working Group of the Ministries of Food and Agriculture and Irrigation and Power observed "that only about half the irrigation potential available at the outlets from the Major and Medium Irrigation Projects was being utilized at the beginning of the Second Plan."

Utilization is now estimated at 81 percent. The Command Area program was initiated in some of the large river basin projects in order to stimulate higher utilization. These are implemented only where water supplies are adequate and include grants for infrastructure development and promotion of intensified agriculture utilizing credit. Items emphasized include soil survey, land-leveling, irrigation practices and drainage, land consolidation and agricultural diversification, as well as roads and markets. Ten of these projects are underway under the Fourth Plan, and may be completed in the next five years, although some are very large and may take longer. Grants are Rs 15 million for each project. Six additional projects are contemplated for the Fifth Plan period. This program has International Development Association (IDA) backing, but some projects require only a small component of foreign capital.

Similar to, but not tied to major project financing, are plans for extending the Pilot Project program. There are three of these at present, initiated cooperatively with USAID. According to Joint Secretary B.B. Vohra, this number has now been expanded to 25 under the Fourth Plan and will be increased to 50 under the Fifth Plan. Attention is now being given to groundwater law and legislation for groundwater is being drafted.

Problems of On-Farm Water Management

The problems of on-farm water management are well summarized in a recent article by N.D. Rege,³ Joint Commissioner, Soil Conservation and Water Management in the Central Ministry of Agriculture. Rege states that of a potential of 13.7 million hectares (34 million acres) in major and medium irrigation schemes estimated for the end of the Fourth Plan (1974), 11.7 million hectares (28.9 million acres) are expected to be utilized, i.e., actually receiving water. This does not necessarily mean that water made available has been efficiently utilized. Rege gives the primary reasons for poor utilization of water as:

1. Lack of coordination between Departments of Irrigation and Agriculture at the time of formulation of the projects.
2. Failure to carry out adequate soil surveys and classification of soils and land to determine their suitability for irrigation.
3. Absence of field distribution systems, water courses, field channels and drainage facilities.
4. Failure to reduce seepage losses from distribution systems.
5. Failure to formulate cropping patterns based on availability of soil and land characteristics.
6. Failure to get land leveled or shaped so as to make the water spread evenly.
7. Absence of other infrastructure facilities, such as provision for roads, marketing, credit, etc.
8. Lack of proper extension services.
9. Lack of group activity.

As the result of lack of coordination between agricultural and irrigation departments, Rege states

³Rege, N.D., Soil and Water Management Problems in India. Indian Farming, May, 1972.

Whenever an irrigation project is formulated, the main emphasis is still on the engineering structures such as dam, canal and distributaries up to the outlet. Beyond this outlet, the responsibility is of the cultivator to distribute the water. The cultivator is supposed to be guided in this by the Department of Agriculture. By and large, the Departments of Agriculture have not been able to discharge this responsibility fully. The distribution system beyond the outlet has always remained the missing link between the outlet and the field, and, in many cases, over a long period. The project is thus defective because of the working of these departments in isolation.

Rege points out that the design of the canal system is based on topography, while water needs are the result of soil characteristics and crops. As a result the system "suffers from its inadequacy to supply water in required quantity and at a time when the plant needs it most. Hence application of irrigation water becomes more of a ritual."

Recently the World Bank, while agreeing to loans for Mahi-Kadana project in the State of Gujarat, suggested that "in order to ensure timely construction of water courses and field channels, *their construction should be undertaken by the Government as a part of project work*—the cost may be recovered through appropriate increases in water charges."

According to representatives of the Central Water and Power Commission consideration is being given to providing water courses serving farms and fields as part of projects although the primary mission remains development of water supply. The Agricultural Ministry now has responsibility for project review and Irrigation Departments utilize soil survey capability of Agricultural Departments in developing project data.

Rege also cites the problem of seepage losses, pointing out that studies indicate that only about 40 percent of the water delivered at the canal head reaches the field. With regard to land-leveling, Rege states that demonstrations show that fine leveling can save as much as 15 to 20 percent of water. According to Rege, one of the reasons farmers do not adequately shape their fields is lack of proper equipment and availability of credit. At present, most land-leveling is done by heavy duty bulldozers which increases the cost considerably; however, recently it has been proven that a proper combination of dozer, scraper and land plane, tractor, etc., can substantially reduce the cost of leveling.

Leveling is expensive and the writer feels that it probably cannot be afforded unless there is opportunity for intensive agriculture, which means an adequate water supply. CWPC representatives stated that "policy is *extensive* irrigation in the desert and to give emphasis to maximum number of people rather than primarily to production." This is gradually shifting; for example, the Sandurnagar project, which was originally set at 20 percent intensity is now planned for 70 percent. "Wherever sufficient water has been made available, things are better. There isn't much change if water is inadequate."

CWPC representatives felt that attention particularly needs to be given to rice irrigation. Many soils used for rice are unsuitable. They may be too light and result in waterlogging. "Rice is a 'status' crop."

The concern with under-utilization of irrigation potential and the problems leading to it are well summarized in a paper by B.B. Vohra, Joint Secretary, Ministry of Agriculture, entitled "Development of Common Areas of River Valley Projects." A copy of this paper is appended to this chapter.

M.A. Quraishy, Additional Secretary of Agriculture, pointed out that one of the pressing problems is integration of groundwater and surface water. Most groundwater development is coming through financing by private sector banks and farmers' savings. The 16,000 state tubewells cost something over 100,000 rupees each and serve from 200 to 400 acres. They are managed by the Irrigation Departments and suffer from some of the same problems of distribution and management as canal services.

With the integration of minor irrigation, groundwater, and soil conservation and water management and the formation of the Central Ground Water Board in the Ministry of Agriculture, the already accelerated development of private tubewells, in contrast to state wells, will probably continue. In a paper "Ground Water Comes of Age," B.B. Vohra⁴ outlines the potential and advantages of groundwater usage. Vohra states "according to all indications there are no signs of any slackening in the tempo achieved in groundwater development during recent years—if anything, the rate of growth might in future exceed that which has been registered in the past." Vohra points out that:

...it was no accident that the Green Revolution should have first taken root in precisely those regions—the alluvial plains of the North West and the deltaic plains of the South—where groundwater is not only most readily available but also has been tapped for irrigation to the greatest extent. For if there is one thing the new high yielding varieties and multiple cropping systems demand more than anything else for their success, it is water—water at the right time and in the right quantity. This is a requirement that can be met only by a source of irrigation that is completely under the farmer's own control—no surface irrigation system (in India) can even remotely hope to compete with ground water in this respect.⁵

According to a study made by J.K. Jain,⁶ Joint Commissioner, Minor Irrigation, Central Government, it has been demonstrated that the Green Revolution (for wheat) in India has occurred only where groundwater is available.

The government has decided⁴ to provide massive-scale farm loan finance for on-farm groundwater development. The total cost of an individual groundwater project seldom exceeds Res 10,000; state tubewells, which tap deeper aquifers cost in excess of Res 100,000. Vohra points out:

A well or tubewell takes little time to construct, begins to operate as soon as it has been completed and starts yielding returns within a single crop season.... Having sunk his own money in the project, and knowing he will have

⁴Vohra, Shri B.B., *Ground Water Comes of Age. Some Policy Implications*. Ministry of Agriculture. Offset Press. New Delhi. January, 1972. 8 pp.

⁵Parentetical insert is the writer's.

⁶Personal communication.

to bear the full cost of operating it, the farmer is naturally anxious to make the best use of his investment. This impels him to carry out land leveling and other farm improvements with the maximum expedition and at his own cost as well as to use fertilizers and other inputs in the recommended manner. As a result he achieves significantly higher yields right from the very first crop after the completion of his project.

During the Fourth Plan period (1969-1974) total investment in groundwater development is likely to be Res 20,000 million not including an additional Res 7,500 million for electrification. The figure for surface water development is Res 11,000 million.⁴

Exploitation of groundwater supplies on the scale now apparently foreseen will raise a host of technical, administrative, and legal questions. Response to these is still in the very early stages. Vohra's paper identifies a number of public considerations that will need a great deal of attention.

The movement to intensify agriculture in India utilizing irrigation appears to pose a difficult dilemma. There is really no viable in-between solution. If intensification is to succeed, all of the inputs must be available or the farmer will be worse off than before. In desert areas where land is in excess with regard to irrigation water supply, under-irrigation, maximizing production per unit of water, may well be the logical course. Moreover, the problem of operating the canals in order to provide exactly the water supply a farmer needs when he needs it, involves a great deal more than the intractability of irrigation engineers. Run of the river supplies do not match crop needs and the potential for reservoir storage is quite limited. Revision of canal systems will not solve this problem. Redesign of canals to provide full supply at minimum river flow would greatly reduce the area commanded. A great deal of water could be saved by canal and ditch lining, but this would be expensive. Fine land-leveling likewise is costly and probably will not pay unless full intensification is possible. Regardless of the shortcomings of distribution systems and the inefficient use of water due to lack of land-leveling, the writer would strongly question heavy investment in inputs for intensification *except* where a *full water supply* is clearly in the offing.

Participation in the Seminar and Contacts Made

India has consistently supported the NESAs seminars and has been diligent in preparation of papers and discussions even though the number of participants sent in some cases was necessarily small. The Fifth NESAs Seminar was held in New Delhi in 1964 under joint GOI and USAID sponsorship. High-level attention was given to this seminar and addresses were made by G.M. Kamat, Secretary, Department of Agriculture; USAID Director, C. Tyler Wood; Dr. K.L. Rao, Minister for Irrigation and Power (Dr. Rao still holds this post), and Sardar Swaran Singh, Minister for Food and Agriculture. At this seminar, India took advantage of the opportunity to invite, not only delegates from the Central Government, but high-level representatives from the state Agricultural and Irrigation Departments also. In this latter category, 28 representatives from 14 states attended.

The number of participants from India, exclusive of USAID personnel, have been as follows:

Year	Participants	Interviewed
1956	2	0
1958	3	1
1960	2	0
1962	2	0
1964	38*	2
1966	5	3
1968	3	0
1970	5	3
Total	60	9

*Seminar held in New Delhi.

Four delegates attended twice and one, three times, making a total attendance of 54 individuals. Because one of the persons interviewed had attended two seminars, the total number of interviews of ex-delegates was eight. As near as could be ascertained, only nine ex-delegates were available in New Delhi. One could not be contacted and a second failed to keep his appointment. One of the state delegates to the fifth seminar was in residence in Kabul as UN Representative and was interviewed there. In addition to the ex-delegates, two other interviews were held. These were with B.B. Vohra, Joint Secretary, Ministry of Agriculture, who heads the Soil Conservation and Water Management wing in the Central Government and with S.K. Jain, Chairman, Central Water and Power Commission. At the time of the writer's visit, USAID was in the process of phasing out its technical assistance program in India and communications were sometimes rather difficult due to this disruption.

General Evaluation by Participants

According to J.K. Jain, Joint Commissioner, Minor Irrigation, Ministry of Agriculture, who attended the fifth and sixth seminars, the seminars have helped a great deal in generating a climate whereby agricultural irrigation became of interest. A lot of thought went into the seminars. These highlighted the problems, particularly those of the farm. They helped identify a whole field to which much thought had not been given previously. The 1964 seminar led directly to the "Command Area Development Program."

"A great deal has been done in the development of groundwater supplies, but on-farm water management was lacking. State officials are now much more conscious of these problems. The seminar did help in arousing this consciousness and was very much worth the effort. Since 1964 there has been good development of soil and water management. The Soil and Water Management Division has been created in the Ministry of Agriculture and some pilot projects have been taken up. A number of documents have been prepared.

"The knowledge is available to improve on-farm water management, but the infrastructure problem hasn't been solved although there has been lots of change in India. Nineteen sixty-five was the watershed of agricultural development in India."

Jain felt the seminar should be held not oftener than every four years and that the International Commission on Irrigation and Drainage (ICID) was not the proper agency to lead the seminar.

A meeting was held jointly with Mr. J.K. Naegamwala, Member of the Central Water and Power Commission in charge of Planning and Progress, who attended the eighth seminar, and Mr. S.K. Jain, Chairman of the Commission. They felt that energization toward the problems discussed by the seminar is coming from several sources including the seminars and all of these tend to excite action. Other sources are the World Bank, UN, etc. The seminar is complementary to these; like the meetings of ICID, it causes an impact. The main burden of implementation of irrigation agriculture is on the Agriculture Ministry.

Dr. N.D. Rege, who also attended the eighth seminar, heads the technical organization of the Soil Conservation and Water Management programs now unified under a single joint secretary in the Ministry of Agriculture. He stated that the delegates have always felt that the NESA seminar was one of the best and should be continued. This was the reason that the Kabul (eighth) seminar made a specific recommendation. It felt there should be a continuing secretariat to look after the seminar.

"The seminar has had pronounced effects in the following sense:

"Delegates have been made to understand the technological progress in different aspects of water management in differing situations. Among the many ways it has helped India are:

- a) Ideas on the way work may be planned;
- b) How participation of the beneficiaries can be obtained;
- c) Exchange of notes on difficulties and problems. In this respect, it has been very good.

"Presently the technical background is wrong. We look at it from two points of view: 1) where water (supply) is not a problem, but its use may create certain difficulties; 2) where water supply is a problem. We need more efficient utilization in our semi-desert climate."

The seminar should be formulated around working papers for discussion rather than on reports as in the past. There should be more opportunity for discussion. Dr. Rege would like to see a permanent secretariat, but a rotation arrangement among the countries backed by a full-time expert with understanding of the problem backed by USAID or someone else, but also to which all participants would contribute financing. The secretariat should keep in touch with all countries and also see if decisions are implemented properly. Unless member countries take part in management there will be no interest. The secretary could be from the host country, but the expert could be located anywhere.

Three arguments were advanced by A.B. Joseph, Commissioner for Engineering, Water Management (Technical), and Y.P. Bali, Commissioner for Engineering,

Soil Conservation (Technical), who attended the sixth (1966) seminar in Jordan, in positive evaluation of the seminar. These were:

- 1) Gain by discussions with other delegates when new things occur.
- 2) It causes a stock-taking and appraisal.
- 3) One sees new ideas under different conditions.

Joseph felt that the seminars should cater more to technicians than to administrators, but Bali pointed out that they have administrative as well as technical problems and that how to get things done is as difficult as knowing what to do. Joseph felt that a number of participants were people in charge of engineering works who were not in a position to implement recommendations. The "irrigation" engineers do not take into account peak requirements, but only averages when designing distributaries. "We have advanced since the last seminar. Here we presented what our approach would be, now we are implementing that approach."

They would like to see more of a continuous effort as far as the seminar is concerned. The seminar provided a chance to see other projects in developing countries. "It is hard to make a politician believe that we can do things just because they are being done in developed countries. If they are being done in other developing countries, then our politicians will believe they can be done in their own countries, too."

Mr. Bal Ram Shori, Member for Resources and Planning of the Central Water and Power Commission attended the second (1958) seminar. He felt the seminar had been useful but that the agricultural people should know to what degree.

Mr. M.A. Quraishi, Additional Secretary, Ministry of Agriculture, included Dr. Rege and Mr. Jain in the discussion. Quraishi, in contrast to the other delegates interviewed, is within the administrative service (Indian Civil Service) rather than the technical service, which means he has generalist training. He attended the eighth (1970) seminar as head of the Indian delegation. Secretary Quraishi stated that that seminar had a distinct and significant effect in bringing the present program in soil conservation and water management about. One benefit is "we learned it could be done." Likewise, other countries were greatly interested in India; i.e., they gained ideas from our experience. (In India) the basic things that were being neglected are now being implemented and are pushed in place of short-term, less basic programs.

Mr. Quraishi's experience illustrates the value of having participation of high-level people in positions to influence policy attend the seminar, jointly with technical people.

Topical Evaluation

Generally, Indian officials felt that actions had been taken to respond to all 13 of the questions designed for topical evaluation, and that all were very much in

"focus." Generally, these topics were covered by the paper by Joseph, Gupta, and Gandhi, "Planning and Designing for Optimum On-farm Water Use" (Eighth Seminar Report, p. 223). Where specific comments were made, these are summarized below. No attempt has been made by the writer to make interpretations based on other evidence than the direct responses received although some inferences could have been drawn from other sources.

1. *Establishment of an irrigation and drainage service to provide technical assistance at the farm level for on-farm water management.*

Action is being taken. It still is in the pilot stage. We do not have a technical service for irrigation and drainage in the sense that we have one for soil conservation.

2. *Improved program coordination between water supply development agencies and agencies responsible for on-farm water management.*

Action is being taken. No irrigation project is approved any longer without approval of the Ministry of Agriculture which sees if water is adequate, if soil and water table levels are satisfactory and that a land development plan is included. These reviews are made by the staff of the Soil Conservation and Water Management Division. Water requirements for crops are computed.

Each state has a soil survey which supplies soil data. Except for the states of Gujarat and Maharashtra (where they are in the Irrigation Departments) these services are in the Agricultural Departments and are loaned to the Irrigation Ministry. Guidelines and uniformity have been built into the procedures.

There is a strong need to consider integrated operation of surface and groundwater supplies.

3. *Education and training of manpower in irrigation and drainage.*

- a. *Irrigation and drainage courses at the university level for engineers and agriculturists.*

Action is being taken. At the university level, soil and water management has been introduced into agricultural engineering, but not much into civil engineering. A number of universities have started irrigation and drainage courses.

- b. *Improved farmer education programs for on-farm water management through extension services.*

No comments.

- c. *Establishment of institutions for training technicians in irrigation and drainage and related service.*

Action is just being formulated and is likely to be taken shortly. There are very few technicians who can do planning at the farm level. These are being trained on the pilot projects. Two institutes, one post-graduate, will be set up. Institutes are planned for equipment operators. Some of these were started in connection with the heavy construction programs and one is being taken over for land development. Field supervisory people will be trained in the same institute.

d. *In-service training programs for technicians in irrigation and drainage and related service.*
Action is being taken.

e. *Use of pilot projects for new developments or for rehabilitation of older developments.*
Action is being taken.

f. *Farmer training courses.*
This is being done in part on pilot projects and under extension.

4. *Development of the elements of the distribution system actually serving the farm units. (Variously termed tertiary or quaternaries, water courses, or minors.)*

This is being taken up on a large scale. The Agricultural Refinance Corporation are working on this and have made an effort. Schemes have been sanctioned.

5. *Improved farm-field management for irrigation and drainage. Consolidation of fragmented holdings, optimal field size and distribution systems land-leveling (land-forming), etc.*

This is being taken up now. On land-leveling, machinery is being used—scrapers, land planes, and even bulldozers. Increasing use of machinery for land development and water courses is foreseen. Attempts are being made to develop machinery units and to build equipment locally. There is a considerable awakening and “you will see a tremendous change in two years.”

We are not very far yet. These are now being attempted on a number of large projects using recoverable loans as a means of financing. Our credit system has been strengthened.

Because of the high cost of land-leveling, we (CWPC) are only going to do a few projects. An additional five maunds/acre⁷ production is attributed to land-leveling.

6. *Integrated project planning of water supply and distribution works and farm development.*
Yes, being undertaken. Hasn't gotten very far.

7. *Development of farmer organizations, cooperatives, joint companies, private custom, etc., for on-farm management activities requiring joint action.*
“This is not successful yet but is being undertaken.”
“Has not been successful.”

8. *Large-scale supervised credit systems or programs for improvement of irrigation on the farm and distributary systems serving the farm units.*
“Credit is in the Ministry of Agriculture” (CWPC).
“This program is very much underway through different banks” (Ministry of Agriculture).

9. *Development of water rights laws and improved water use through administrative procedures.*
“India is drafting legislation on groundwater.” “Partly taken up; maybe will move ahead in about a year.”

ECAFE has helped with water laws. This is a field in which there has been considerable recent activity.

10. *Transfer of distributaries or water courses to farmer organizations. Participation of users in operation and management of distribution and water course systems.*

“Not yet succeeded. We are trying our best.” “This has been difficult. Fourteen pilot projects are underway and there'll be 11 more by the end of the year.” “States now have laws making it possible to obtain rights-of-way for field distributaries or water course.”⁸

11. *Inclusion of drainage in development plans and implementation of drainage works.*

“Yes.” “Very much behind in drainage. We are producing technical design information and also putting out a drainage handbook.” It has been suggested that CWPC increase its capacity for dealing with drainage.

12. *Intensive cropping and rotation practices.*

“Yes.” “The Water Technology Center is working on this. We have to go ahead with intensive cropping and we now have a multiple cropping program.”

13. *Research.*

“This has been taken up by the research department and we are getting some data back.”

“Research is carried out in the agricultural universities” (CWPC).

List of Persons Interviewed

Delegates

SHORI, Bal Ram, Member, Water Resources and Planning, Central Water and Power Commission, 2.

JAIN, Jagat K., Joint Commissioner, Minor Irrigation, Ministry of Agriculture, Member of Central Ground Water Board, 5,6.

RAHMAN, M.A., United Nations Project Manager, Water Management, Kabul, Afghanistan. Formerly Chief Engineer, Public Works Department, Andhra Pradesh and Member, Central Water and Power Commission, 5.

JOSEPH, Ambooken P., Deputy Commissioner of Engineering, Water Management (Technical), Ministry of Agriculture, 6.

BALI, Y.P., Deputy Commissioner, Engineering, Soil Conservation (Technical), Ministry of Agriculture, 6.

QURAIISHI, M.A., Additional Secretary, Ministry of Food and Agriculture, 8.

NAEGAMWALA, J.P., Central Water and Power Commission, 8.

REGE, N.D., Joint Commissioner, Soil and Water Management, Ministry of Agriculture, 8.

Others

JAIN, S.K., Chairman, Central Water and Power Commission.

VOHRA, B.B., Joint Secretary, Ministry of Agriculture.

⁸Writers comment. Actually farmers have been responsible for this function traditionally. Organization and effectiveness has been less than adequate.

⁷One maund is 82 pounds.

**DEVELOPMENT OF COMMAND AREAS OF
RIVER VALLEY PROJECTS**

Presented by
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Joint Secretary,
Government of India

Ministry of Food, Agriculture, Community Development & Cooperation
(Department of Agriculture)
New Delhi

Ministry of Food, Agriculture, Community Development & Cooperation
(Department of Agriculture)

SUB : DEVELOPMENT OF COMMAND AREAS OF RIVER VALLEY PROJECTS

I - INTRODUCTION :

The under-utilisation of the irrigation potential created by Major and Medium Irrigation Projects has been a source of concern to the Government of India ever since the early sixties. The Joint Working Group of the Ministries of Food & Agriculture and Irrigation & Power which was set up in 1963, under the Chairmanship of the then Secretary Agriculture, to examine this problem observed that "only about half the irrigation potential available at the outlets from Major and Medium Irrigation Projects was being utilised at the beginning of the Second Plan". The latest available figures of utilisation (upto the end of 1968-69) are given in Annexure I and show that the percentage of utilisation has reached as high a figure as 81. However, this figure should not give rise to any feeling of complacency, firstly, because the unutilised potential is still as high as 40 lakh acres and secondly because figures of potential utilised do not reflect the efficiency with which irrigation is in fact being carried out. In this connection, it needs to be emphasized that the engineering concept of water utilisation merely represents the area of surface to which water has been applied and does not take account of the needs of crops grown in respect of the quantity and timing of irrigation. Thus, areas which suffer from waterlogging as a result of the application of more water than they can hold as well as areas which might receive only a couple of waterings in a season and

even these at timings unsuitable from the point of view of crop growth are equally categorised as areas in which the potential has been "utilised". As has been separately mentioned in a note on Water Management, we should not be content even with 100% utilisation of potential in the above sense but should aim at making the optimum use of water by adopting cropping patterns and irrigation practices based on a careful study of water requirements of crops in the particular soil and climatic conditions of any given area.

However, even after the best possible use has been made of available water resources, the development of a command area will depend upon the extent to which the necessary agricultural inputs, services and infra-structures can be made available to it. Finally, attention must also be given to the maintenance of the storage on which the command area depends for irrigation. It would obviously be extremely short-sighted to concentrate on the development of command areas while neglecting the health of the catchment areas which contribute the silt which threaten the life of our dams.

In the paragraphs that follow, an attempt has been made to consider each of the four ingredients of planned command area development in some detail before discussing certain issues of policy.

II. - UNDER-UTILISATION OF POTENTIAL

3. The causes of under-utilisation of the irrigation potential created by river valley projects spring from the bare fact that, by and large, these were conceived primarily as engineering works and enough thought was not given during their planning and execution to the needs of agriculture. The three most important

deficiencies which have come to light during the examination of individual projects where utilisation has been most unsatisfactory are as follows :-

(a) Failure to construct water courses in time :

The Joint Working Group observed as follows :-

"The excavation of field channels and the completion of appurtenant structures did not often synchronise with the construction of dams, canals, minors and distributaries. The field channels thus remained the missing links between the outlets and the fields in many cases, for unduly long periods."

A typical example of this default is to be found in the Chambal Project which was completed about 10 years ago and was recently inspected by a Joint F/O-UNDP GOI Team of Experts led by Sir Joseph Hutchinson. The Mission has reported as follows :-

"When the canals were put in, construction was limited to main canals and major distributaries. No designs or layouts were prepared for the field network and this was left to the farmers. In consequence, the field distributaries in without order or system and losses from it are great. The design was implemented up to the minor canal stage by the construction engineers, but few regulators were provided, either for the minor canals or for the field channels. The field channels were left to be installed by the farmers. No investigations were carried out and no plans or instructions were provided for them."

Again this is what the World Bank had to say about the Mahi-Kadana Project in Gujarat in 1969 :-

"The project was started in 1954 as a run-of-river scheme. While the major works related to this phase of the project were completed in 1959, progress on the distribution systems has been slow largely because of inadequate funding. Works completed to date include the Wanskarbori Weir, a lined main canal and a distribution system capable of serving about 143,000 hectares in the Right Bank area. The area actually being irrigated however is only about 10,000 hectares primarily because of delay in construction of water-courses and field channels."

While agreeing to the loan request, the World Bank has insisted on timely completion of water courses and field channels and has observed as follows :-

"Often in the past, permanent irrigation outlets and water-courses have been installed in Indian irrigation projects long after completion of the minor canals, thereby unnecessarily deferring irrigation benefits. Also, outlets have frequently been located so that they serve too large an area for efficient water distribution. To provide for better distribution and to achieve early benefits from the projects, permanent outlets serving areas no larger than 25 hectares should be constructed before each minor canal is commissioned. The locations of outlets should be determined jointly by the Irrigation Department, the Department of Agriculture and the farmers. In order to ensure timely completion of water-courses and field channels, their construction should be undertaken by Government as a part of the Project works -- the cost would be recovered through appropriate increases in the water charges."

(b) Failure to carry out adequate soil surveys and to provide drainage systems, where necessary.

Soils which are heavy and comparatively impermeable require drainage if serious damage by waterlogging and salinity is to be avoided. It is, therefore, necessary to carry out a survey of the irrigability characteristics of soils of command areas before designing distribution and drainage systems. Experience has, however, shown that in many cases sufficiently detailed soil surveys were not carried out before introducing irrigation waters. In at least one case, namely Chambal, soil surveys were carried out prior to the construction of the Project, but the dangers pointed out by them were ignored by the Irrigation authorities responsible for the construction of the Project. The Hutchinson Report observed as follows :-

"Soil surveys were carried out before the irrigation scheme was built, and it is quite clear from the reports that the two major problems of the scheme, waterlogging and salinity, were foreseen, in particular, the need for a well conceived drainage system, executed and operative

before irrigation water was applied, was apparent to the reader of the soil survey reports. No drainage was included in the plan although it was known that waterlogging and salinization were major hazards in the scheme. Against the gains of irrigation must be set serious losses of land through waterlogging and salinization. Waterlogging and salinization are due to the great length of the canal system in relation to the land irrigated and to the lack of planning of the farmers' distributary systems. In the absence of drainage, waterlogging and salinization are inevitable. Saline lands existed in the area before the irrigation scheme, but salinization and waterlogging have become progressive and will continue so until their causes are removed."

It is a matter of some gratification that, profiting from the experience of Chambal, steps are being taken to carry out soil surveys in the command of the Rajasthan Canal Project and that soils which are likely to be affected by waterlogging and salinization have been already identified in the area covered by Phase I. In the case of Mahi-Kadana, the World Bank has insisted on the creation of an adequate drainage system to serve an area of 2.5 lakh acres and has included the cost of this work in the Project.

(c) Land levelling :

The Joint Working Group observed that "land was not properly developed for irrigation by levelling, grading and sub-division into compartments of optimum sizes." Experience has shown that it is generally beyond the resources of the farmer to carry out such work on his own. Not only does he not possess the necessary financial means but there is also the absence of any agency which can carry out the work in an efficient and economical manner with the use of modern land levelling and earth moving equipment. As far as long-term credit needs for land development are concerned, it is now possible to meet them through institutions such as, land mortgage banks, commercial banks and the Agricultural Refinance Corporation. However, a great deal of detailed surveys and organisational work are required to be done to ensure that every farmer in the command is enabled to make use of these opportunities, and that carefully considered schemes are prepared for acceptance by banking institutions.

The physical execution of land levelling work has been found to be even more difficult to organise in the absence of private agencies willing and equipped to undertake such work on a large scale. It is clear that till such time as private contractors of the requisite quality appear on the scene, work will have to be undertaken by State Governments themselves either directly or through the agency of Agro-Industries Corporations etc. Small beginnings in this direction have been made in the commands of Tunrubhadra, Nagarjunasagar and Kosi Projects, but no where can it be said that entirely satisfactory arrangements exist.

The work involved is of a colossal nature and the States have yet to gear themselves for it. Arrangements for long-term credit for everyone who needs it must go hand in hand with topographical surveys and detailed schemes for levelling and earth-moving work, which should be implemented with the minimum delay by efficiently managed fleets of bull-dozers and scrapers.

It may be mentioned that in the case of Mahi-Kadana, the World Bank has insisted on all the land levelling work covering over 100,000 acres being carried out by the State Department of Agriculture with proper equipment and against loans to be provided by the Land Mortgage Banks to individual farmers.

III. - INTRODUCTION OF SUITABLE CROPPING PATTERNS AND WATER MANAGEMENT PRACTICES :

The Joint Working Group observed as follows :-

"The dry-land farmer accustomed to traditional methods of farming was not conversant with the nature of adjustments necessitated by the change of conditions brought out by the availability of irrigation water".

The Hutchinson Mission has made similar observations :-

"The tract now irrigated has long been settled by farmers who depended entirely on the monsoon except for very small plots irrigated from wells. They had no other experience of irrigated farming and no instructions in water use and management has been given to them. Indeed it appears that no formal instruction in water management has been given to the extension officers. Under these circumstances the irrigation net work that has emerged is primitive and unplanned, without adequate levelling and proper spacing between channels."

In the case of Mahi-Kadana, the World Bank has insisted on an adequate agricultural support programme being undertaken in the command area and on the setting up of trial-cum-demonstration farms by trained Extension staff.

It must, however, be emphasised that as of today there is insufficient knowledge of soil-water-plant relationships under various climatic conditions in the country and that a great deal of study of soil conditions and water management problems will have to be carried out before recommendations can be made to the farmer with regard to the cropping patterns and irrigation practices which are best suited to the area. In a separate note on the subject, a recommendation has been made, inter alia, that each State should be helped to get acquainted with the subject and to undertake necessary studies by locating in it at least one Centrally financed Water Management pilot project.

It seems to be fairly clear that ultimately we shall have a body of trained workers somewhat on the lines of the Soil Conservation Service of the United States Department of Agriculture which would be competent to advise individual farmers on how to make the best use of their water and soil resources.

IV - INTEGRATED DEVELOPMENT OF COMMAND AREAS :

The greatest stress in any programme of Command Area Development must naturally be laid on achieving the full utilisation of available water resources but this alone is by no means sufficient to ensure maximum agricultural production. To achieve the objective of maximum production, all necessary inputs and supporting services must be provided and adequate agricultural infra-structures built up. This, however, is easier said than done. Some of the ingredients of an integrated development programme are as follows :-

(a) Consolidation of holdings. It is obviously necessary that, as far as possible, each farmer should have all his land in one compact block, so that he can plan its development economically;

(b) Supply of farmers' needs in respect of credit, seeds, fertilisers, pesticides, agricultural machinery, etc;

(c) Research facilities aimed at catering to the special needs of the area;

(d) Improvement of communications and market facilities. In order to ensure the efficient transport of agricultural inputs into the area as well as the movement of marketable surpluses to mandis, it is necessary to create an adequate network of roads linking villages with market towns. It is also necessary to create adequate physical facilities by way of godowns, storages and shops for dealers in the new

mandi towns. However, the regulation of market activities through legislation has also to be ensured, as in the absence of regulated markets it is impossible to ensure that the farmer will get a fair return for his produce;

(e) Processing and agro-industries. There is great need in the new mandis towns for the setting up of units for the processing of paddy, sugarcane, cotton, etc. as well as for establishments like tractors workshops and machinery hiring centres.

(f) Town planning. In order to avoid the unregulated growth of new townships and slum conditions, it is very necessary that the centres of urban concentration should be properly planned by teams of town planners and architects before serious damage takes place. In the Tungabhadra command area, for instance, the Mysore Government has already taken a decision to set up a special Town Planning Unit which will be responsible for its planning in a balanced manner.

(g) Supplemental irrigation from groundwater sources. The study and development of groundwater resources must be undertaken, as supplemental irrigation makes multiple cropping possible and insures farmers against failures in surface water supplies in drought years.

(h) Diversification of agriculture and mixed farming programmes. Dairying, animal husbandry, poultry, vegetable production etc. are important activities which must figure in any plan of command area development.

The wide range of activities mentioned above makes it necessary that there should be a single planning and co-ordinating authority to look after the working of all the departments and agencies concerned. Such an organisation was created in the shape of the Kosi Area Development Commissioner in Bihar many years ago and has been commended by us to other State Governments as a model to follow. In Andhra Pradesh, an Ayacut Development Commissioner has been appointed with overall responsibility for the major river valley projects of the State and a similar arrangement is likely to be made by the Mysore Government very shortly. This principle has been accepted in the Mahi-Kadana Project also - the World Bank has insisted on a Project Co-ordinator to look after all the aspects of development.

V - WATER SHED MANAGEMENT :

Recent studies have indicated that, thanks to soil erosion in the catchment areas, reservoir sedimentation is taking place at a much higher rate than was envisaged when they were built. In some of the projects even live-storage capacity has been already affected. It is obvious that unless very energetic steps are taken to control erosion in the catchment areas of our river valley projects, the tremendous investment that these projects represent will be endangered. As much attention, therefore, needs to be paid to the conservation of water sheds above, as to the development of command areas below the dams. What is required is to complete, as early as possible, the identification of the most-eroded areas and to proceed to treat them with the utmost despatch. This, however, a colossal job, both in terms of money as well as of the organisational effort needed to be put in.

VI - THE SCOPE OF THE PROBLEM :

No proper studies have yet been made of the exact requirements of each

command area by way of cost of providing all the services and infra-structures listed in parts II, III & IV above. However, even if it is assumed that an amount of Rs. 400 an acre would be required for the development of the 40 lakh acres which represent "the unutilized potential" a sum of Rs. 160 crores would be needed for these areas alone. However, even in the 176 lakh acres which fall under the "potential utilized" category, development is by no means complete and it would be safe to estimate the requirements of these areas at around Rs. 100 crores, thus making a total of Rs. 260 crores or so. Against this, the total amount spent in these commands so far on the items under discussion is probably not more than 80 crores at the very outside.

The Fourth Plan contains a provision of Rs. 15 crores for a Central Sector scheme which aims at extending financial assistance to State Governments to build market roads and market complexes (including storages) in the command areas of the 10 projects mentioned in the margin, on the express condition that the State Governments shall set up integrated planning and co-ordinating authorities for these areas and also undertake to look after all their other needs as mentioned in parts II, III and IV above. This programme has been in operation for less than a year and has shown some results. However, it is not yet possible to say that the States have been jolted into action by this programme, and what exactly they have included in their Plans for command area development.

As regards water shed management, it has been estimated that if only the critically-eroded areas in the catchment areas of our biggest 20 projects, were to be treated with soil conservation measures, the amount required would be as much as Rs. 500 crores. If all the projects were to be taken up and soil conservation measures carried out throughout their catchment areas (and not merely in the worst-eroded areas) the amount required would be of the order of Rs. 1,500 crores. Against this, we were able to spend only about Rs. 20 crores on soil conservation works in 12 major river valley project water sheds upto the beginning of the Fourth Plan. In the Fourth Plan, the provision for such works in the Central Sector is Rs. 27 crores and is meant to cover 20 projects. Although State Government have been prevailed to take up this work on their own, so far their response has not been very helpful.

VII - SOME SUGGESTIONS

It is clear from the above that the resources which are in sight to-day for dealing with the problems of river valley projects are not at all commensurate with the requirements of the situation. Since there are very definite limits to direct Central participation in such activities - both 'Land' and 'Water' being State subjects -- what perhaps needs to be done is to stimulate the interest of State Governments in a matter which concerns them vitally and to assist them to undertake the job to the best of their ability. A practical suggestion in this regard would be to utilise a part of the Central Plan funds provided for command area development (Rs. 15 crores) and for Water Shed Management (Rs. 27 crores) for carrying out intensive studies of the needs of water sheds as well as command areas of major river valley projects. Such studies should be undertaken by joint G.O.I. - State teams of experts drawn from the various disciplines concerned, such as irrigation engineering, water management, forestry, soil conservation,

agronomy, agricultural economics and marketing and should result in the preparation of well-documented project reports containing specific schemes for implementation as and when funds become available. Here it may be mentioned that expenditure on many items of command area development - for instance, land levelling, construction of water channels -- can be met by loans from institutional sources, while certain other schemes may prove to be economically viable enough to attract loans from bodies like the World Bank. Only a portion of the investment represented by such schemes as soil conservation measures in Government-owned lands in water sheds and the construction of roads will have to be met by direct State outlays, but even here it may be possible to meet part of the charges at least through betterment levies and increases in water rates which to-day stand at uneconomical levels. Such project reports would, in any case, focus attention on the total needs of river basins and prove useful in relating irrigation projects with water shed management on the one hand and command area development on the other.

Another suggestion which might be usefully considered is whether it would not be advisable to concentrate on making the best use of existing and ongoing river valley projects by completing them quickly, fully developing their command areas and paying more attention to their water sheds than to invest in further irrigation projects of the same "incomplete" nature, as have been built in the past.

Sd/-
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(B. B. VOHRA)
Joint Secy. to the Government of India.

ANNEXURE

Major & Medium Irrigation Projects - Position of Utilisation of Potential

State	Ultimate Benefit	000 acres		
		Potential	Achievement to end of 1968-69 Utilisation	Percentage
Andhra Pradesh	4035.71	1855.26	1668.44	90
Assam	181.11	40.00	40.00	100
Bihar	7719.58	2819.48	1468.40	52
Gujarat	3458.07	1277.65	745.58	58
Haryana	3518.56	2276.50	2213.40	97
Kerala	1258.40	442.97	442.97	100
Madhya Pradesh	2457.34	1053.16	426.46	40
Maharashtra	4986.24	858.94	500.71	58
Mysore	3894.05	1170.50	967.51	83
Orissa	2703.97	1570.87	1461.26	94
Punjab	3676.56	1738.82	1696.95	97
Rajasthan	3463.10	1749.60	1516.60	86
Tamil Nadu	1998.24	776.04	722.66	93
U. P.	5483.99	2493.53	2286.23	91
West Bengal	2541.00	1628.00	1513.00	93
	50,651.03	21,778.32	17,680.17	81

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CHAPTER 8

NEPAL

General Situation

The Kingdom of Nepal extends along the southern slope of the Himalayas beginning between latitude 27°N and 30°N and longitudes 80°E and 88°E. The country is roughly rectangular, about 900 kilometers (550 miles) long and 160 kilometers (100 miles) wide following the generally east southeast orientation of the Himalayan mountain axis. Moving from south to north the entire transition from the Gangetic Plain to the Himalayan divide is transected. Along the south is a strip, the *Terai*, that constitutes Nepal's share of the fertile plain between the boundary of India and the foothills and that lies at an elevation ranging from 90 meters (200 ft) to 225 meters (750 ft). Immediately north is the 15-kilometer (10 miles) wide *Bhabar* belt of tropical jungle occupying the sands and gravel brought down from the *Churia* hills (Siwaliks) which rise to elevations of 1,500 meters (5,000 ft) and terminate with the Mahabharat Lekh, a parallel range of mountains along the north up to 3,000 meters (10,000 ft) high running the full length of the country. Between the Himalayan Mountains and the Mahabharat Lekh lie the Midlands or Mahabharat belt which is about 125 kilometers (80 miles) wide ranging in elevation from 600 to 1,800 meters (2,000 to 6,000 ft). The Himalayan belt rises to more than 6,000 meters (20,000 ft); and its peaks along the Chinese border to more than 8,800 meters (29,000 ft). Thus, the country comprises four principal belts running its full length—the *Terai-Bhabar*, the *Churia* hills, the *Mahabharat* or midlands, and the *Himalayan* Mountains. Variation in elevation ranges from 90 to 8,850 meters (200 to 29,000 ft) across a 100-mile transect. Arable lands lie almost entirely in the Terai and Mahabharat regions; however, maize may be grown in the Himalayan belt to elevations of about 2,700 meters (9,000 ft) and winter wheat to 4,500 meters (15,000 ft).

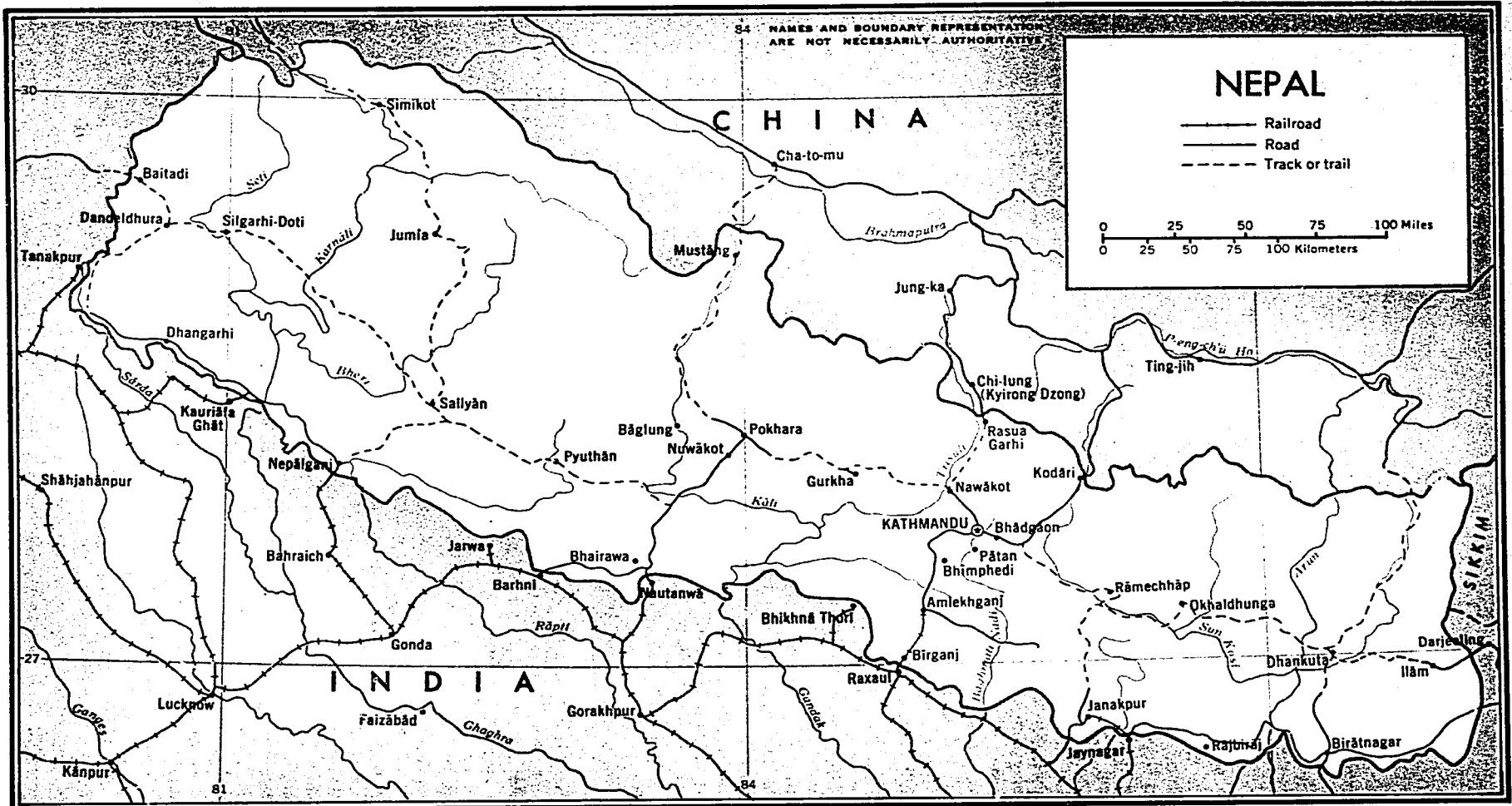
Nepal lies entirely within the drainage basin of the Ganges River. There are more than 6,000 rivers in the country, 1,000 exceed 12 kilometers (7 miles) in length and more than 100, 240 kilometers (150 miles). Streams respond quickly to rainfall and are highly variable even during the monsoon season. Many are dry during the dry season. The country also lies within the southeast Asia monsoon which brings heavy precipitation beginning in early June in the east ranging to early July in the west and terminating in October. About 70 percent of the precipitation falls during this period. Annual precipitation exceeds 3,000 mm (100 in.) in the east and ranges to as low as 300 mm (10 in.) in portions of the Tibetan watershed. Generally throughout most of the country the range is from 1,200 to 2,100 millimeters (40 to 70 in.) decreasing generally westward. Since the Mahabharat falls somewhat under the rain shadow of the Mahabharat Lekh, this belt is generally more arid than the Terai. Actually, monsoon rains are not continuous in either space or time and there may be considerable time, in spite of high humidity and cloudiness, when rain does not occur. Tremendous amounts of sediment are produced by the rivers because of the nature of the rocks and overgrazing.

The annual runoff for the entire country is about 210 billion cubic meters (170 million acre-feet). In the Terai, the temperature ranges from 4°C to 40°C (40°F to 110°F) and from 3°C to 27°C (38°F to 80°F) in the Midlands. Above 1,800 meters (6,000 ft) the country is sub-alpine to alpine. Nearly 15 percent is under permanent snow. Population is approximately 11 million.

Agriculture and Irrigation

Of the total area of 140,000 sq. kilometers, 14 million hectares (54,000 sq. miles—35 million acres), 1.8 million hectares (4.5 million acres) are arable; 1.2 million hectares (3 million acres) of the arable lands are in the Terai. About 1.1 million hectares (2.7 million acres) are classed as "wet" and the remainder as "dry." "Wet" lands are planted 95 percent to rice and 65 percent of the dry lands, to maize. About 20 percent of the Terai grows winter (dry season) crops principally wheat, but including gram, oilseeds, and tobacco. Besides rice, summer crops include jute and sugar cane and some maize on the higher, drier areas. In the midlands, rice is grown on about one-third of the area; maize on more than 50 percent. Soy is commonly planted with the maize. Other crops include fruit and vegetables. All told, total crop area is 2 million hectares (5 million acres) of which 1.1 million hectares (2.7 million acres) are paddy and 450,000 hectares (1.1 million acres) are maize. Arable lands in the midlands include limited valley bottoms, but intensive cultivation of terraces formed on the steep hillsides on slopes as steep as 45 percent has been practiced for centuries. Almost all possible cultivable land is utilized. Transport to and within the inner region is extremely difficult, largely by back pack. About 50 years ago, a 40-mile rope way was installed to bring goods from the Terai into Katmandu Valley. Within the decade, a road has been opened between Katmandu and the Terai. This road was constructed utilizing Indian aid. It is about 90 miles long to cover 25 air miles. The principal east-west road extends about one-half the length of the country between Katmandu and Lhasa, Tibet. It was built with Chinese aid.

Traditional efforts to develop irrigation have existed since time immemorial. Except for small streams, diversions have been extremely difficult to implement. Irrigation can increase the number of crops grown by providing water during the dry season. It can also insure against periods of drought during the wet monsoon. Paddies may be managed either to catch and entrap the rain that falls, impounding it between rains, or to utilize stream water passed from paddy to paddy in series. Modern canal construction started in 1924 when the Chandra Canal was diverted from the Trujiga River to command 20,000 hectares (50,000 acres). By 1950, government projects served only 14,500 hectares (36,200 acres) in the Terai. By the end of the second Five-Year Plan (1965), 58,600 hectares (145,500 acres) had been commanded. Target for 1970, the end of the Third Plan, was about 220,000 hectares (543,500 acres). Three projects totaling 145,000 hectares (359,000 acres) for the Terai are under construc-



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tion. Under investigation is the Sunkosi Terai Project covering a gross area of 1.3 million acres. Utilizing surface supplies from the Sunkosi, Bagmati, Mamala, and other rivers and groundwater, a general study will be made of the entire area; a detailed study of 200,000 acres identified as believed to be the optimal area for the Sunkosi River supply. Minor projects costing generally less than \$10,000, are handled through the Department of Agriculture. For minor projects, 50 percent of the cost must be provided by the farmers in cash or labor.

There are innumerable shallow wells in the Terai. Some tubewells have been drilled both under minor irrigation and by the Irrigation Department under the Ministry of Irrigation and Power. For the past four or five years, a group under a U.S. Geological Survey team has been conducting a study of two groundwater regions in the Terai. One region, the Bharai area, has just been completed and some of the 99 test wells drilled appear useful for production.¹ Groundwater may be the best source for irrigation supply in the Terai because of lack of potential for surface storage, high reservoir sedimentation rates and because the river flows fluctuate in phase with the monsoon rains so that surface water supplies are shortest when most needed.

Administrative Structure

Agricultural and irrigation programs are carried out under the direction of the central government. There is no provincial responsibility for these programs. The most concerned Ministries, as far as irrigation is concerned, are the Ministries of Food and Agriculture, and of Irrigation and Power. There is also a Ministry for Land Reform, and a Home Ministry.

Departments of the Ministry of Food and Agriculture include Agricultural Research and Education, Agricultural Extension, Fisheries, Horticulture, Livestock (Improvement and Veterinary), Food Research and Laboratory, and Resettlement. A Department of Minor Irrigation was planned, but has not been implemented. Interest in irrigation practice centers in the Department of Research and Education of the Division of Agricultural Engineering. Other divisions of this Department include Agronomy, Soils, Plant Pathology, Botany, and Entomology. The following corporate entities are associated with the Ministry of Agriculture: Agricultural Supply Corporation, Dairy Development Corporation, Food Management Corporation, Resettlement Company, Agricultural Development Bank.

The Ministry of Irrigation and Power has responsibility for public water supply including major irrigation works, and electricity. Irrigation projects are under the Department of Irrigation of the Ministry.

¹Three artesian aquifers were found at depths ranging from 200 to 600 feet. Drilling has been as deep as 1,500 feet using both percussion and rotary drilling. Many of the wells are flowing. Normal production is about 1.5 cusecs, but one well flows at 2,000 gpm. No information on recharge possibilities was obtained. Nothing was said about an "unconfined" water zone.

Provincial governments are not involved in programs of resource development and agriculture. These are conducted directly through or by the central government.

Problems of Irrigation

Nepal has an emerging administrative capability in irrigation agriculture. The difficulties are much the same as elsewhere, but responsibility lines are still being defined.

As for most of monsoon Asia, Nepal suffers from the basic problem of a feast and famine water supply. When it rains, the rivers flood; when it doesn't, they dry up. Drought is a real hazard even during the monsoon, but lack of stored water supplies virtually terminates agriculture between November and May. Large irrigation works and groundwater development have some potentials--as yet unknown--for firming up the year-around supply. According to officials of the Irrigation Department, service designs are now based on minimum river flows at duties ranging from 40 to 80 acres per cusec. This should provide full service for lands commanded if this criterion is maintained; however, because of the extreme variability of flow, the area of land that can be provided with a full supply from canal systems may be quite limited. In the past, canal systems have evidently not been designed to provide a full water supply during the entire year. As a general policy, the Irrigation Department does not plan to operate its groundwater and canal supplies conjunctively, i.e., areas commanded by canals will not also be served by wells and vice versa.

Implementation of desirable on-farm water management has made little progress. There are eight demonstration farms, but wells had to be developed in order to demonstrate irrigation practice. Four have now been provided with tubewells and a fifth with dug wells. The Agricultural Ministry is developing capability in this general area, although there are organizational and manpower frustrations. Responsibility is centered in the Agricultural Engineering Division of the Department of Agricultural Research and Education. Leadership in the Irrigation Department of the Ministry of Irrigation and Power accepts "on-farm water management" as part of its task and states that the sequence of planning has been reversed so that it begins with the farm rather than the water supply, although criteria defining to what level the Irrigation Department will actually design and construct distributaries and become involved have not yet been defined. Up to now, construction of distributaries and farm layout and infrastructure apparently is not done as a feature of project construction. Irrigation Department officials are cognizant of this problem. For the Chitwan Valley Project, inclusion of full land development increased the project cost from about \$250 per hectare to \$1,000 to \$1,200 per hectare. One of the difficult problems is obtaining rights-of-way for distributaries.

Extended periods required (beyond those originally planned or desired) for settlement and realization of returns from irrigation development have been discouraging and disappointing to financial officials in Nepal. This is a common problem and probably is more acute for Nepal, where public-financed irrigation development is

relatively new, even newer than in some of the other countries in the region. At best, irrigation development is a long and complex process and no tried and true techniques have been found to accelerate the process. Evidence, however, strongly suggests the need for more comprehensive planning giving more attention to realistic economic and social elements of the settlement phase.

Land-leveling (except for traditional terracing on the steeper hillsides) is another common problem. Nepal's Agricultural Engineering section has this in mind and has a 2½-yard scraper and Eversman land plane on hand for demonstration. Under discussion is purchase of 400 tractors under an ADB loan. There is some feeling that 35-h.p. tractors are too small; however, this size has been demonstrated to be the most economical in Turkey and India.

Custom and a legal base for sale of water is also a problem in Nepal. There is some opinion that, by tradition and custom, water cannot be sold. A national law sets the annual price of water at 4 rupees per acre per crop or 6 rupees per acre per season. There is a wide range of opinion on what legal action will be required. Some hold that price can only be set by law; others seem to feel that there will be no difficulty in obtaining legislation which will permit realistic pricing or "cess" for water depending on its cost. In any case, this issue appears to be an important one which will need to be resolved.

Participation and Contacts Made

Nepal participated in the sixth and seventh seminars. One delegate was sent to the former and three to the latter. The single delegate to the sixth seminar represented the Agricultural Engineering Division. The delegation for the seventh seminar included one representative from the Agricultural Engineering Division and two from the Department of Irrigation. The writer was able to contact two of the four delegates, one from each of the seminars attended, but both were from the Agricultural Engineering Division.

General Evaluation

With Mr. John W. Probst, Irrigation Advisor, USAID, Nepal, a conference was held with Mr. Tope B. Basnyat, Chief of the Agricultural Engineering Section, Department of Research and Education, Ministry of Agriculture who attended the seventh seminar held in Lahore in 1968. Mr. Basnyat is a graduate of Allahabad University in India and attended the AID-sponsored irrigation short course held in the United States in 1969. Mr. Basnyat made only limited comments but indicated that the seminar "covered too wide a field and its recommendations are difficult to implement." He felt that he had learned a lot but was frustrated about implementation. There is also a lack of continuity in the delegation.

Mr. K.D. Adhikary, Chief Engineer, Irrigation Department, Ministry of Irrigation and Power, has not attended the seminar himself, but two members of his staff, who were not available in Katmandu, had. Mr. Adhikary stated that the tangible results of the seminar were difficult to assess. The awareness brought to people has been useful.

Agricultural production is the essence of irrigation itself and this concept is getting around. The Irrigation Department has accepted on-farm water management as a part of its task and the criterion of on-farm development toward water management should be planned from the beginning. This sequence of planning has been reversed. It now proceeds from the field to the water supply. Three projects are at various stages of planning and the thinking of the Irrigation Department has been influenced. Designs are now being based on minimum river flows.

Mr. P.P. Gorkhaly who attended the sixth (1966) seminar in Jordan is an agricultural engineer in the Department of Agricultural Education and Research. He was educated at Allahabad, has spent about a year with the U.S. Soil Conservation Service (1961) and studied agricultural engineering in England (1967-68). He is temporarily on leave to the Extension Service. He stated that he had seen the projects in Jordan, but is not sure how useful this is to Nepal. The seminars are useful to countries where programs are underway, but this is not yet the case in Nepal so they are not very relevant. Nepal is trying, but hasn't gotten far enough to report meaningfully. Because of lack of experience of Nepalese in irrigation, seminars are like studying textbooks.

Topical Evaluation

What follows reflects views stated by representatives of the Agricultural Engineering Division plus some inputs by officials of the Economic Analysis and Planning Division, Ministry of Agriculture, the Department of Irrigation and the Ministry of Finance on some of the topics.

1. *Establishment of irrigation and drainage service to provide technical assistance at the farm level for on-farm water management.*

There is no correlation or differentiation of assignment between the Irrigation Department and the Ministry of Agriculture. The tax on canal water is very low or nothing and this has hampered tubewell development. The Irrigation Department has not provided the needed distributaries. Nepal is trying, but, so far has only developed the research farms.

2. *Improved coordination between water supply development agencies and agencies responsible for on-farm water management.*

Tried six years ago but nothing is being done now. This is not possible until there is an organization developed for on-farm irrigation and drainage. Presently agricultural engineers can't find employment and the Agricultural Engineering Division has not been recognized for what it can do.

3. *Education and training of manpower in irrigation and drainage.*

a. *Irrigation and drainage courses at the university level for engineers and agriculturists.*

There is some special out-of-country training; none within the country. Twenty-one agricultural engineers, graduating in 1972, were trained in India.

b. *Improved farmer education programs for on-farm water management through extension programs.*

Three or four years ago some field-day type of training was done. Training programs were set up for about 1,000 farmers and about 2,000 were trained.

c. *Establishment of institutions for training technicians in irrigation and drainage and related service.*

Haven't done. Fifteen staff personnel have been sent to India to study irrigation practice.

d. *In-service training programs for technicians in irrigation and drainage and related service.*

Not being done. There is some training of overseers on experimental farms.

e. *Use of pilot projects for new developments or for rehabilitation of older developments.*

Has not been started, but Agricultural Engineering is exploring possibilities in connection with a site served by tubewell or in some other area.

f. *Farmer training courses.*
See b.

4. *Development of the elements of the distribution system actually serving the farm units.*

"The Irrigation Department builds canals down to 10 cusecs. Only seasonal water is available. Development of watercourses and distributaries is not being done."

"Nothing. We are supposed to do this, but haven't."

5. *Improved farm-field management for irrigation and drainage. Consolidation of fragmented holdings, optimal field size and distribution systems, land-leveling (land forming), etc.*

Consolidation of holdings hasn't started. Land reform has broken up the larger holdings. Forty acres is the maximum size.

With regard to land-leveling, 400 tractors are being procured under an Asian Development Bank Loan. The question was raised as to whether or not farmers would permit destruction of old bunds, but apparently this is not visualized as a problem. Some leveling using head baskets and "eyeball" for grade is going on.

In the Chitwan Valley project, feasibility studies that were financed by Asian Development Bank estimated costs including farm-level land development over simple command service increased from \$250 per hectare (\$100 per acre) to \$1,000 to \$2,000 per hectare (\$400 to \$800 per acre). Land-leveling and consolidation need to go forward together.

Increased investment means increased liability for farmers. Servicing of debt is costly. Operation and maintenance costs will have to be recovered from the beneficiaries, but this is feasible with about a 25 percent increase in farm income.

6. *Integrated project planning of water supply and distribution works and farm development.*

"Because of lack of storage there is no security of water. Usually the command area that could be served has been over estimated."

Conversations with Irrigation Department officials indicated that efforts are being made to take agricultural and farm-management factors into consideration.

Apparently soil classification work has been completed in the Terai.

7. *Development of farmer organizations, cooperatives, joint companies, private custom, etc., for on-farm management activities requiring joint action.*

Cooperatives have tended to cause farmers to be less independent. Previously they voluntarily worked cooperatively in managing their water supplies.

Cooperatives have failed. They are being placed under the Agricultural Bank and some are being reorganized. The strategy is first to provide some management, but gradually to have the farmers take this function over. The government has not had much experience in water management cooperation, but cooperation in other areas has not proved fruitful. Some kind of "mutual" company would be best.

The problem of institutional arrangements is a crucial one and must be most carefully thought out. The main problems are economic, legal, and development of a structure with power to charge for water.

There is some private custom and informal cooperation on distribution systems.

8. *Large-scale supervised credit systems or programs for improvement of irrigation on the farm and distributary systems serving the farm units.*

The Agricultural Bank is going to do this. It has some engineers and Agricultural Engineering will try to help with the supervision of credit. The Bank gives loans for shallow tubewells, but these are not very secure. (Apparently wells are not adequately designed.)

One problem is how to recapture the costs. The "cess" or charge must be authorized by the Government. Cooperative societies could operate wells. Money for irrigation pump sets can be had at 7.5 percent for three years. The Bank has some technical help and is employing five of the young agricultural engineers recently trained in India.

The Bank gives loans for pumps but not for land development.

9. *Development of water rights laws and improved water use through administrative procedures.*

This has been talked about, but no real progress has been made.

Improvement is needed. Presently an upstream irrigator can put in a dam 500 ft upstream from a diversion and intercept the flow. There is no groundwater law.

There are no clear laws governing water rights and use of water.

10. *Transfer of distributaries or water courses to farmer organizations. Participation of users in operation and management of distribution and water course systems.*

This has not started. The Minor Irrigation Department tried to do some of this.

11. *Inclusion of drainage in development plans and implementation of drainage works.*

Not much is being done. There is no technical service. The problems are quite extensive.

12. *Intensive cropping and improved rotation practices.*

There are some intensive programs in some of the districts. Improved varieties and fertilizer are used, but water supply is a problem.

13. *Research.*

a. *Irrigation practice, i.e., farm use of water, best field layout, measuring and controlling water losses, ditch erosion, frequency and amount of irrigation, etc.*

Some irrigation research is being planned. Some simple techniques are needed. Doesn't want to start on "too sophisticated a research program."

Some research is being done but not on farmers' fields.

b. *Drainage, salinity, reclamation, including tube-wells, etc.*

Don't have salinity problems yet.

c. *Water quality problems.*

Not applicable.

d. *Soil, water, crop, fertilizer relations.*

No work being done.

List of Persons Interviewed

Delegates

GORKHALY, P.P., Agricultural Engineer, Department of Research and Education, Ministry of Agriculture.

BASNYAT, TOPE B., Chief, Agricultural Engineering Section, Department of Research and Education, Ministry of Agriculture.

Others

ADHIKARY, K.D., Chief Engineer, Department of Irrigation and Water Supply, Ministry of Water and Power.

KORAILA, D.R., General Manager, Agricultural Development Bank.

PRADHAN, B.B., Secretary, Ministry of Finance.

DHITAL, B.P., Chief, Economic Analysis and Planning Division, Ministry of Agriculture.

CHAPTER 9

SRI LANKA (Ceylon)

General Situation

The island of Sri Lanka (Ceylon) lies in the Indian Ocean southeasterly off the tip of subcontinental India between latitudes 5°55'N and 9°50'N and longitudes 79°45'E and 81°50'E. The island is 270 miles long, north and south, and 140 miles wide, east and west. Rocks are 90 percent crystalline *Archaean*, with *Miocene* limestones mostly along the northwest coast. Relief centers in a mountainous area ranging from 900 meters (3,000 ft) to 2,100 meters (7,000 ft) in elevation in the south central portion surrounded by an upland belt ranging in altitude from 300 meters (1,000 ft) to 900 meters (3,000 ft). The highest peak rises to 2,530 meters (8,297 ft). The coastal plain is narrow on the west, south and east, but broadens out to occupy much of the northern portion of the island. Temperatures are moderate, averaging 26°C to 27°C (80°F to 82°F) in the lowlands. They seldom exceed 37°C (99°F). In the hills, temperatures are lower, minimums are generally around 7°C (45°F), but occasionally fall below freezing. Largely because of the effect of the mountains on the monsoon, the southwest quadrant is "wet" with rainfall ranging from 1,900 up to 5,000 mm (75 to 200 in.). The remainder of the country is "dry," precipitation ranging from 1,000 to 1,900 mm (40 to 75 in.). The "wet" region receives most of its rainfall from May to September; the "dry" region, from December to February. Sri Lanka's area is about 6.45 million hectares (25,322 sq. miles—15.2 million acres); about 1.65 million hectares (4.1 million acres) are cultivated. In 1966, crop distribution was: rice, 535,000 hectares (1.32 million acres); tea, 240,000 hectares (595,000 acres); rubber, 272,000 hectares (671,000 acres); coconut, 465,000 hectares (1.15 million acres); upland crops, 151,000 hectares (372,000 acres). Only a small acreage of crops other than rice is under irrigation. About 240,000 hectares (800,000 acres) of rice is irrigated. Double cropping of rice adds possibly 100,000 hectares (250,000 acres) to the cropped acreage. The population of Sri Lanka is in excess of 12 million. The country has limited resources other than agricultural. Even so, it has had to import food items but it exports more tea than any other country. In 1966 it produced only about 60 percent of its rice needs. Increase in rice production using new varieties has been spectacular since then and the country is currently nearing self sufficiency in rice.

Irrigation in Sri Lanka

Tank irrigation of rice has been practiced for about 2,500 years; the first dam is reputed to have been constructed in 504 B.C. Irrigation reached its peak in the 12th Century, A.D. By this time, 10,000 "tanks" ranging in size from 5 million to 125 million cubic meters (4,000 to 100,000 acre-feet) are said to have been built. Following several centuries of disrepair, a program of rehabilitation was started in 1857 under the British. The

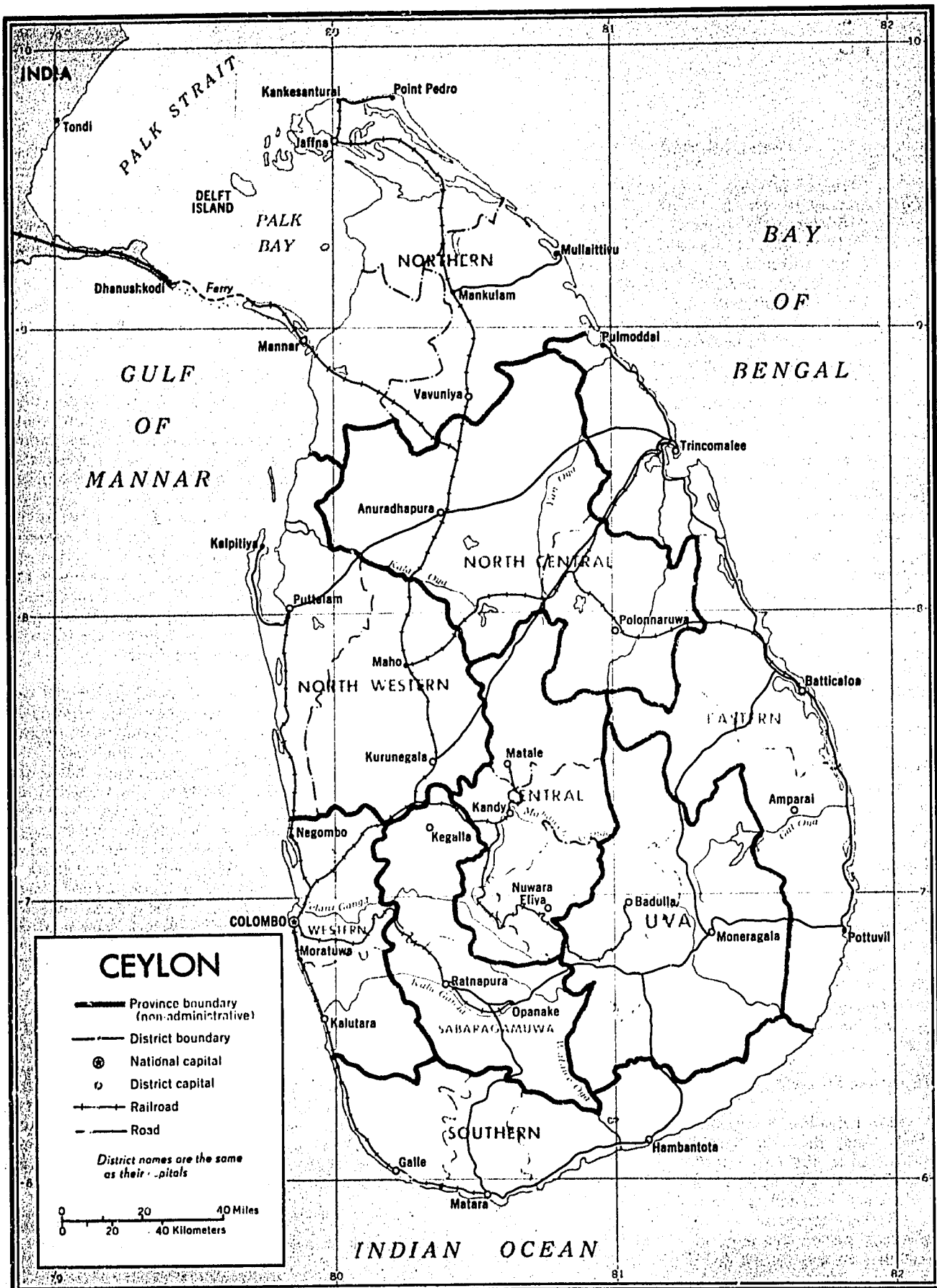
modern era of irrigation development began with the first 6-year plan started in 1947 and a number of projects are presently under development. The largest of these, by far, is the Mahaweli Ganga Diversion Scheme which covers 39 percent of the country's area. This project would provide about 7.5 billion cubic meters (6 million acre-feet) of water to serve 360,000 hectares (900,000 acres), 620,000 of which would be new lands in the dry zone. Including hydroelectric development (492 MW), drainage, flood protection and land development, the estimated cost (1968) was 5,300 million rupees (\$833 million).

Irrigation works are classified as "major," and "minor" or village works. Major works include tanks whose capacity ranges upward of several million cubic meters (several thousand acre-feet). Both major and minor works are constructed by the Irrigation Department. Major works are maintained and operated by the Irrigation Department and the user assessed an irrigation "rate."¹ Minor works are maintained and operated by the users and no charge for water is made. The Irrigation Department is under the Ministry of Lands, Irrigation and Power. The Department of Agrarian Services under the Ministry of Agriculture and Food exercises supervisory control over minor works. The multiple-purpose Mahaweli project is under the Mahaweli Development Board under the Ministry of Lands, Irrigation and Power.

Agricultural land is almost all developed in the wet zone. In 1964, there were 160,000 hectares (400,000 acres) of paddy in this zone, about 140,000 of it irrigated. Irrigation schemes are mostly small diversion works from the perennial streams. In the dry zone, even though the rainfall is between 1,000 and 1,900 mm (40 to 75 in.) this occurs mostly during about 100 days in September through January and there are frequent droughts during even this period so that irrigation is quite essential to organized agriculture. In 1964 about 240,000 hectares (600,000 acres) out of 340,000 hectares (850,000 acres), were irrigated in the dry zone. Settlement is most dense in the wet zone and strategy involves resettlement of the lands to be brought under irrigation in the dry zone. Under the Mahaweli scheme, water produced mostly in the wet zone will be exported to the dry zone.

Purchase of rice up to self-sufficiency is underwritten and subsidized by the government. When self-sufficiency is reached, possibly in 1973, farmers will be forced into multiple cropping. A principal problem is said to be that they do not know about agricultural water science. They have no tradition in upland irrigation, or in "irrigation practice." There is no furrow irrigation and paddy irrigation is "flow through." There is fear also that

¹Maintenance charge was set at 5 rupees (\$0.82) per acre according to Sri Lanka's report in the 1968 seminar. Consideration was being given to raising it to 7 rupees (\$1.16) per acre-foot at this time.



CEYLON

- Province boundary (non-administrative)
- District boundary
- National capital
- District capital
- Railroad
- Road

District names are the same as their capitals

0 20 40 Miles
0 20 40 Kilometers

"puddling" of the new soils will ruin them for crops other than rice. For the upland soils the range between field moisture holding capacity and wilting point is very small, so irrigation will need to be frequent. Upland soils still appear "wet" at wilting point so that it is difficult to tell when water is needed based on the appearance of the soil. "Lift" irrigation is rapidly developing both from wells and rivers, although the groundwater potential appears to be limited principally to the limestone zone.²

Until 1962, USAID had a capital development program largely in the water area, but this was discontinued at that time under provisions of the Hickenlooper Act when retail petroleum outlets were expropriated. Issues were resolved in 1966, but since that time, U.S. assistance has been primarily in the form of P.L. 480 wheat flour. Capital assistance for water also has been provided by the international lending agencies.

Participation in the Seminar and Contacts Made

Sri Lanka sent representatives to all of the seminars beginning with the second (1958) through the seventh (1968). The number of seminar participants from the country and contacts made by the writer in 1972 are shown in the following tabulation:

Year	Participants	Interviewed
1956	0	0
1958	4	1
1960	4	1
1962	3	1
1964	1	0
1966	2	1
1968	2	0
<u>1970</u>	<u>0</u>	<u>0</u>
Total	16	4

Since one delegate who was also contacted, attended two seminars, the number of individuals who attended the seminars totaled 15 of which 3 were interviewed. Of the 15 individual delegates, one is deceased and 6 are retired. Only 4 were stationed in Colombo.³ Five other government officials; two expatriate members of the IRRI-Ford rice project and the UN resident representative were also contacted.

General Evaluation

Mr. V.E.A. Witramanayake attended the second and third seminars. He is on the staff of the Agricultural Engineering Department of the University of Sri Lanka but is on leave serving as an engineer with the IRRI-Ford

²The material from this paragraph results from conversations with William G. Golden, Rice Production Specialist; James E. Wimberly, Rice Processing Advisor, both of the International Rice Research Institute-Ford Foundation Ceylon Rice Project and V.E.A. Witramanayake, Agricultural Engineer of the Paddy Marketing Board and IRRI-Ford Foundation project.

³The writer is greatly indebted to Mr. Roy E. James, USAID administrator, Sri Lanka and his assistant, Mr. Walter Dios and staff for their assistance in briefing and in locating and contacting former delegates to the seminar.

rice processing project. He received his undergraduate training at the University of Poona in India and graduate work at Guelph, Canada. Since the seminars, he has been working principally on equipment; however, he has directed one student in irrigation practice research. This student is now research officer in agricultural engineering at the Dry Zone Research Station, Mahaweli Project. He and an agronomist associate are the only ones engaged in irrigation practice research. Actually there has been little opportunity to apply irrigation practice since only rice is irrigated. Professor Witramanayake stated that he used the material from the first three seminars in his university training courses.

Mr. K.R. De Silva attended the fifth seminar (1966). He has since retired from the Irrigation Department, but is on special assignment with the Mahaweli Development Board as Deputy General Manager for Engineering. He stated that those most capable of an evaluation happened to be assembled and that the writer could meet with them. Present were R.S. Cooke, General Manager; M.W. Thenabadu, Assistant General Manager, Agriculture; D.M. Arayaratne, Assistant General Manager, Development Planning; A. Veerakathy, Assistant General Manager, all of the Mahaweli Development Board and D.P. Ganewatte, Sociologist, Land Commissioner's Department. The group was meeting on the draft of the project feasibility report. The list of topical evaluation questions was read and Mr. Cooke stated that this was a list of almost exactly what the Board was attempting to do. Some effort was made by those assembled to comment on the questions individually, but only the first 5 or 6 were covered because of limited time. Mr. De Silva later made comments on the general value of the seminar stating that they were especially interested in the problems discussed and that it was useful to see how problems are attacked in other countries. "This adds to our confidence and helps to identify things that may be wrong in our approach. On certain problems that we have not tackled, seeing these taken up elsewhere gives us an impetus to tackle these same problems. We did not tackle drainage 15 to 20 years ago since all of our irrigation was related to paddy, but now there is a need for cash crops which will require drainage. For the same reason we were not concerned about land use patterns, but now we are classifying lands and trying to adopt the proper crop usage."

S.M. De Silva, Deputy Director, Ministry of Planning, attended the fourth seminar in Ankara in 1962. He was trained in agronomy and agricultural economics, doing graduate work at Guelph. He had the reaction that engineers attending the seminar were out of place because they knew nothing about such topics as irrigation practice, consumptive use, etc., that were subjects of the seminar; however, he agreed that they needed to understand that dams and anicuts⁴ alone didn't do the job. In Sri Lanka, the seminars did influence those civil engineers who attended to work more closely with agriculture; however, bureaucratic policy prevented change. This need for closer coordination is now realized by the Planning Commission. Mahaweli Board and the World Bank are now very interested in irrigation practice. For 12 years the

⁴Diversion weirs.

Planning Commission has been trying to give this orientation to engineers.

"The Middle East participants were much more conscious of irrigation practice than were those from Sri Lanka; however, the country papers emphasized physical progress rather than irrigation practice." Mr. De Silva stated that the seminars had influenced his own thinking and his approach to planning.

Dr. Hart Schaff, United Nations resident representative in Colombo cited the phenomenal increase in rice production. While he is not a water engineer, he stated that he was well aware that the great problem in Ceylon is improved irrigation practice on the farm and seminars on this topic could not help but be a good thing. He pressed the idea that Ceylon should host such a seminar.

Mr. Roy E. James, USAID representative, felt that the most needed effort in irrigation is to rehabilitate and improve small irrigation works and that this could be done largely by labor. He felt that a seminar would not be particularly useful in accomplishing what is needed.

Topical Evaluation

Owing to the short time only partial comments were compiled on the topical questions.⁵

1. *Establishment of an irrigation and drainage service to provide technical assistance at the farm level for on-farm water management.*

The Mahaweli Board is trying to establish this on 80,000 hectares (200,000 acres). Fifty percent of this area has established irrigation. 50 percent is new.

2. *Improved program coordination between water supply development agencies and agencies responsible for on-farm water management.*

The Mahaweli Board has combined to handle agriculture, irrigation and hydro-power in the project area, which covers one-third of Sri Lanka. The Board brings together, at the senior level, representatives of the various development agencies.

3. *Education and training of manpower in irrigation and drainage.*

- a. *Irrigation and drainage courses at the university level for engineers and agriculturists.*

Apparently not done. The Irrigation Department will start programs for training its engineers in irrigation practice. There is a Faculty of Agriculture at the University of Sri Lanka.

- b. *Improved farmer education programs for on-farm water management through extension programs.*

IRRI has four farmer training centers on multiple cropping. One- or two-week courses are held for officers and two-month courses for the 22 district extension officers. There have been some farmer courses, but "thousands" of "ditch bank" discussions with farmers.

- c. *Establishment of institutions for training technicians in irrigation and drainage and related service.*

Mahaweli Board has established some and work is in progress. (See 3b, also.) For 25 years, farm schools have been maintained. These train both extension officials and farmers; some of the trainees are matriculated people. The course takes two years and emphasizes methods and techniques.

- d. *In-service training programs for technicians in irrigation and drainage and related services.*

Have programs at Maha Illuppalama and at Gannayuw⁶ research stations of the Department of Agriculture. Illuppalama is in the Mahaweli area and provides courses for farmer training and field officers.

- e. *Use of pilot projects for new developments or for rehabilitation of older developments.*

No specific information.

- f. *Farmer training courses.*

Training courses are organized at the village level by agricultural extension officers.

4. *Development of the elements of the distribution system actually serving the farm units.*

See footnote 5.

5. *Improved farm-field management for irrigation and drainage. Consolidation of fragmented holdings, optimal field size and distribution systems, land-leveling, etc.*

This has not been started, but it is being researched.⁵

On land consolidation, the Mahaweli Board visualizes problems. Plots of say 0.2 hectare size (0.5 acre) may be in three separated places. They are compiling statistics on this situation and would like any information available from other countries.

In the Wallawe, land has been shaped using a bulldozer, but has not been planned.

6. *Integrated planning of water supply and distribution works and farm developments.*

This is in a fluid state. The idea is there but nothing concrete is happening yet.

7. *Development of farmer organizations, cooperatives, joint companies, private custom, etc., for on-farm management activities requiring joint action.*

In the "think" stage. The ideas are there.

8. *Large-scale supervised credit systems or programs for improvement of irrigation on the farm and distributary systems serving farm units.⁵*

See footnote 5.

9. *Development of water-rights laws and improved water use through administrative procedures.⁵*

See footnote 5.

⁵According to S.M. De Silva programs are underway on all topics except Nos. 4,5,8,9 and 10. Topic 5 is being researched.

⁶Headquarters of the IRRI-Ford Foundation rice project.

10. *Transfer of distributaries or water courses to farmer organizations. Participation of users in operation and management of distribution systems.*
See footnote 5.

11. *Inclusion of drainage in development plans and implementation of drainage works.*
No comment.

12. *Intensive cropping and improved rotations practices.*
IRRI has four farmers' training centers on multiple cropping.

13. *Research.*

a. *Irrigation practice, i.e., on-farm use of water, best field layout, measuring and controlling water losses, ditch erosion, frequency and amount of irrigation, etc.*

Apparently the only work being done is by two people at the Mahaweli Dry Zone Research Station. University of Sri Lanka has one person training at University of California at Davis.

b. *Drainage, salinity, reclamation including tube-wells, etc.*

No comment.

c. *Water quality problems.*

No comment.

d. *Soil, water, crop, fertilizer relations.*

No comment.

e. *Economic and social research.*

No comment.

List of Persons Interviewed

Delegates

WITRAMANAYAKE, V.E.A., Agricultural Engineer, Paddy Marketing Board, Ministry of Agriculture and International Rice Research Institute-Ford Foundation Ceylon Rice Project. On leave from the University of Sri Lanka, 2,3.

De SILVA, S.M., Deputy Director, Ministry of Planning, 4.

De SILVA, K.R., Deputy General Manager, Engineering, Mahaweli Development Board, formerly Divisional Engineer, Irrigation Department, 5.

Others

JAMES, Roy E., Administrator, USAID Program, American Embassy, Sri Lanka.

GOLDEN, William G., Jr., Rice Production Specialist. IRRI-Ford Foundation Ceylon Rice Project. Central Agricultural Research Institute, Gannaruwa, Paradeniya, Sri Lanka.

WIMBERLY, James E., Rice Processing Advisor, IRRI-Ford Foundation Rice Processing Project. Paddy Marketing Board. Colombo.

COOKE, R.S., General Manager, Mahaweli Development Board.

THENABADU, M.W., Assistant General Manager, Agriculture, Mahaweli Development Board.

ARIYARATNE, D.M., Assistant General Manager, Settlement Planning, Mahaweli Development Board.

VEERAKATHY, S., Assistant General Manager, Mahaweli Development Board.

GANAWATTE, D.P., Sociologist, Land Commissioner's Department.

SCHAFF, Hart, United Nations Resident Representative. Sri Lanka.

LITERATURE CITED

- Asian Development Bank. *Asian Agricultural Survey*. University of Tokyo Press. 1969.
- Assifi, A.T. "Helmand Valley Shamalan Land Development Project Plans" in *Eighth NESA Irrigation Practices Seminar*. Kabul, Afghanistan. 1970.
- Eighth NESA Irrigation Practices Seminar*. USAID. Kabul, Afghanistan. 1970.¹
- Fifth NESA Irrigation Practices Seminar*. USAID. New Delhi, India. 1964.¹
- First NESA Irrigation Practices Seminar*. USAID. Ankara, Turkey. 1956.¹
- Fourth Five-Year Plan. Government of India. New Delhi. 1969.
- Fourth NESA Irrigation Practices Seminar*. USAID. Ankara, Turkey. 1962.¹
- Hussain, Ch. Mohammed. "Water Quality in Relation to On-Farm Water Management in West Pakistan" in *Eighth NESA Irrigation Practices Seminar*. Kabul, Afghanistan. 1970.
- Jones, G.N., and R.L. Anderson. *The Problem of Under-Irrigation in West Pakistan: Research Studies and Needs*. I.D. 70-71-GNJ-RLA-19. June, 1971.
- Mann, Chas. K. "Formulating a Consistent Strategy Toward On-Farm Land Development in Turkey." Discussion Paper No. 8. USAID/Turkey.
- Provisional Indicative World Plan for Agricultural Development*. FAO, Rome. 1970.
- Rege, N.D. "Soil and Water Management Problems in India." *Indian Farming*. May, 1972.
- Report of the Irrigation Commission, Vol. 1*. Ministry of Irrigation and Power. G.O.I. New Delhi. 1972. 430 p.
- Seventh NESA Irrigation Practices Seminar*. USAID. Lahore, Pakistan, 1968.¹
- Second NESA Irrigation Practices Seminar*. USAID. Tehran, Iran. 1958.¹
- Sixth NESA Irrigation Practices Seminar*. USAID. Amman, Jordan. 1966.¹
- Third NESA Irrigation Practices Seminar*. USAID. Lahore, Pakistan. 1960.¹
- United States Agricultural Review Team. "Agricultural Development in Afghanistan with Special Emphasis on Wheat." A Report to the Royal Government of Afghanistan. USAID. Kabul, Afghanistan. 1967. 106 p.
- Vohra, Shri B.B. *Ground Water Comes of Age. Some Policy Implications*. Ministry of Agriculture. Offset Press, New Delhi. January, 1972.

¹Reprinted 1972 and available from U.S. Agency for International Development, ASIA/TECH/AGRICULTURE. Washington, D.C. 20523.