WM - 15 - 84

BANGLADESH AGRICULTURAL RESEARCH PROJECT PHASE-II

Report of the External Evaluation Team for the Irrigation and Water Management Program Area

R. J. McConnen
D. C. Slack
Md. I. H. Khan
M. N. Haq

BANGLADESH AGRICULTURAL RESEARCH COUNCIL
INTERNATIONAL AGRICULTURAL DEVELOPMENT SERVICE
July, 1984

This is a working document published informally by the Bangladesh Agricultural Research Council. The views and interpretations in this document are those of the author(s) and should not be attributed to BARC, to its affiliated organizations, or to any individual acting on their behalf.

Additional copies of this publication are available free of charge from BARC.

Bangladesh Agricultural Research Project-Phase II

Report of the External Evaluation Team

for the

Irrigation and Water Management Program Area

R.J. McConnen
D.C. Slack
Md. I.H. Khan
M.N. Haq

Bangladesh Agricultural Research Council
International Agricultural Development Service
Airport Road, Farmgate, Dhaka-15

July, 1984

ACKNOWLEDGEMENTS

The members of the Evaluation Team appreciate the help given to them by people who were already extremely busy with their regular jobs. In our discussions, we found both the Bangladeshis and expatriates to be frank and honest in their comments and appraisals. The people in BARC and IADS Bangladesh were particularly helpful. We wish to express a special thanks to two drivers who served us, Kamal and Musa. Mr. Mohammed Easin, Secretary, used his skills and willingness to work long hours to help us complete the report in a short period of time. The two U.S. representatives on the team were pleased to have the opportunity to work with two fine individuals, Professor Md. I.H. Khan and Mr. M. Nurul Haq. The two U.S. representatives also profited greatly from a four day field trip particularly the village visit and demonstrations arranged by Mr. Haq of the Bogra Rural Development Academy. Finally, the team wishes to give a special thanks to Dr. David Duagherty for his help and in particular for his willingness to let us use his personal computer. The members of the Irrigation and Water Management Program area team of specialists Carlos Garces, David Gisselquist and Roger Lazaro also deserve special thanks for their help and hospitality.

CONTENTS

	Page
I. Introduction	1
A. Objectives of the Irrigation and Water Management Program	1
B. Purpose of the External Evaluation	2
C. Perspectives of Irrigation and Water Management in Bangladesh	3
II. BARC/IADS Project Irrigation and Water Management Program Area	7
A. Make up and Expertise in the Team	7
B. Evaluation of the team	7
III. CONSULTANTS	8
A. Expatriate Consultants	8
B. Local Consultants	9
IV. TRAINING	10
A. Overseas Degree Training	10
B. Overseas Non-Degree Training	11
C. Evaluation of Out-of-Country Training	11
D. In-country Training and Sabbatical Leave	13
E. Evaluation of In-country Training and Sabbatical Leave	13

V. CONTRACT RESEARCH ---------- 16

A. Description and Purpose of the Program --- 16

B. Evaluation of the Contract Research Program ---------- 16

VI. Commodities ---------- 18

A. Background ---------- 18

B. Discussion and Evaluation ---------- 19

VII. Impact of the Irrigation and Water Management Program on Bangladesh -------- -- 21
Institutions

A. Introduction ---------- 21

B. Impact on Participating Institutions ----- 22

VIII. Relevance of the Irrigation and Water Management Program to Bangladesh ---------- 25

IX. CONSTRAINTS ---------- 26

A. Irrigation and Water Management Team ----- 26

B. Consultants ---------- 26

C. Training ---------- 26

D. Contract Research ---------- 27

E. Commodities ---------- 27

X. Recommendations and Concerns ---------- 28

A. Recommendations ---------- 28

B. Conclusion and Suggestions ---------- 30

I. Introduction

Irrigation during the dry season in Bangladesh is both an ancient practice and at the same time a relatively new agricultural practice. Large scale surface projects were built shortly after Partition. Low lift pumps began to be installed along major rivers in the early 1970's, shallow tube wells (STW) began to be developed in large number by the mid-1970's and deep tube wells (DTW) began to be developed in significant numbers somewhat later. Of the 21 million acres of cropland, 1.86 million hectares (4.6 million acres) are presently irrigated. A five fold increase in the area irrigated from groundwater was planned between 1980 and 1985 and this will account for about half the area irrigated in Bangladesh by 1985 (Master Plan Organization Second Interim Report. Vol. III, Page 2-1 June, 1984). In other words, most of the land currently irrigated is newly irrigated land. Unless large scale surface water irrigation projects are implemented, virtually all of the future expansion of irrigated area in Bangladesh will be based on the use of groundwater.

Between 1972/73 and 1982/83 an estimated 53 percent of the increase in foodgrain production came from rabi (winter) season crops. The potential exists for the expanded exploitation of groundwater which will permit a large area of irrigated land to be planted to rabi season crops such as HYV boro (winter rice) and upland crops such as wheat. An expansion of land irrigated from ground water represents a significant portion of the potential for expanded food production in Bangladesh. The cost of the expanded exploitation of groundwater and hence the cost of expanded food production will be significantly influenced by the level of economic efficiency which prevails in development of Bangladeshi groundwater resources. In addition, important equity issue will probably be involved. In virtually every other part of the world, the way in which irrigation projects have been designed, implemented and administered have had major impacts in determining who benefits from such projects.

The purpose of this report is to present the findings and recomendations of the External Evaluation Team which evaluated the Bangladesh Agricultural Research Council-International Agricultural Development Service (BARC/IADS) Irrigation and Water Management Program area of the Agricultural Research Project-Phase II (ARP-II) during July of 1984.

A. Objectives of the Irrigation and Water Management Program

The objectives of Phase II of the Agricultural Research Project states:

"The purpose of the Agricultural Research Project - Phase II is to increase the effectiveness of agricultural research necessary for development of appropriate agricultural technologies for Bangladeshi farmers. This will require both: (a) building capabilities to move agricultural research activities into farmers fields where production problems can be identified and solutions tested; and (b) building strong, responsive core discipline research programs to develop the new technologies that can address these problems. Additionally, concentrated efforts must be made to link different agricultural institutes into a research system relevant to achieving the country's agricultural development objectives of greater food production through more productive use of land and labor."

This statement generally described the basic objective of the project. The objectives of the Irrigation and Water Management Program area of the Project is made more explicit in the amendment no. 6 to the contract.

"This amendment recognizes the inter-relationships between increases in rice production and expansion of irrigated acreage. The complementaries among research efforts directed toward increasing water use efficiency, improving cost and energy efficiency of water lifting devices, expanding irrigated command areas and growing more rice per cropping season and per unit of land, are the main objectives. Benefits are directed toward those 9 million farmers growing crops, principally rice, on 0.80 hectare (2 acres) or less, 55 percent of whom only plant one crop per year and 38 percent of whom only plant two crops per year. Irrigated acreages must be greatly increased and better rice varieties and cultural practices developed if Bangladesh is to reach and maintain food self sufficiency. Research efforts to develop improved technologies in rice production and water management support this goal."

B. Purpose of the External Evaluation

The purpose of the evaluation is stated in the Terms of Reference for the External Evaluation Team.

"1. Evaluate the performance of the IADS Irrigation Water Management team and their BARC's counterparts in terms of their ability to plan, coordinate, implement, monitor and evaluate activities of the program.

2. Evaluate progress in each one of the line items called for under the program:

(I) Specialists and Consultant,
(II) Local Support,
(III) Overseas Training and Travel,
(IV) In-country Training and Sabbatical Studies,
(V) Contract Research,
(VI) Commodities

3. In connection with 2 above identify constraints and suggest remedial actions if pertinent.

4. Assess the impact of the program area on participating institutes

5. Assess the relevance of the program area on the country's Irrigation Water Management needs."

The Evaluation Team has placed considerable emphasis on the fifth item, the relevance of the program relative to the country's needs.

C. Perspectives of Irrigation and Water Management in Bangladesh.

During the rabi season (from November through early March) intensive agriculture is not possible in Bangladesh without irrigation. In addition, supplemental irrigation has an importent role to play during those years when the monsoon either starts late or is otherwise inadequate. Irrigation from shallow tube wells (STW) and deep tube wells (DTW) has expanded rapidly in the recent past and in some areas total water abstraction has been great enough to cause some STW's to become non-operational. While such areas are limited in number, those people well informed about the use of groundwater in Bangladesh have come to understand that ground water is indeed a scarce natural resource. A few individuals are more alarmed and view the situation as a potential crisis. An authoritative statement on the situation which come to the attention of the Evaluation Team can be found in the Second Interim Report (June-1984), Master Plan Organization (MPO) of the National Water Plan Project. In the remainder of this section, we will (1) summarize those conclusions of that report which are relevant to the responsibilities of the Evaluation Team, (2) discuss alternative agricultural responses which are either proposed or which are already taking place within the country on a limited scale and (3) relate these two sets of ideas to the role of a relevant research program in irrigation and water management.

The Second Interim Report of MPO states, "At present eleven percent of the net cropped area is irrigated from

groundwater. With full development of groundwater this may be increased to 34 percent under the present rice based regime but it could expand to 50 percent under a mix of rice and wheat depending on soil constraints "(pg 5-12, vol 1). The MPO stresses that while the data used in the analysis was the best available and was consistent with both small scale detailed surveys carried on by MPO and the general principles of ground water hydrology, much more information must be gathered before the conclusion can be treated as definitive. However, at the present time, the most likely estimates of the proportion of the net cropped area of 8.50 million hectares (21 million acres) in Bangladesh which could be irrigated with groundwater during the rabi season would include the statements:

(1) If the irrigated land is planted to boro-rice and traditional irrigation practices are followed, it may be possible to irrigate no more than a 3rd of the area.

(2) If the cropping pattern on irrigated land included at least one half of the irrigated land planted to upland crops such as wheat and the rest of the land planted to boro-rice, it may be possible to irrigate at least half of the net cropped area from groundwater.

(3) It is highly unlikely to irrigate all of the net cropped area from groundwater in Bangladesh.

Conditions throughout the country are not uniform and site-specific conditions must be considered in planning the development of water resources in a given area. The cause of the problem is that the annual rate of recharge of the groundwater acquifers is significantly less than the consumptive use of water by most of the irrigated season crops which are likely to be grown on the land.

Groundwater in Bangladesh is therefore in the process of becoming perceived as a scarce resource which must ultimately be rationed among its potential users. With increased emphasis on privatization in Bangladesh, the emphasis on groundwater development has shifted towards the development of private STW. While government subsidization of pumps , credit etc. have continued, the rate of groundwater development has been much more rapid than was the case when development depended much more on direct action by government. However, in some areas credit programs for private groundwater development have been withdrawn because of the decreased level of groundwater acquifers caused by high levels of abstraction. The country wide rate of expansion in the numbers of STWs has also begun to slow down.

It seems increasingly clear that the optimum development of groundwater resources in Bangladesh will not take place without appropriate policies to guide development.

The basic economic problems involved in the development of a resource with the characteristics of ground water in Bangladesh are clear. Groundwater acquifers of the type found in Bangladesh are a common pool resource and some of the cost of pumping (those associated with increasing cost for neighboring wells due to a draw down in the level of the water table) are externalities. A "market failure" will occur when such externalities exist. A "market failure" means that the pattern of resource use generated by market forces will not be socially optimum. Given the evidence cited by Gill (Gerard Gill, "The Demand for Tubewell Equipment in Relation to Groundwater Availability in Bangladesh" BARC Agricultural Economics and Rural Social Science Paper No.13, November, 1983)and by MPO, it is clear that in some locations in Bangladesh,the magnitude of the market failure is likely to be significant. While the problem is clear, the solution is not. A common approach in such situations is to regulate the number and spacing of wells as well as the rate of abstraction. However, if the number of wells in an area are limited, those wells themselves become the scarce resource and the controllers of those wells are capable of charging prices for water which far exceed the marginal cost of pumping and distributing the water. This condition not only permits the existence of another market failure, it also raises serious questions about the equity or fairness of irrigation well developments; that is, the act of regulation will influence who will gain as the result of irrigation well development.

The physical response to the rationing problem where the potential demand for irrigation water exceeds the potential supply would be to bring about changes which would lessen the amount of water demanded at any specified water price, i.e. cost of water paid by the farmers. The three basic means of accomplishing this objective would be (1) change the cropping pattern to modify the consumptive use of water, (2) increase conveyance efficiency and (3) increase field efficiency. In evaluating alternatives for increasing conveyance and field efficiencies, the impact of return flow to the acquifer must be considered. The Evaluation Team has become aware of three alternative cropping patterns which have either been proposed or are already being used by farmers which could change the consumptive use of water.

1. A shift from boro rice to either a boro rice and wheat or a wheat crop during the rabi season.

2. A shift from an Rice (T. aman)-Rice (Boro)-Rice (aus) cropping pattern to an aman boro-rice green manure crop. Some farmers have shifted to this type of a cropping pattern after experiencing falling yields with either an aman-wheat-aus or a aman-boro-aus cropping pattern.

3. A shift from a aman-boro-aus cropping pattern to a aman-early wheat- late boro (or boro-aus) rice cropping pattern.

While there may be additional cropping patterns which could change the consumptive use of water, they were not called to the attention of the Evaluation Team. The Evaluation Team was not able to perceive that any systematic research work was being done or is planned on the economic - financial, agronomic, fertility, disease and water-use implication of any of these alternative cropping pattern. In fact in the case of the most widely discussed alternative, the proposed shift from boro rice to wheat, both the enterprise cost studies available and the actions of farmers indicate that farmers have sound financial reasons for not making such a change in their cropping pattern.

Irrigation development is relatively new in Bangladesh. That development appears to have reached a stage where enough information is available so that the image of the most likely future for irrigation in Bangladesh is beginning to change and a more realistic idea about both the potentials and the problems are beginning to emerge. The potential for irrigation to contribute to expanded food production in Bangladesh is significant and the importance of this expanded food production to the well being of this country is obviously great. If the Evaluation Team is correct about the changing image of the most likely future for irrigation in Bangladesh, this seems to be an important time for planning irrigation and water management research and associated agricultural research in Bangladesh. While individual scientists and administrators are aware of and excited by this change, the implications of this change or perception does not seem to be generally recognized. As a result, the required general re-thinking and analysis of the research opportunities and problems is not yet complete. The work of the Evaluation Team was significantly influenced by this view of the current stage of irrigation development in Bangladesh. However, the Evaluation Team also realizes that full information about this change is not available and this prompted the Evaluation Team to present both Recomendations, where the evidence seems strong, and Concerns, where the evidence is indicative, but not conclusive.

II. BARC/IADS Project Irrigation and Water Management Program Area

A. Make up and Expertise in the Team

The contract amendment increased expatriate technical assistance from one on-farm water management specialist for 60 months to two additional specialists, an agricultural engineer for 48 months and a water management extension specialist for 48 months. All of these individuals are now on-site although the on-farm water management specialist has only been on site for a little more than one month and the agricultural engineer since September 1983. Terms of reference for each of these position are listed in appendix A. Obviously these terms of reference provide broad guidelines and it appears that the individual team members have tended to concentrate on one or two of the terms listed or on others assigned on the basis of need.

The Evaluation Team believes that in order to function effectively the expatriate team members need to work closely with local professionals. While these need not be the only people that the team members work closely with, such a relationship is necessary to provide the team member with reliable linkage to BARC. The Evaluation Team has identified the technical working relationships as follows: water management extension specialist works with the Member - Director for Soils and Irrigation, Agricultural Engineer works with the Member-Director for Agricultural Engineering (or since that position is currently vacant with the senior officer in that division), and the Water Management Specialist works with the Principal Scientific Officer for Irrigation in Soils and Irrigation. These relationships are not explicitly identified in any documents reviewed but were deduced from interviews with individuals. All members of the team, both expatriates and local professionals, are well qualified from an educational and experience standpoint:

B. Evaluation of the team

In a general sense the IADS team members appear to have specialised in certain areas within their terms of reference. Thus the water management extension specialist has emphasized planning and implementation of short courses and workshops while the agricultural engineer has concentrated on developing the contract research program. The irrigation engineer (water management specialist) has been in the country slightly more than one month and is still in the process of defining his working relationships and priorities.

Working relationships among the team members appear to be good. Their ability to plan, coordinate, implement and monitor programs is evidenced by the two very successful workshops and

the diagnostic analysis short course. These appeared to be well planned, smooth in operations which have contributed to the project objectives. Similarly the team appears to be doing a good job of implementing, maintaining, and evaluating the contract research program.

However, some problems are evident which may limit the ability of the team to work effectively. While we earlier identified counterpart relationships this identification was not easy as the individuals were not certain, in all cases, with whom they should be working. This was true of both IADS personnel and BARC Officers. It is important that the IADS team members not develop and execute programs on their own but rather with their counterpart. In order to do so effectively they must be able to identify the working relationship and the counterparts should also be aware of the relationship.

A constraint on the effective utilization of the skills of the Irrigation Water Management Specialist is the proposed split of his time between Bangladesh Agricultural Research Institute (BARI), Joydebpur and the BARC office. Although the original contract stated that the water management specialist "May be based at a participating institute", it did not require that he be located at BARI. It did note that he "will work with the BARC Member-Director (Soils and Irrigation)". While we recognize that the irrigation and water management program at BARI needs strengthening, unless research leadership, more senior staff and more technical equipment is provided, the Evaluation Team does not believe it would be productive to have the water management specialist spend most of his time at BARI.

The only other obvious constraint is the lack of engineering manpower in BARC. This often results in delays in planning and approval for activities such as workshop. Filling of the Member Director position for Agricultural Engineering would do much to alleviate this problem. It also seems logical to locate the Irrigation and Water Management Program under Agricultural Engineering rather than under Soils. The Research Program in soils is large and so important that those programs may be better served if the Member Director could devote his full efforts to that area alone.

III. CONSULTANTS

A. Expatriate Consultants:

The contract amendment which expanded the scope of the Irrigation & Water Management program called for an increase in expatriate consultancies from 2-six month consultancies to 40 persons months. Documents provided to the review team indicate that nine consultancy reports have been submitted in the past 2 years. These consultancies involved 15 expatriates. The reports covered irrigation equipment(2), economics(3), water law

and policy(2), workshop feasibility (1) and university program (1). In general these reports appear to be timely and have addressed problems of immediate concern to development of the Irrigation and Water Management research program. However, it is unclear how the results of these consultancies will be utilized. The reports generally offer suggestions for program direction or specific research problems. One would hope that a consultant report is a means to an end rather than an end in itself. Therefore it would seem that each consultancy should be followed by an in-house BARC/IADS seminar/workshop to discuss the utility of the consultancy to the Irrigation and Water Management Program and initiate any action required as a result of the consultancy and workshop. (i.e. there should be some mechanism to assure that there is adequate follow-up for each consultancy).

A second point of concern regarding the use of consultants is that a consultancy be undertaken only with adequate in-country support and back stopping. Each consultant should have a local counterpart for the duration of his consultancy. Some of the individuals interviewed in this evaluation felt that consultants should work more closely with BARC staff rather than primarily with IADS expatriates as now seems to be the case. Assignment of a local consultant counterpart would help facilitate this.

B. LOCAL CONSULTANTS:

A total of 60 person months of local consultancies was called for in the contract amendment. It appears that this will be very difficult to achieve based on performance to date. Information supplied to the reviewers indicates that only one report, an internal review, was submitted by a local consultancy team of three individuals. One of the BARC Member-Directors commented that there was money to spend on local consultants but no people to spend it on. The team questions this allegation for while there is a general shortage of trained people in the Irrigation & Water Management area in Bangladesh, there are some highly qualified individuals at some of the local institutions, including those associated with BARC, who could make significant contributions to specific problems.

It might be well to consider the use of local consultants in conjunction with expatriate consultants. This would also help ensure that the expatriate has a local counterpart with whom to work. While such an arrangement may not be appropriate in all cases this approach should be followed unless a deviation from this practice can be justified.

IV. Training

The training component for irrigation and water management comprises almost 30 percent of the budget added in the 1982 amendment to the original contract which greatly expanded the irrigation and water management component of the contract.

A. Overseas degree training

Given the task of increasing the effectiveness of irrigation and water management research necessary to develop irrigation water resources of Bangladesh, it appears obvious that it was necessary to train a number of individuals in irrigation and water management areas. The only institution in the country which offers such training is Bangladesh Agricultural University (BAU) (Johnson et.al. 1983) and there only at the MS level. That degree program was viewed as weak by the October 1983 review team and in need of strengthening. Thus the training of a significant number of individuals in degree programs out of country seems the logical alternative unless the BAU rpogram is strengthened. The original contract apparently included provisions for training of people in the irrigation and water management area. These included 3 at the MSc level in Ag. Engineering and 1 MSc in Rural Social Science (Amendment Documents 1982). It appears from project training records that in fact only three people are being trained in the irrigation and water management area under the original contract. This includes a PhD at Colorado State University, an MSc at Fresno State University and an MSc in the Ag. Eng. Machinery area at the University of the Philippines at Los Banos (UPLB).

These people should be returning to Bangladesh within the next year although it is uncertain where they will be assigned upon return.

An amendment to the original project called for third country degree training for 10 persons at the MS level in irrigated agricultural systems. Information from the project training officer indicates that these 10 individual are now in degree programs at various institution as follows:

Agricultural Engineering

3 students in water resources at the Asian Institute of Technology (AIT)

Agricultural Economics

3 students at UPLB

Water Management Extension

2 students at Central Luzon State University (CLSU)

Agronomy

2 students at CLSU

This appears to be a good mix providing that the Agricultural Economics students are in a program geared toward water resources management.

There are apparently plans for additional degree training with emphasis in the irrigation engineering area. Since expenditure of funds for in-country training has been less than planned it has been proposed that some of these funds be used to finance training for 4 individuals at the PhD level and 6 at the master level. Of the PhD level traineees 2 would be in the US and 2 in third countries while for the proposed MSc Programs 2 would be in-country and 4 in the US.

B. Overseas Non-Degree Training

The original contract called for 9-six month courses in non-degree type training. The amendment calls for an additional 40 individuals with non-degree level training in irrigation systems.

The Jan-June 1983 six month progress report indicates that 8 individuals received short term training in water management and one received training in Agricultural Enginneering. This appears to be in line with the nine called for in the original contract. However the July-Dec 1983 report indicates that only four agricultural engineers received short term out-of-country training in that time period.

C. Evaluation of Out-of-Country Training

Out-of-Country training forms an important part of the means of achieving the overall project objective of strengthening the research capabilities of institutions in Bangladesh. The out-of-country degree training programs appear to be well underway with all planned scholarships currently filled. The mix of disciplines represented appears to be appropriate to the objective of the water management program. The critical factor which will determine the contribution of these individuals to agricultural research in Bangladesh will be their placement in research positions upon their return and the mandate and funding required to carry out meaningful research.

The proposal to utilize in-country training funds to support additional out-of-country degree programs would appear to be a good use of those funds given the present limitations in water management in Bangladesh (Johnson et. al 1983). However, care should be taken to ensure that the individuals chosen pursue degrees which can be identified as a need in the irrigation and water management area. Such needs currently appear to exist for PhD level training in economics of water resources and in irrigation engineering with emphasis on on-farm water management and tube well irrigation systems. At the MS level similar needs exist although concentration at the MS level is generally less narrow. However, it appears that expertise in well design and development techniques is lacking in the current research program. One of the MS students should emphasize this area of study.

Non-degree out-of-country training can be a valuable means of introducing new concepts to professionals who already hold advanced degrees. It also is a valuable mechanism of technology transfer. The tour of pumped irrigation schemes in India is an excellent example of such training. However the non-degree training appears to be constrained by the difficulty of getting timely approval for out-of-country travel. Timely approval is especially important in those cases when the training involves attendance at a scheduled meeting, conference or training workshop. In as far as possible, the out-of-country short term training effort should continue. Adequate advance planning to ensure time for government approval is a necessity in these cases and it might be well to review current procedures and draw up some guidelines in cooperation with the Ministry of Agriculture to ensure that minimum time tables for clearances are met. While clearance for travel has also been noted as a problem for out-of-country degree training it appears to have been less of a constraint in those cases than in the short term training and in fact appears not to have constrained the degree training program.

The training unit of BARC and IADS have developed an excellent Handbook for Manpower Development which sets forth procedures to be followed in selecting individuals and programs for training in-country as well as abroad. This handbook serves to standardize application and selection procedures and is aimed at ensuring that the most highly qualified individuals are selected for training. The handbook also gives procedures for the sabbatical leave program. One requirement relative to the degree training program is that it is required that scholarships be announced in a newspaper and applications are accepted for screening from a wide number of institutions. Thus the training is not associated with a particular position in a particular institution but rather a national need. While this approach is laudable and will serve to increase the level of

training of persons in the country, it does not allow the program to be used explicitly for strengthening the irrigation water management manpower within a specific institution. Thus an individual may be selected from an institution which already has a reasonable level of expertise in the area and he will most likely return to that institution upon completion of training. Meanwhile there may be an institution with a greater need to strengthen its capabilities in the area. While this is not a major constraint it does appear to limit the capability of the degree training program to fullfill needs of specific institutions.

An additional problem that has been noted is that a number of individuals sent for training in a particular area and the type of training which they are to receive is often determined by the training office rather than the Soils and Irrigation Division. It seems that the Division should hav a better assessment of training need and their recommendations should be followed whenever possible.

D. In-Country Training and Sabbatical Leave

The 1982 amendment to the original contract greatly expanded the in-country training component. In that document it was envisioned that 720 persons would be trained in farm water management through a series of 36-six week courses. Twenty four national workshops and seminars would be utilized to train 1200 scientist and extension personel in improved water management techniques through a series of three-day national workshops and seminars. In addition, the contract research program was recognized as a means of developing inter-disciplinery research capability among the research institutes. Although not explicitly mentioned in the contract amendment the sabbatical leave program is included in the budget for in-country training and has the objective of strengthening institutional linkages and providing opportunities for scientist to update their expertise. There appears to be no specific goals in terms of the number of sabbaticals to be covered by the project. No in-country degree training was anticipated in the irrigation and water management area.

E. Evaluation of in-country training and sabbatical leave

Major accomplishments in the past two years of the project relative to in-country training have centered around short courses and workshops.

Two important workshops have been conducted. The first, a workshop an "Research and Research Priorities in Irrigation and Water Management", served to bring scientist from a number of institution together to discuss research priorities. This workshop led to publication of research recommendation by BARC titled: "Research Priorities For Research in Irrigation and Water Management". This appears to be an excellent and timely piece of work and it may be concluded that the workshop was a significant contribution to Irrigation and Water Management Research in Bangladesh.

A second workshop an "Improved Distribution Systems for Minor Irrigation in Bangladesh" was held in July 1984 and attended by members of the Evaluation Team. This workshop appeared to be well planned and the team members were impressed by the quality of papers presented. Follow up discussions led to a set of recommendations regarding distribution systems which will be published.

The quality of these workshops appear to be good and they are resulting in some valuable guidelines for Water Management research as well as providing a forum for interaction among professional at the various institutes. However, given that only two such workshops have been held in two years it would appear that the plan for 24 such workshops authorised in the contract amendment was over ambitious and will be difficult if not impossible to achieve.

Two short courses on Dignostic Analysis were conducted. The first in March 1983 involved a joint expatriate - local expert team of trainers and was conducted over about a 5-week period. The shortcourse appears to have been well planned and executed although there has been some criticism that there may not have been adequate in-country back stopping for the expatriate team. This does not, however, appear to have been a serious limitation. This shortcourse led to a follow-up course on Diagnostic Analysis conducted by the Bangladeshi team at the Bogra Rural Development Academy (RDA) in March 1984. Although the final report from that workshop has not been completed it appears to have been a useful exercise for the in-country training. There is a question of what the additional follow-up will be and to what level training should be directed. Discussion indicates that Diagnostic Analysis will be incorporated into the IMP training program for Upazilla level officers now being conducted at the RDA. This will make good use of the training provided by the initial shortcourse. Additional follow-up should be considered for training at other institutes.

Five short courses are planned for 1985, including one on groundwater and one or wells. pumps and pumping. They will follow a format similar to that of the diagnostic analysis course in that an expatriate team will be used. The topics are appropriate and the courses should be a positive contribution toward project objectives.

The format of using an expatriate consultant team with pre-trained Bangladesh counterparts to conduct the short courses seems to work well and additional short courses of this type are encouraged. However, it again appears that the contract was over-ambitious for it will be difficult as well as unwise to conduct 34 of these short courses within the next two years.

Given that there is a considerable amount of confusion regarding ground water, optimal cropping patterns under tubewell irrigation and irrigation development strategies it would be useful to conduct a series of true workshops of up to one week in length which use modelling technique to assess impacts of alternatives. Such workshops would bring together professionals from the various institutes with a team of expatriate consultants and should result in a better understanding of which direction irrigation development should take. In addition the participants would receive valuable training in computer modelling and interdisciplinary teamwork. If properly conducted, the results of the workshops would provide some much needed direction to research in irrigation water management in the country.

There appears to have been no participants in the sabbatical leave program within the irrigation and water management area. Our interviews indicate several possible reasons for this. First the sabbatical program was not well advertised initially. Secondly individuals in some institutions, especially BAU have only a vague understanding of what the program entails. At BAU there is no provision for taking over the duties of a professor on sabbatical. Although the university does not explicitly discourage participants it also does not encourage it. Possible participants are concerned about added expense of living in Dhaka and are very reluctant to take the risk of losing money.

Perhaps the greatest constraint to the sabbatical program however is the BARC requirement that sabbatical participants be associate professor or above and have 7 years experience. Only two of the faculty members at BAU fall into this category. A similar situation exists at Bangladesh University of Engineering Technology (BUET). Under the circumstances it would appear that a seperate leave program for strengthening junior faculty members should be initiated.

V. Contract Research

A. Description and Purpose of the Program.

The stated purpose of the BARC contract research program is to focus efforts on immediate practical agricultural production problems and to foster inter-disciplinary and inter-institutional research. The contract research program provides the mechanism by which resources may be allocated to various research institutions depending on their mandates, resources and capabilities. In addition to the obvious research function, we see the contract research program as a powerful tool for institutional development in terms of both personnel and equipment. Contract research comprises almost 20 percent of the water management component of the IADS/BARC budget in irrigation and water management and one would thus expect that a significant amount of effort put forth by the irrigation and water management team would focus on contract research.

B. Evaluation of the Contract Research Program.

The evaluation team has not attempted to evaluate individual projects but rather has chosen to look at the overall program in irrigation and water management and the impact of the contract research program on participating institutions.

At the time of evaluation there were 10 funded on-going research projects dealing with irrigation and water management and 12 proposals in various stages of review. Many of these projects seem to be well planned and address important problems.

A number of on-going contracts and proposals however, appear to deal only marginally with irrigation and water management research. Given the great need for research information in irrigation and water management, steps should be taken to ensure that the research funded under contract research has irrigation and water management as its primary focus, not merely a peripheral concern. Of the on-going projects reviewed by the evaluation team, 6 projects deal only marginally with irrigation and water management.

The research program seems to lack focus and reflects somewhat the fragmented nature of irrigation and water management issues in Bangladesh in general. A strong effort should be made in request for proposals and in the review process to focus research toward the highest priorities listed

under Irrigation and Water Management in the National Agricultural Research Plan 1984-1989 which were compiled from the workshop on research and research priorities mentioned earlier.

Some of the on-going research projects which deal with command area development often do not have adequate participation by social scientist, either economists or rural sociologist. This may simply be a reflection of the scarcity of these professionals who have a background in water in Bangladesh but never-the-less represents a constraint.

Engineering manpower within BARC is inadequate to properly develop the liason and monitoring relationships required with participating institutions. This was identified as a constraint in the 1983 external review of contract research and still remains a problem. Not only is the problem one of not enough professionals, the engineers in BARC, although competent and well trained, are generally junior too and comparatively inexperienced relative to many of the engineers in the participating institution with whom they will interact. To provide the leadership required in irrigation and water management research the BARC engineers need a team of experienced professionals led by a senior experienced individual. We suggest that some BARC positions be filled by rotating people from other institutions into BARC for a one or two year period. An alternative to the present situation would be to have those positions immediately subordinate to the Member-Director filled by senior professionals rotated in from other institutions. Such an arrangement should serve to strengthen linkages between BARC and the institutions it serves and would also contribute to the career development of the professionals involved.

A significant constraint to United States Agency for International Development (USAID) funded contract research is the limitation which excludes vehicles and manufactered equipment outside of Bangladesh from the contract. To assume that an institution has the equipment necessary to carry out the prescribed research runs counter to the basic premise of the project that there is a need to build research capability of the research institutron. Equipment is often one of the major constraints to meaningful field research. If this policy is inflexible then we suggest that BARC fund projects from more than one source where vehicles and/or foreign made equipment is a genuine requirement of the project. For example, USAID funds could be used for salaries, local travel and supplies and expense while World Bank funds or those from other less restrictive sources could be used for vehicle and equipment purchases. In any case principal investigators submitting proposals should be made aware beforehand of the possible limitations.

An additional constraint which has been identified is the the often extreme delay in the release of funds for contract research. In a case brought to our attention the delay was so great that scientific officers paid from project funds went for several months without pay. Such a situation is intolerable. We were not able to determine the cause of such delays but point it out here as a constraint in which the cause needs to be determined and action taken to correct it.

The contract research program has the potential to be a significant catalyst for development of participating institutions. Young scientists at the institutions are enthusiastic about the opportunities the program provides. The irrigation and water management team and BARC engineers have done a good job of informing those scientist of the opportunities and of helping them develop proposals. Care should be taken not to dampen this enthusiasm.

VI. COMMODITIES

A. Background:

Commodities represent an important element of the irrigation & water management component. Research equipment is not readily available in Bangladesh and in fact one of the constraints to irrigation and water management research has been lack of adequate equipment for field research. The contract amendment (irrigation and water management component) budgeted a total of 190,000 dollars for commodities for institutions in addition to the commodities for water management from other sources within the project. The importance of commodities to contract research was discussed in the previous section and it was pointed out that the inability of a researcher to obtain funds for equipment is a severe constraint on that program. In retrospect it seems that less than 5 percent of the total budget is an inadequate amount with which to undertake, let alone strengthen, research programs at several institutions. By contrast USAID provided funds to Bangladesh Rice Research Institute (BRRI) which included 1.6 million dollars for commodities which represents nearly 30 percent of that budget and the BRRI research program is reasonably well established.

The 1983-84 annual financial plan proposed expenditure of 200,000 dollars for commodities within the irrigation and water management component. The annual internal evaluation by the IWM team notes that, in fact, 168,00 dollars were committed for commodities during fiscal 1983-84. A total of 241,086 dollars has been committed to Irrigation Water Management (IWM) as of

1 April, 1984. That document also indicates that 43,604 remained in the commodity budget for the irrigation & water management program. Furthermore 125,310 dollars were transferred from the irrigation and water management program to the soil management program. It should be pointed out that these latter funds were discretionary funds from the original contract and not a part of the irrigation and water management amendment, although they had earlier been designated for the irrigation and water management program.

It is the understanding of the Evaluation Team that all commodity funds in the project have been committed. We are concerned that there still exists significant need for commodities to support the objectives of the Irrigation and Water Management component of the project. A possible source of additional funds would be to transfer funds from under utilized line items either within the program or from other programs to fund commodity items in the irrigation and water management program.

B. Discussion and Evaluation

It is not clear to the Evaluation Team what the status is with regards to the future purchase of commodities. On the one hand, the current allocation for commodities appears to be committed and no future purchases of commodities will be possible. On the other hand, there is some precedent for requesting limited transfers from one budget catagory to another; in which case, future purchases of additional commodities would be permitted. It does appear that regulations of USAID-Dhaka prohibit both the purchase of vehicles under funds from this project and the purchase of commodities using contract research funds. Unless BARC takes the lead in combining USAID funds with other funds which can be used to purchase vehicles and commodities, these USAID policies represent serious constraints on the viability and meaningfulness of the contract research program. Even if the needed commodities for a contract research project can be obtained, if USAID funds are used, receipt of the commodities would delay the start of the research effort by one or two years. The serious impact of an inability to purchase commodities in the future can be illustrated by examining three cases the Evaluation Team is aware of; (1) a recently approved contract research project, "A Comprehensive Study on Economic Viability of Deep Tubewell Irrigation in Joydebpur Area," P.I.-Dr. Kh Azharul Haq- BRRI, (2) a proposed contract research project, "Groundwater Resource Assessment for Development. P . ning of Tubewell Irrigation System in Tangail Area", P.I.-Dr Lutfor Rahman Khan- BAU and (3) the proposed development of a viable Irrigation and Water Management Section of the Agricultural Engineering Division of BARI.

In the case of the recently approved BRRI project, BARC's aproval indicates the project is considered to deal with an important problem and to be staffed by competent individuals. The P.I., Dr. K.A. Haq told the Evaluation Team that the commodities were crucial for the successful completion of the project and that he did not know commodities could not be purchased until he received the check for the first quarter of the project and noted that the amount was significantly less than he had requested. On investigation, he found the difference existed because the commodities had been excluded.

Dr. Haq told the Evaluation Team that if the commodities could not be made available from some source, he would have to consider requesting cancellation of the project. The Evaluation Team would consider such a development very undesirable.

The proposed groundwater resource assessment project located at BAU certainly deals with a crucial issue; knowledge about the impact of alternative abstraction regimes on groundwater. This type of information is key to planning future groundwater development. The P.I. of this proposed project, Dr. L.R. Khan, completed a PhD in the UK in 1982 and specialized in groundwater modelling. The Evaluation Team was told by several knowledgeable people that L.R. Khan is the only Bangladeshi in country who has had specific training which is called for in the proposed project. The Evaluation Team was very impressed during their discussions with Dr. Khan and his academic record was first rate. He is struggling to begin a research program and similar work has not been done in Bangladesh by a Bangladeshi. His commodity requests could undoubtedly be trimmed, but if the project is funded he cannot begin this important work if all the commodities are eliminated. The USAID and Bangladeshi policies on purchase of vehicles are particularly troublesome since the successful completion of the project would require considerable travel to field sites by both Dr. Khan and his assistants. It is not conceivable to the Evaluation Team that this would be a meaningful project without the commodities being made available. The Evaluation Team is not aware of any on-going efforts to find alternative sources of fund for the needed commodities. The Evaluation Team considers such an obvious conclusion to be a source of great concern.

The proposed development of a viable Water Management Section of the Agricultural Engineering Division of BARI is apparently a high priority objective of BARI and BARC which is shared by the USAID Agricultural Research Project-Phase II. The Evaluation Team agrees with this priority. There appear to be several problems; the Water Management Section is currently staffed by junior people and the irrigation and water management work is currently coordinated out of the Soils Division. IADS

is currently considering assigning one of its expatriate specialists to assist in the development of the new section. While BARI is scheduled to receive commodities earmarked for irrigation water management work, the Evaluation Team concludes that it is almost inevitable that the Irrigation Water Management Section cannot become a viable research unit without the simultaneous commitment of (1) more senior staff members (2) research leadership, (3) technical assistance and (4) a significant build up of technical equipment. Failure to provide any of these four catagories of help will probably mean a failure to achieve the objective: a viable research unit in BARI for irrigation and water management research. Once again, unless other sources of funds are found, the current policies on purchase of commodities will probably mean the failure to achieve an important objective which will affect the future success of Bangladeshi agriculture.

VII. Impact of the Irrigation and Water Management Program on Bangladesh Institutions

A. Introduction

From all the discussions we had and from all the documents presented to us it was clear that ARP II provided an immense opportunity to Bangladeshi Research Institutes. Individual researchers can be provided with additional resources (including foreign experts) with which to do better research which is more production oriented. The Bangladeshi researchers are now in better position to help the policy makers and planners with more accurate information and the farmers with new technology and economical ways of producing more food and fibre crops.

Individual researchers in any of the constituent institutions can take the initiative and prepare a research proposal asking BARC for funding. BARC on the other hand can establish contacts with individual researchers, both within constituent institutions and outside the BARC umbrella, to support useful research projects to strengthen the Irrigation & Water Management work by those institutions and individuals. The constituent institutes are aware of these opportunities and have utilized the research resources of BARC through contract research programs, overseas and in-country training programmes and by taking advantage of the assistance of the expatriate advisors.

E Impact of Participating Institutions

Any changes which take place in an organization are caused by the interaction of many forces. No attempt was made by the Evaluation Team to analyze the changes which are taking place in participating institutions. While only the impact of the Irrigation and Water Management Program is discussed here, the Evaluation Team is aware that many more forces are involved in both augmenting and diminishing the changes discussed. Of principal importance are the efforts of the Bangladeshi professionals, but the impact of other donor agencies has been very significant.

Modern irrigation tubewell agriculture is relatively new in Bangladesh and research in the area of irrigation and water management is of even more recent origin. The Irrigation and Water Management Program was only recently established and because of problems of recruitment, the team of three expatriate specialists was only completed six weeks ago. The participating institutions received their first commodities under the program only a few months ago. Therefore, the impact must be thought primarily in terms of the likely potential impact.

1. BARC. The Review team felt the BARC publication, "Priorities for Research in Irrigation and Water Management" (December, 1983) represents a significant accomplishment in agricultural research policy. The recently sponsored workshop on irrigation distribution systems will result in a similar publication which will deal with a narrower, but still significant set of issues. The Contract Research Program, which has problems discussed elsewhere in the report, has been actively promoted by BARC. While the various training programs have also encountered problems, significant progress has been made in implementing a program which will result in increasing the quality and quantity of individuals with skills relevant to irrigation and water management research. These advances would either not have taken place or would have taken place on a much reduced scale without the Irrigation and Water Management Program. However, perhaps the most important impact that the Irrigation and Water Management has had on BARC has been intangible in terms of its role in highlighting the opportunities which exist for productive research work in the field of irrigation and water management in Bangladesh. All of these impacts also influence other Institutions in Bangladesh, but these impacts will not be repeated below.

2. BAU. The impact on BAU has been in three areas. (a) Commodities have been ordered which will provide necessary improvements in labs and in the ability to do field research -

a critical component of any irrigation and water management research program. Because of the initial starting point in a new research field, much remains to be done in the area of needed additions to lab and field equipment-particularly with regards to transportation. (b) In-country training, workshops, visitations by project experts and consultants, the availability of a contract research program as well as the opportunities for long term and short term out of country training all contribute towards both building and maintaining the professional viability of staff members. The faculty of the Department of Irrigation and Water Management at BAU is generally young, highly motivated (perhaps in part because of the program) and a significant number have advanced degrees from good universities. (c) the graduate program in irrigation and water management at BAU is struggling as all new graduate programs do. In order to build that graduate program, additional funding for graduate students must be found. Generally, that means graduate students need to be classified as Scientific Officer (S.O.)s and the students would work on contract research projects in the area of irrigation and water management. An in-country graduate program in irrigation and water management is necessary if Bangladesh is to realize its potential from irrigated agriculture.

3. BARI. The discussion of equipment and staff viability also apply at BARI. In addition, the commitment to build a viable Irrigation and Water Management Section in the Division of Agricultural Engineering has been made. However, it appears to the Evaluation Team that the impact of this general commitment will not be significant unless specific commitments are made which have been discussed elsewhere.

4. BRRI. BRRI is an older more professionally mature agricultural research organization with a well earned reputation for good research work. This is one instance where the Irrigation and Water Management Program can capitalize on and compliment on-going research programs. However, the program has had a major impact on encouraging BRRI research to branch out and include work on groundwater, pumps and distribution systems.

5. Other Research Institutions and Donor Funded Programs.

The Evaluation Team visited the Rural Development Academy at Bogra and became aware of their research and training program. As of yet, the Irrigation and Water Management Program has not had a major impact on the RDA although one RDA sociologist did participate as a member of the Diagnostic Team

and the expertise of this individual was expanded. This individual appears to be the only sociologist in Bangladesh who has developed some expertise on farmer irrigation organizations.

The Evaluation Team is aware of the likely impact on other organizations such as Bangladesh Agricultural Development Corporation (BADC), the Water Development Board (WDB), the Planning Commission and other organizations, but the team did not have the opportunity to assess the impact on these organizations.

The Master Planning Organization appears to be doing excellent work on the development of a National Water Plan. While BARC has an established relationship with MPO, the Evaluation Team was not aware of a plan to provide for the wide dissemination and discussion of MPO material within BARC and all of its associated organizations. The Team feels this is an important activity to pursue since the work of the MPO could have a significant impact on the determination of future agricultural research priorities.

The Evaluation Team met with representatives of the World Bank and Ford Foundation. The project specialists have done a good job of keeping other donor agencies informed about project work. This effort undoubtedly makes it easier for donor agencies to identify problems and to make their joint efforts more effective.

C. Impact on Bangladeshi Laws and Social Institutions

The project has sponsored work on productive changes in water laws. While this work will undoubtedly have a long gestation period, its need and impact are both considerable. As research results are generated, they will contribute to the needed character of water law in Bangladesh.

Wherever irrigation is practiced in the world by farmers owning small tracts of land, some sort of water - users organization has been necessary for successful irrigation development. The Irrigation and Water Management program is beginning to encourage awareness of the importance of water-users organizations in Bangladesh. Not much work has been done to date, but at least an awareness about this crucial factor is in the process of being developed.

VIII. Relevance of the Irrigation and Water Management to Bangladesh

The gap between what has been done and what needs to be done in irrigation and water management research is considerable. However, this gap is not the fault of the Irrigation and Water Management Program, but rather the gap exists because of the revolution which is taking place in irrigation in Bangladesh. The parameters of this revolution are just beginning to be perceived. The ultimate success of the program must be judged on the basis of the help given to Bangladesh agricultural research leaders and scientists in building a research foundation on which an effective rabi season food production system can be built. The purpose of this evaluation should be to help decision makers learn from the impact of past actions and where warranted, make changes in policies, practices and personel which will increase the chance of realizing the potentials for the future. Therefore, the question of relevance for the program must be rooted in a perception of what the future can be.

Based on the experience elsewhere in the world, research in irrigation and water management must pay attention to both technical and social issues. With this in mind, the relevance of the Irrigation and Water Management Program will depend on the answers to four types of questions.

(1) Has the program contributed towards the building of a foundation upon which a future research program can be built? The answer to this question is a definite "Yes" although elsewhere in this report considerable attention is paid to ideas about how this building process could be made more effective.

(2) Has the program contributed to the identification of significant researchable problems? Again the answer is a definite "Yes" although too little explicit attention has been paid to the social issues in the past.

(3) Has the program contributed to the solution of production problems with the result being an increase in the production of food in Bangladesh? The answer to this question appears to be "No". Such an answer is understandable at this stage of the development of a research program, but in developing future research projects, the importance of being able to answer this question with a definite "Yes" must be kept in mind.

(4) Has the program contributed to the education of agricultural research policy makers and working scientists about the problems and potentials of further development of irrigation in Bangladesh? The Evaluation Team would answer this question, "Probably yes". However, we saw little evidence of direct efforts to bring this about. The Team's recommendation for an Irrigation and Water Management Newsletter and the development of a strong and active two-way working relationship with MPO grew out of the Teams' inability to give an unqualified answer of "Yes" to this question.

IX CONSTRAINTS

A. IRRIGATION WATER MANAGEMENT TEAM:

1. Location of the Water Management Specialist at BARI, Joydebpur will significantly limit his usefullness to the Project. A time split between BARI and BARC with a major portion of the time at BARI could be counter productive.

B. CONSULTANTS:

1. Expatriate Consultants generally work only with the IADS team leading BARC professionals to question value of consultancy to the BARC program.

2. Apparent lack of trained local personnel results in non-utilization of local consultancy funds. The review team questions that this is a true constraint.

C. TRAINING:

1. Difficulty in obtaining approval for travel appears to be a serious constraint to short-term out-of country training. If this type of training is to remain an element of the overall program a well defined timetable for approval needs to be developed.

2. Lack of incentive for both individuals and the institutions in which they serve has resulted in non-participation in the sabbatical leave program. Requirement that participants be of 7 years experience as associate professor or above, seems to be most significant constraint.

3. Planning lead time required and development of adequate in-country back-stopping appears to put a limitation on the number of short courses which can be conducted using expatriate teams. While such short courses should continue, non-utilized funds may be best used for additional out of country degree training.

D. Contract Research

1. The limitation which excludes vehicles and equipment from USAID funded contract research projects is a severe constraint to development of research program at BARC participating institutions.

2. The lack of experienced senior engineers within BARC limits the ability of BARC professionals in the irrigation and water management area to advise and monitor principal investigators at participating institutions and to provide the necessary leadership role to the IWM research program.

E. COMMODITIES

1. The limited amount of funds available for commodities has severely limited the ability to develop research capabilities at research institutions.

2. Maintenance of equipment purchased under the contract and assigned to participating institutions is a problem which has been identified by previous consultants and continues to be a problem.

3. Long lead time between order and receipt of equipment means that there will be little or no time to install equipment and train researchers in its use before the contract ends.

X. Recommendations and Concerns

After reviewing and analysing both the material made available to the Evaluation Team and the notes from interviews with over thirty people, the Evaluation Team developed a series of recommendations and clarified a number of concerns. In general, recomendations were developed whenever the Evaluation Team had both enough information about a situation so that it could be understood and the team was able to specify a course of action which they believe would either solve a problem or capitalize on an opportunity. However, some recomendations were made when both of these conditions were not satisfied. For example in the case of the second recomendation dealing with commodities, the Evaluation Team did not believe it had a single operational solution to the problem. However the Team regarded the problem as a critical problem which needed to be solved and the Team suggested several alternative methods of dealing with the problem which they felt deserved further consideration. In the case of concerns, the Evaluation Team felt they did not have either an adequate understanding of the situation or they could not propose what they felt would always be an operational solution to the problem. In the case of some specific concerns, the Evaluation Team thought their thinking had developed far enough so they could make some suggestions which they hoped would at least prove helpful.

1. Some excellent national workshops have been put together by the BARC/IADS team. These workshops on research priorities and distribution systems have addressed problems of significant importance to development of irrigation and water management in Bangladesh. We recommend that additional workshops of this type be held.

2. BARC should develop a means of funding projects from non-USAID sources when vehicles are required and in many cases when equipment is required. Current USAID policies and regulations in combination with current policies and regulations of Bangladesh cause either long time delays in receiving needed equipment or in some cases make it impossible to receive needed equipment such as vehicles under the Irrigation and Water Management Program. Use of USAID funds for salaries, supplies, local travel, etc. could be combined with World Bank or other less restrictive funds which could be used for equipment and vehicles. An alternative could be the creation of a vehicle and equipment pool at BARC to be used only for contract research on a loan basis. BARC is urged to take the initiative in dealing with this most serious problem.

3. The irrigation and water management program is a new program in BARC which will take a great deal of administrative effort if it is to realize its potential. In BAU and BARI, the administrative decision has already been made to vest a good deal of the research effort in administrative units bearing the title of Irrigation and Water Management which are lodged within a larger Agricultural Engineering unit. In the case of BRRI, it appears that a de-facto decision has been made to assign much of the responsibility for irrigation and water management within the Department of Agricultural Engineering. This is consistant with the practice follpwed in many other places in the world. We recomend that BARC give serious consideration to assigning the responsibility for irrigation and water management to the Member Director for Agricultural Engineering.

4. Pair local consultants with expatriate consultants by drawing on local expertise in participating institutions or other in-country institutions. An expatriate consultant who is not paired with a local consultant should be a rare exception and these exeptions should be justified.

5. Develop a leave program for development of junior professionals similar to the sabbatical program but without the restriction of seniority.

6. We are concerned that locating the expatriate water management specialist at BARI for a major portion of his time would be counter productive unless the situation at BARI were changed. A more productive alternative would be to locate him at BARC for the majority of his time with the specific added responsibility of assisting development of the the research capabilities of the BARI Irrigation Water Management Section.

7. Funds should be made available to purchase commodities deemed as necessary by the irrigation water management specialist for strengthening capabilities of the irrigation and water management division at BARI.

8. We recommend that BARC initiate an irrigation and water management newsletter to be published on a regular basis (perhaps monthly) which gives current information on on-going research projects, up-coming workshops and

seminars and sabbatical opportunities. The irrigation and water management newsletter should be distributed to all participating institutes as well as other organizations dealing with irrigation and water management research (e.g. World Bank, Ford Foundation, M.P.O. etc.) An alternative would be to use the present BARC newsletter and devote several special issues to irrigation and water management.

9. BARC should develop a strong and active two-way working relationship with MPO. The present working relationship seems both unlikely to give all research administrators and working scientists the needed level of knowledge about MPO activities and their relevance for planning research programs and to restrict BARC to the role of merely supplying technical data to MPO rather than being an active partner.

10. Utilize unspent in-country training and short-term out-of-country training funds to either provide additional out-of- country degree training (including at least one PhD in Resource Economics) and/or critical research equipment.

B. Conclusion and Suggestions

1. Designate one of the IADS Water Management professionals as a team coordinator on a rotating basis. This would serve to better focus and coordinate team efforts. However, care should be taken to ensure that this arrangement does not by-pass counterparts and does not diminish the development of the ability of BARC professionals to build research programs.

2. Formally define working counterpart relationships so that both IADS Specialist and BARC officers know with whom they are working.

3. Initiate an in-house mechanism for follow-up on all consultancies.

4. Develop one or more week-long workshops utilizing a combination of expatriate and Bangladesh scientist to assess the impact of limited ground water on cropping patterns and ground water development strategies. These workshops should utilize existing data for some simple broad scale computer modelling of alternatives.

5. The BARC/IADS water management team have done a good job of informing potential researchers of the opportunities in contract research and have followed up with guidance in proposal writing. We recommend that these efforts continue.

6. We suggest that some BARC positions, in the irrigation water management and engineering areas immediately below the Member-Director level, be filled on a rotating basis by senior, experienced professionals from participating institutes. This would also be especially helpful in the career development of such individuals.

7. The Evaluation Team heard of several incidents involving delays in the release of funds including a case involving contract research under the project where a delay in the release of funds resulted in a situation where some S.O.s were not paid for several months. The Evaluation team was not able to determine the cause for the situation sited in this last example. However, while such situations must not be allowed to develop because of the impact of such delays on the morale of staff, the Evaluation Team was not able to suggest an operational solution to this problem.

8. The Evaluation Team became concerned about the apparent lack of knowledge of the time tables required for the Government of Bangladesh (GOB) approval of proposals and the consequences of failing to satisfy such time tables. The Evaluation Team recomends further efforts be made to increase the awareness of the time tables required for GOB approval.

9. It appeared to the Evaluation Team that several project members were not well informed or were informed on a delayed basis on the general financial situation in the project and the impact of changes in policies which affected the ability of those individuals to do their job. The Evaluation Team thinks this issue should be reviewed and procedures considered which would improve communication within the project.

Appendix A

Terms of Reference

External Evaluation of Irrigation Water Management Program in Bangladesh

1. Evaluate the effectiveness of the irrigation water management component in terms of BARC/IADS planning, coordination, implementation, monitoring and evaluation capacity.

2. Evaluate progress in each of the line items under the program:

   (i) specialists and consultants,

   (ii) local support,

   (iii) overseas training and travel,

   (iv) in-country training and sabbatical studies,

   (v) contract research, and

   (vi) commodities: as called for in the annual work plans and annual financial plans.

3. Identify constraints and suggest remedial actions if pertinent.

4. Assess the impact of the program on participating institutes.

5. Assess the relevance, cost-effectiveness and use of results of the program on the country's irrigation water management need.

TERMS OF REFERENCE

Water Management Extension Specialist

The Specialist will be involved in the following activities:

- Assist participating institutes, the Rural Development Academy at Bogra, the Bangladesh Rural Development Board, and the Department of Agricultural Extension in transferring technical improvements related to irrigation systems to water users.

- Work with field station staff in the identification of successful water sharing arrangements and in determining the social and institutional factors of productive water use schemes.

- Help training program designers to incorporate the role of water user groups and farmers irrigation behavior into water use efficiency programs.

- Document the systematic collection and evaluation of farmer knowledge of water use and management systems and transfer the same to extension workers, trainers and researchers through in-country workshops, seminars, and training programs.

- Work closely with agronomists, agricultural engineers, economists and soil scientists in identifying the major interactions between the physical and social environments affecting water availability, control and management.

- Carry out other duties related to management of BARC's irrigation and water management program as directed.

TERMS OF REFERENCE

AGRICULTURAL ENGINEER

The specialist will be involved in the following activities:

- Develop and evaluate water conveyance systems.
- Assess various water measuring devices and control structures for off-farm and on-farm use.
- Explore the possibilities of incorporating the use of small reservoirs into the farming system.
- Develop field testing procedures and guidelines for optimal matching of pumps and prime movers, in order to enhance the present performance of this equipment.
- Assist in design and testing of more efficient manual irrigation pumps.
- Assist and encourage research on animal-driven water lifting devices.
- Assess the impact of well spacing on the performance of pumps (DTW and STW), and study well siting procedures.
- Assist in the development of field manuals on the operation, repair and maintenance for different types of pumps.
- Promote, coordinate and/or participate in the organization of short-term training on the above mentioned topics to improve the skills of staff in Bangladesh research institutions involved in irrigation and water management
- Identify specific water related questions that can be tackled through short-term consultants (local or foreign). Participate in the recruitment of such consultants.
- Promote, encourage and/or assist in the elaboration of contract research proposals pertinent to the above issues. Participate in the implementation and monitoring of contract research related activities.
- Identify suitable/pertinent research issues, in addition to the above, to further strengthen the IWM research activities in the country.
- Coordinate activities with other program area specialists (i.e. Multiple cropping, economists, soil scientists etc.) in order to incorporate a team approach to the solution of IWM problems of Bangladesh.

TERM OF REFERENCE

WATER MANAGEMENT SPECIALIST

The specialist will be involved in the following activities:

- On-farm experiments involving water requirements and water use; these should be directed more towards the determination of adequate" water supplies rather than number of irrigations and amount applied.

- Develop practical field quidelines for defining command area boundaries and the layout of on-farm water distribution systems.

- Design, field testing and evaluation of block irrigation schedules. Assess crop yield data and financial returns to investments when scheduled and non-scheduled irrigation systems are used.

- Develop monitoring and evaluation procedures to assess quality of the water supply at the source.

- Develop/recommend irrigation and water management practices for saline coastal areas of the country.

- Promote, coordinate and/or participate in the organization of short-term training on the above mentioned topics to improve the skills of staff in Bangladesh research institutions involved in irrigation and water management.

- Identify specific water related questions that can be tackled through short-term consultants (local or foreign). Participate in the recruitment of such consultants.

- Promote, encourage and/or assist in the elaboration of contract research proposals pertinent to the above issues. Participate in the implementation and monitoring of contract research related activities.

- Identify suitable/pertinent research issues, in addition to the above, to further strengthen the IWM research activities in the country

- Coordinate activities with other program area specialists (i.e. Multiple cropping, economists, soil scientists etc.) in order to incorporate a team approach to the solution of IWM problems of Bangladesh.

Appendix - B

B - 1

EVALUATION TEAM MEMBERS

1. Professor Md. I. H. Khan was educated at Dhaka University and the Muslim University, Aligarh (India) before he got his Bachelor Degree in Agriculture in 1943, from the Dhaka University. He was trained at IARI (New Delhi) and got his MS

He served in the Agriculture Department as Asstt. Economic Botanist, Economic Botanist and Head of the Agronomy Division as Professor of Agronomy. While acting as Professor of Agronomy. Professor Khan was deputed to the Agricultural University, Mymensingh where he served as Professor and Dean of the Faculty of Agriculture for about 8 years. He guided over 2 dozen graduate students for their Master degree in Agronomy. He published a number of Scientific papers on subjects relating to Crop Planning, Crop Production, etc. Prof. Khan was recalled from the University by the then Department of Agriculture, where he served as Principal, Bangladesh Agricultural Institute and Director of Agriculture (Research & Education) till 1972 when he retired from the Govt. Service but immediately after retirement he was re-appointed as Director, Cotton Development Board and worked up to July 1974.

During the service period Prof. Khan acted twice as Chairman, Crash Programme Evaluation Team as constituted by the Govt. in (1961-62) and (1963-64). He also acted as Chairman, Evaluation Committee of Seven Thana Projects under Comilla District (PARD - 1967-68). He was the Member-Secretary of the Committee for Evaluation of Agricultural Research Activities in different Institutions of the then East Pakistan (1967-69).

After retirement from the Govt. Service, Prof. Khan has been working as Consultant Agronomist in various project with the local as well as foreign consulting firms. Prior to this assignment Prof. Khan was working with the SAHM Associates Ltd. which is one of the leading, oldest consulting firms in Bangladesh.

2. Richard J. McConnen is currently a Professor of Agricultural Economics and Economics at Montana State University. He was Department Head for ten years. He has been on the staff of the U.S.F.S. Pacific Southwest Forest Experiment Station at Berkeley, CA, the University of California at Davis, CA and the Agricultural Research Center, Dublin, Ireland (as a Visiting Fulbright Lecturer). During the past six years, he has worked as a consultant on the Egyptian Water Use Project. He has been a consultant to the Federal Reserve Bank, The US Forest Service, the US Bureau of Land Management, a member of the

Governor of Montana's Council of Economic Advisors and an economic advisor on agricultural policy to state and national grain producer groups. He is a member of various state boards and commissions and is a Past President of the Western Agricultural Economics Association and a Past Member of the Executive Board of the American Association of Agricultural Economics. He was the chairman of Montana State University's Faculty Senate during the 1983-84 year. His teaching and research are in the areas of agricultural policy, natural resource economics and economic development.

3. Dr. Donald C. Slack, P.E. has a B.S. Degree in Agricultural Engineering from the University of Wyoming (1965). He served as an Assistant Civil Engineer for the City of Los Angeles CA. for one year before returning for an MS Degree in Agricultural Engineering which was awarded by the University of Kertucky in 1968. He served on the Staff at the University of Kentucky in a Teaching and Research capacity from 1966-1970 when he joined the University of Kentucky contract team in Thailand. He spent three years and eight months on that project as the Engineering Adviser. The objective of the Kentucky-Thailand Project was to develop on Agricultural Research Station in Northeast Thailand. In 1973 Dr. Slack returned to the University of Kentucky where he completed his PhD in 1975. Since August 1975 he has been on the Faculty at the University of Minnesota in St. Paul and is currently an Associate Professor in the Agricultural Engineering Department. Beginning August 15, 1984 he will assume duties as a Professor in the Soils, Water and Engineering Department at the University Arizona, Tucson.

Dr. Slack has published over 40 papers and articles in the field of Agricultural Engineering and has written chapters in two books. In addition to his three and half years in Thailand he served on an Interdisciplinary Watershed Management Team in that country in February 1984. He has also been involved in the University of Minnesota, Moroccan Project and has spent time in Morocco. In 1979 he presented an invited paper to the International Conference on Watershed Management in the Tropics held at IITA in Ibadan, Nigeria.

4. Mr. M. Nurul Haq has a Honours and Master Degree in Economics from the Dhaka University. He received fulltime education in the College of Technology and Commerce in Cardia and attended courses in the Regent Street Polytechnic, UK and obtained Diploma in Management studies in 1958.

He joined the Bangladesh Academy for Rural Development, Comilla as Instructor in Rural Business Management in 1958 and reeived in-service training in Michigan State University, USA and obtained a certificate of proficiency in Development Administration. He worked as a close associate of Dr. Akhter Ahmed Khan and actively participated in the development of the Comilla model for Rural Development especially the Comilla-type Cooperatives. Since then he received Master Degree in Development Administration from the American University of Beirut, Labanon. For a short while he served the Bangladesh Rural Development Board as Director of Cooperative, Credit and Marketing.

He was assigned the Directorship of the Rural Development Academy, Bogra in the year 1975 and has been working there ever since.

Appendix - C

C - 1

LISTING OF DOCUMENTS AND REPORTS

Materials reviewed by the Members of the External Evaluation Team Irrigation and Water Management Program Area, Agricultural Research Project - Phase II, July 1984.

1. Terms of Reference of Resident Specialists
2. 1984 Internal Evaluation Report
3. Excerpts from the Project Grant Agreement
4. Excerpts from the Contract Document
5. Amendment No. 6 to the Contract Document
6. Proposed Pump Study
7. This is BARC.
8. Research Priorities, November 1983 Workshop Proceedings
9. Johnson, S.H. (1984, March) Economic and Technical Operation of Deep Tubewells in Bangladesh
10. Radosevich, G.E. (1984, January) Water Law Bibliography for Bangladesh
11. Weaver, T., Roumasset, J.A., Rosegrant, M.W. and J. Keller (1984, January) A Framework for Economic Research on Water Management in Bangladesh
12. Howes, R.R. (1983, December) Options in Powering Irrigation Equipment for Tubewells and Low Lift Pumps in Bangladesh
13. Radosevich, G.E. (1983, November) Ground Water Development and Management in Bangladesh, Institutionalizing and Strategy.
14. Johnson, D., McCarthy, F., Oad, R. and M. Walter (1983, October) Review Irrigation Water Management Program at Bangladesh Agricultural University, Mymensingh.

15. Chaudhuri, S.D., Ali, S.M.A., and Hamid, M.A. (1983 October) 1983 Internal Review of BARC's Irrigation Water Management Research Program.

16. Levine, G. (1983, August) Water Management Workshop

17. Hanratty, M. (1983, April) Minor Irrigation Development in Bangladesh

18. BARC-IADS (1983, November) Annual Work Plan - 1983-84

19. BARC-IADS (1983, July) Annual Financial Plan - 1983-84

20. BARC-IADS (1983, November) Six Months Progress Report IV: January-June, 1983

21. BARC-IADS (1984, February) Six Months Progress Report V: July-December, 1983

22. Alim, A., Jabbar, M.A. and H.E. Khan (1983, March/April) An External Review of the Contract Research Program of the BARC.

23. Cambell, J.K. (July, 1983) Report of 3 week study in Bangladesh for the Cornell/USAID Water Management Synthesis II Project.

24. Gill, Gerard J. (November, 1983) The Demand for Tubewell Equipments in Relation to Groundwater Availability in Bangladesh.

25. Husain, A. and D. Dorsey. (November, 1983) Handbook for Manpower Development

26. Anderson, J.R., K.W. Bridges, O. Hess and C.E. Pray (May, 1983) Report of the May External Evaluation Team.

27. BARC (May, 1984) Manual for Contract Research

28. Master Plan Organization (June, 1984) Second Interim Report

29. Karim Z. et. al. (October, 1983) Diagnostic Analysis of Five Deep Tubewell Irrigation Systems in Joydebpur, Bangladesh. Water Management Synthesis Project.

30. BARC (May, 1984) National Agricultural Research Plan 1984-1989

31. Wennergren B.E., C.H. Antholt and M.D. Whittaker (August, 1983) An Assessment of the Agricultural Sector in Bangladesh, USAID/Dhaka.

32. World Bank (March, 1983) Bangladesh: Recent Economic Trends and Medium Term Development Issues.

33. Alim, A. (January, 1974) An Introduction to Bangladesh Agriculture, Swadesh Printing Press, Dhaka.

34. BARC (1983) Agricultural Research in Bangladesh

35. Hossain, M.M. and M.E. Harun (April, 1983) Cost and Returns for Transplant Aman Cultivation Joydebpur 1981-82

36. Elias, S.M., M.S. Hussain and S.C. Borman (May, 1983) Agro-Economic Survey of Groundnut in Some Selected Areas of Bangladesh, BARI

37. Swenson, C.G. et al. (October, 1980) A survey of the economics and agronomy of wheat production in Jessore and Pabna districts, BARI.

Appendix - D

D - 1

Team Schedule and Persons Contacted

Meeting at BARC with

Dr. Kazi M. Badruddoza, Executive Vice-Chairman, BARC

Dr. David M. Daugherty, Project Supervisor, IADS/BARC

Dr. Dorsey F. Davy, Training Specialist, IADS/BARC

Dr. B. A. Greene, Agricultural Economist Specialist, IADS/BARC

Dr. M. A. Mannan, Member Director (S & I), BARC.

Dr. E. Ahsan, Member Director (AE&SS), BARC

Dr. A. Rahim, Director(Nutrition), BARC

Mr. Kamaluddin Ahmed, Member Director (C&F), BARC

Mr. Ahmed Husain, Director of Training, BARC

Dr. Carlos Garces, Agricultural Engineering Specialist,IADS/BARC

DR. D. Gisselquist, Water Mngt. Extension Specialist, IADS/BARC

Dr. Avtar Kaul, Crop Specialist, IADS/BARC

Dr. R. C. Lazaro, Water Management Specialist, IADS/BARC

Mr. S.M. Hossain Saif, P.S.O.(Ag.Engg.), BARC

Mr. Nurul Alam Akhand, P.S.O.(Irrigation), BARC

Dr. Guy Baird, IADS/Headquarter Program Officer

USAID

Mr. B. J. Jadwin

Mr. William Joslin

Mr. L. Rahman

Ford Foundation

Mr. Anthony Bottrall

World Bank

Mr. Walter Kock

BRRI

Dr. Shamsul Alam, Associate Director

Dr. Kh. Azharul Hoq, Head, Ag. Engg. Division

Mr. Mosharraf Hossain, S.S.O.(Agri. Econ.)

BARI

Dr. Z. Karim, P.S.O (Soils)

Mr. Md. M. Rahman, S.S.O

Mr. M. H. Rashid, P.S.O.(Ag. Engg.)

Mr. Ismail Hossain, P.S.O.(Ag. Econ.)

BAU/Mymensingh

Dr. M. Hossain, Professor and Dean,
Faculty of Agric. Eng. and Technology

Dr. M.R. Biswas, Professor, IWM Department

Dr. Hoque, Asstt. Professor, Head, IWM Dept.

Dr. Sk. A. Ali, Asstt. Professor, IWM Dept.

Dr. L.R. Khan, Asstt. Professor

Mr. A. Khair, Asstt. Professor

Mr. M.A. Samad, Asstt. Professor

Mr. S.C. Datta, Asstt. Professor

Mr. M. Rahman, Scientific Officer

Dr. Md. Z. H. Bhuiyan, Prof. Soil Science

Dr. M. Eaqub, Associate Professor, Soil Science,

Mr. A.K.M. Abdur Nur, Librarian

Mr. Abdul Gafur Dewan, Asstt. Librarian

RDA/Bogra

Mr. Keith H. Gorey	-	Chief Technical Advisor, FAO/United Nation, Bogra, IMP
Dr. Md. Amjad Hossain	-	Project Co-ordinator, Dy. Director
Mr. M. Baset	-	Joint Director, BRDB
Mr. A.K.M. Bari	-	Dy. Director(Training, BRDB, Dhaka
Mr. Md. Z. Islam	-	Project Director, BRDB, Bogra
Mr. M.A. Mannan	-	Dy. Director, RDA, Bogra
Mr. P. Kanoksing	-	FAO, Irrigation Engineer,
Mr. K. B. Karim	-	Instructor in Sociology, RDA, Bogra
Mr. Rezaur Rahman	-	Dy. Director & Counterpart, IMP, Bogra
Mr. Md. A.K. Khan	-	Dy. Project Director BRDB, Bogra.
Mr. Md. A. Martin	-	Asstt. Enggr. Irrigation, RDA, Bogra
Mr. P.S. Onkingco	-	Irrigation Agronomist, FAO/UNDP

IRRIGATION WATER MANAGEMENT PUBLICATIONS

The following publications are available upon request to the IWM Program Area IADS/BARC.

BARC. Soils-Water Management Research Inventory and Problems in Bangladesh. 1979

Oswal, M.C. Soil and Water Management Program for Bangladesh. BARC. July 1979.

BARC. Fertilizer Guide for Major Crops of Bangladesh. Soils and Irrigation Division. October, 1979.

Brammer, H. Ploughpans and Tillage Problems in Bangladesh Soils. BARC. March, 1980.

BARC. Potassium in Bangladesh Soils and Crop Response. Soils and Irrigation Division, 1980.

Siddique, A.B. and C. Pray. Survey of Irrigated Cropping Patterns in Bangladesh and Implications for draft SFYP. A/D/C - BARC. November 1980.

Khan, M. R. and M. A. Rahman. Water Requirement of Cotton for Optimum Yield under Different Cultural Practices. First Annual Project Report. BARC. June 1981.

BARC. Inventory on Manpower and Physical Facilities Available for Irrigation and Water Management Research in Bangladesh. Soils and Irrigation Division. November, 1981.

Karim, Z. et al. Coastal Saline Soils and their Management in Bangladesh. BARC. January, 1982.

Karim, D. Water Management for Increased Crop Production. Training Program. CIDA -BWDB. (undated).

Levine, Gil. Irrigation & Water Management, BARC/IADS Consultancy Report. February, 1982.

BARC. First Annual Report: Coordinated Soil Test Crop Response Correlation Studies (1980-81) Soil and Irrigation Division. March, 1982.

Lowdermilk, Max. Final Report on Consultation (Water Management) BARC/IADS Consultancy Report. March, 1982.

BARC. First Annual Report: Coordinated Irrigation and Water Management Project (1980-81) Soil and Irrigation Division. April, 1982.

Gisselquist, David. Proposed Activity for IADS Water Management Extension Specialist at BARC. BARC/IADS Consultancy Report. October, 1982.

Johnson, Loyd. Proposed Water Management Activities Report for BARC/IADS Agricultural Engineer, BARC/IADS Consultancy Report. November, 1982.

Karim, Z. and N. A. Akhand. Net Irrigation Requirement of Rice and Evapotranspiration of Wheat and Potato for Different Locations of Bangladesh. BARC. December, 1982.

BARC. A Synopsis of Lectures on Soil Fertility Evaluation and Improvement. Soils and Irrigation Division. April, 1983.

Hanratty, Martin. Minor Irrigation Development in Bangladesh. USAID/Bangladesh. April, 1983.

Johnson, Loyd. Observations on Water Management Issues in Bangladesh. BARC/IADS Consultancy Report. May, 1983.

Ghani, A. et al. Collection of Different Types of Manually Operated Pumps Available in the Country and Evaluation of Their Performances in Order to Select the Best Available Design to Carry Further Modification, if Necessary, to Improve Performance. Ag. Engineering. Research Report No. 7. July, 1983.

Levine, Gil. Water Management Workshop. BARC/IADS Consultancy Report. August, 1983.

BARC. Second Annual Report: Coordinated Soil Test Crop Response Correlation Studies (1981-82). Soils and Irrigation Division, September, 1983.

BARC. Second Annual Report: Coordinated Irrigation and Water Management Studies (1981-82). Soil & Irrigation Division. September, 1983.

Walter, Michael & others. Review of Irrigation Water Management Program at Bangladesh Agricultural University, Mymensingh. BARC/IADS Consultancy Report. October, 1983.

Padosevich, George E. Groundwater Development and Management in Bangladesh: Institutionalizing a Strategy. BARC/IADS Consultancy Report. November, 1983.

BARC. Priorities for Research in Irrigation and Water Management. Soils and Irrigation Division. December, 1983.

Howes, Richard B. Options in Powering Irrigation Equipment for Tubewells and Low-lift Pumps in Bangladesh. BARC/IADS Consultancy Report. December, 1983.

Gil, Gerry. The Demand for Tubewell Equipment in Relation to Groundwater Availability in Bangladesh. BARC Agricultural Economics and Rural Social Science Papers No. 13, 1983.

Weaver, Thomas, et. al. A Framework for Economics Research on Water Management in Bangladesh. BARC/IADS Consultancy Report, January, 1984.

Radosevich, George E. Water Law Bibliography for Bangladesh. BARC/IADS Consultancy Report. January, 1984.

Blevins, Robert L. Potential for Minimum Tillage in Bangladesh. BARC/IADS Consultancy Report, February, 1984.

Johnson III, Sam. Economics and Technical Operation of Deep Tubewells in Bangladesh. BARC/IADS Consultancy Report, March, 1984.

Chaudhuri S.D., Ali A, Ahmed M.A. 1983 Internal Review of BARC's Irrigation Water Management Research Program. April, 1984.

McConnen R.J., Slack D.C., Khan I.H. and Haq, M.N. 1984 External Evaluation Report of Irrigation and Water Management Program. July, 1984.