PD-AAR-520

WATER MANAGEMENT SYSTEMS PROJECT

INTERIM REPORT

Hammond Murray-Rust

No. 8

October 1983

WATER MANAGEMENT SYNTHESIS II PROJECT

CORNELL UNIVERSITY

WATER MANAGEMENT SYSTEMS PROJECT: INTERIM REPORT

COUNTRY: Bangladesh

ACTIVITY: Water Management Systems Project Paper

CODE NUMBER: 1-02-072-84

DISTRIBUTION OF TDY REPORT: Worth Fitzgerald, Doug Merrey, Mark Svendsen, Jean Kearns, Wayne Clyma

HAMMOND MURRAY-RUST

WATER MANAGEMENT SYSTEMS PROJECT

INTERIM REPORT

		Page
1.	Current State of Irrigation Development in Bangladesh	1
2.	Background to Water Management Issues in Bangladesh	6
3.	Specific Water Management Issues in Bangladesh	10
3.1	Water Resource Planning and Development	11
3.2	Development of Pump and Engine Manufacturing Capabilities	18
3.3	Development of Services for Pumps and Engines	27
3.4	Strengthening Water Management Services to Farmers	40
3.5	Strengthening Policy and Institutional Support	45
4.	Recommendations	47

Attachment A: Summary Scope of Work for Irrigation Equipment Policy and Support Project Team.

1. CURRENT STATE OF IRRIGATION DEVELOPMENT IN BANGLADESH

Bangladesh is currently undergoing a dramatic change in its irrigation sector. These changes have been described in detail by Hanratty in his consultancy report to USAID earlier this year [1/]

Current Bangladesh policy as outlined in the Second Five Year Plan and detailed in the Medium Term Foodgrain Production Plan (MTFPP) is to attain foodgrain self-sufficiency by 1985. Provision of irrigation facilities is a major component of the program both through increasing the number of tubewells and by improving flood control, drainage and land reclamation projects. A large number of donor agencies are involved in a variety of projects that provide support for this overall policy.

From the perspective of the Water Management Systems Project it is instructive to review the major activities being implemented under the MTFPP. Four such activities can be identified:

- increased production of foodgrains by opening up new land for cultivation. This is a relatively minor component involving flood control, drainage and land reclamation, largely in the southern part of the country;

1/ Hanratty, M. (1983) Minor Irrigation Development in Bangladesh. Mimeo, USAID, Dhaka. April 1983

- increased production through increased cropping intensity. This is the major component of the current program with particular emphasis on increasing the number of crops grown each year. Tubewell development is the primary vehicle for increasing cropping intensities;

- increased productivity per unit area by promotion of new technologies, notably HYV of rice and wheat, in conjunction with increased use of fertilizers and other agricultural inputs;

- increased productivity per unit area by improved management of existing resources. These activities include such programs as Command Area Development, World Bank T & V projects, PVO and NGO efforts and so forth.

These four activities are not necessarily compatible within the framework of a short term and rapid development process. Levine, in a consultancy report to USAID, discussed the evolutionary nature of irrigation development 2/. The main thrust of his argument is that in the early stages of irrigation development, management is the scarcest resource because land and water resource development can meet short term production requirements with low levels of efficiency. The rapid growth of tubewell development in Bangladesh appears to be a case in point and it is worth looking at this in detail.

2/ Levine, G (1982) Report on Consultation Visit, January 23 - February 5, 1982. Mimeo, USAID, Dhaka, February 1982.

Until 1967, when tubewell technology was first introduced on a wide scale, there had been increasing pressure on land and water resources. Irrigation was severely constrained because traditional water lifting devices were limited to exploitation of surface water. Although there is no explicit evidence, it is likely that indigenous management of both water and land was at a relatively high level, if for no other reason than the fact that all energy came from human labor.[3/]

Tubewell development, and particularly shallow tubewell development, has radically altered the land: water : management balance. Water is suddenly being made much more available and in such a fashion that it does not need to be so carefully managed. Hundreds of thousands of farm families now have the capability to grow three crops a year with far less uncertainty over water availability. This contrasts so much with previous conditions that it is quite clear that the installation of a tubewell provides a foodgrain production capacity far in excess of current local requirements. There is considerable subjective evidence to indicate that farmers are content enough to grow two good crops in a year, thus leaving substantial untapped potential.

At the same time the goals of government are close to being achieved. National foodgrain self-sufficiency is no longer a politician's pipe dream but an actual probability in the next few years. Thus, while the infrastructure is being used at a lower than hoped for capacity, national and local goals are being met simultaneously.

3/ The introduction of low lift pumps from 1960 also relied on surface water resources, and thus did not alter land and water resource conditions to the same extent as tubewells.

In the long run, however, the prospects are less optimistic because population growth combined with the finite limit of both land and water resources will mean that unless productivity is increased, the country will slowly but surely slip away from self-sufficiency. The danger of the current success is that long term plans will not be made in sufficient time to bring about production increases.

Clearly a major issue is how to prepare government and farmers to adopt more management intensive activities when the time is ripe. Experience from other Asian countries may help Bangladesh in this respect.

In most Asian countries where small scale irrigation predominates farmers generally prove to be very responsive to short term changes in land and water resource conditions. They develop ways to modify their behaviour, sometimes season by season, so that they do not have to face major resource crises. The timing of these managerial modifications is decided at local level, and it has proved very hard for external agencies to successfully intervene. Indeed, in many cases, the farmers tend to be successful despite the efforts of outsiders to help them. Successful interventions require considerable knowledge of local conditions and local capability to accept change, and it is rare to find agencies that have the time and patience to gain this knowledge. The Sederhana program in Indonesia is perhaps the most successful program of this type.

In contrast, national responses to management needs tend to be infrequent, and when they do occur they involve major shifts in policy and implementation. The reaction time to land and water resource pressures is long, and the proposed changes frequently expect to achieve

levels of management that are optimistic and out of balance with current conditions. It has proved very difficult for governments to adopt a practice of smaller and more frequent changes in policy that are more in touch with local requirements.

The Bangladesh case shows all the signs of falling into this classic trap. One one hand the government policy is to expand tubewell development as fast as possible. On the other, it already wishes to introduce legislation that tries to make full use of the installed capacity. Undoubtedly, in time, there will be greater use made of irrigation infrastructure, but it is only likely to come about when the users themselves see this as both necessary and desirable. The problem facing any agency interested in getting involved in water management is that any program, however well intentioned, will only be successful when resource conditions reach a critical point. Before then it is unlikely that any approach, regulatory or educational, will meet much acceptance by users.

2. BACKGROUND TO WATER MANAGEMENT ISSUES IN BANGLADESH

Before addressing the specific water management issues that could be addressed, it is necessary to understand some of the peculiarities of Bangladesh that make it rather a special case. There are four factors that should be considered.

Firstly, Bangladesh has had a very short history of irrigation development. This contrasts with almost all South and Southeast Asian countries where gravity irrigation has been practised for a long time. The result is that there is very little accummulated experience on which to draw when proposing water management programs, and this is as true for government agencies as for farmers. Water management programs in countries such as Taiwan, Philippines, Indonesia and Sri Lanka have had the advantage of long term experience (although water management programs in all of those countries have had to go through a long and difficult process of re-education).

Secondly, tubewell development, which has really only been of major significance since 1975, provides access to irrigation to many farmers whose only experience in the past was with dhones and swing baskets, or who have had no irrigation experience at all. More important, tubewell technology is totally new to Bangladesh, in contrast to other countries where water management focusses on upgrading existing gravity fed systems. The technology was also alien to the government agencies charged with purchase, installation and maintenance of the

equipment. This remains a significant problem, for many senior officials have never had formal training in groundwater based irrigation. This would not be so serious if it were not for the complication of total system failure.

In most gravity based systems there is little chance of total system failure (e.g. reservoir breaching): however badly maintained and operated, some farmers will be able to get sufficient water to grow crops (G.K. Project is a good example). With pump and engine based irrigation, system failure is inevitable and frequent. Admittedly the area affected is small, but the effects for the individual can be catastrophic. The failure of a single component has the potential to cause the loss of an entire crop. The net result of pump and engine based irrigation development is to create an instant and total dependency on service agencies, a complete contrast to gravity fed systems. Surely, there will be some lessening of this dependence over time as users improve their maintenance and repair skills, but they will always remain dependent on wholesalers of parts and operating inputs.

Thirdly, Bangladesh has never had a single agency responsible for irrigation. This not to say that monolithic government agencies are desirable, but at least they provide a jumping off point for water management projects. In the Philippines, for example, the National Irrigation Administration was able to transform itself from a single purpose design and construction agency to a multidisciplinary, water management oriented agency. In Sri Lanka the Irrigation Department may

follow a similar path, or it may be replaced by a new agency entirely. In either case, there is only one organization to either upgrade or kill. In Bangladesh there are several agencies whose activities overlap and who compete for the same audience. It will be very much harder to form a single agency with this background, but the alternative route of having to deal with several agencies simultaneously is equally unattractive.

An added complication is that none of the implementing agencies for tubewell development have any real responsibilities for ensuring that equipment is maintained, because there is no accountability. While Bangladesh is by no means unique in this respect, it is perhaps more critical because the vast majority of irrigation is in the form of very small and isolated user groups. One advantage of water management programs in large scale irrigation systems is that a few key improvements at the head end of the system can materially improve conditions over large areas. In discrete small-scale irrigation development programs, each tubewell represents a special case and needs to have careful monitoring by service agencies to ensure inputs are readily available.

Fourthly, Bangladesh has little capacity to expand its cultivable area. The importance of this cannot be overlooked for it contrasts with many countries that still have some frontier areas remaining. As the country becomes increasingly dependent on groundwater for foodgrain production, the need for careful husbandry of that resource will grow. Failure to conserve Bangladesh's most important resource

would lead to total disaster. Similarly, as foodgrain production is also more dependent on the functioning of hundreds of thousands of pumps and engines, maintenance and management become even more important.

These four factors will make any water management program in Bangladesh more complex and more challenging than in most other countries. Inevitably mistakes will be made, both because the situation is unique and because the pace of growth is outstripping the rate at which knowledge and understanding of these problems is growing: a program that installs 100,000 tubewells per year means that, on average, a new tubewell is installed every five minutes. What is important is to ensure that no irreversible mistakes are made that can upset the critical balance of water and land resources.

3. SPECIFIC WATER MANAGEMENT ISSUES IN BANGLADESH

A general comment of all project consultants has been that there is no conceptual framework within which to discuss water management issues. As a result, many conversations cover a vast number of issues, some of them general, others referring to specific problems at a single location. In an effort to redress this situation slightly, it may be useful to group the issues into five categories:

- water resource planning and development;
- development of pump and engine manufacturing capabilities;
- development of services for pumps and engines;
- strengthening water management services to farmers;
- strengthening policy making and institutional development.

Clearly none of these categories are self-contained. Indeed, the very essence of a good water management program is to develop and foster the linkages between them. Nevertheless, for obvious project oriented purposes some form of categorization is necessary and desirable.

No one project can hope to cover each and every category listed above. However, in addressing parts of one or more of each category it is essential to see how the activities fit into the overall pattern. In the discussion below current activities by various agencies have been briefly identified to indicate where coordination is necessary so as to minimize the risk of providing the government with conflicting aims and objectives among projects.

3.1 Water Resource Planning and Development

3.1.1 Problems Identified

The two most widely quoted problems in this category are the density of tubewells in any given area and how they should be spaced and sited. Although these are undoubtedly genuine issues, they are really symptoms of a more fundamental problem.

In any program of resource development, there has to be an understanding of the finite limits of growth if the resource is to be conserved for future generations. To gain this understanding it is essential to have good quality information about the potential reserves of the resource and its capacity for replenishment. Only when this data is made available can a rational resource development program be established. A fundamental weakness of the tubewell development program in Bangladesh is that this information is not available: nobody knows how much water is available, how rapidly it can be extracted from aquifers without damaging recharge capabilities, how the availability varies from year to year and how much it varies spatially. Instead, there has developed a situation where almost all information is anecdotal.

The implications of an incomplete data base are obvious. In addressing the issues of tubewell density and spacing, planners have had to rely on very limited data collected in only a few areas. There is no indication of the reliability or representativeness of the initial data, and in some cases the "data" are really only extrapolations based

on assumptions: change the assumptions, and the "data" themselves will change.

This is best exemplified by looking at plans to introduce spacing legislation. The spacing of tubewells is determined by two sets of factors: supply and demand. Supply in this case is represented by the total volume of water available in an aquifer during the pumping season. Groundwater storage in the aquifer (the specific yield) is the major source of supply but there may also be lateral recharge due to groundwater flow horizontally through the aquifer, and vertical recharge from rainfall and deep percolation of irrigation water. The supply will vary from place to place depending on aquifer and groundwater conditions and the efficiency of water use by farmers. Given this finite supply, there is a finite amount that can be extracted in any given season without permanently lowering the water table. However, the extraction can take place in any one of a number of combinations of tubewells and discharges up to the limit determined by overall supply. If it is assumed that a shallow tubewell will irrigate 20 acres, then clearly it is possible to determine their spacing. However, if they actually irrigate only 10 acres, and use half the water, then spacing can be much closer together. While it may be desirable to have spacing criteria laid down, they cannot be rigidly followed unless both the supply and demand conditions are known. Knowledge of demand is as poor as knowledge of supply, with very few tubewell discharges known, and none measured with different water table conditions at different times in the year. There are also very few reliable measurements of how much water is used to irrigate given

areas of land, nor what the range of actual tubewell command areas actually is. Further, very little is known about the probable impact of economic changes on command area and water use efficiencies.

The conflict between the desire to have some simple national guidelines and the need to recognize the realities of spatial and temporal variation in water supply and utilization is nothing new, and will no doubt remain for years to come. What is required is not so much regulation of specifics but regulation of the process which will enable local level decision makers to obtain good quality information and use it effectively in the planning process. The consultancy of Dr. Radosevich may be of considerable value in this respect.

One issue that has not been seriously addressed in Bangladesh is the extent to which groundwater development should be regulated from above or allowed to self-regulate. The opponents of self-regulation argue that the net result may be anarchy, creation of water lords and over extraction of groundwater. The proponents argue that with existing and proposed regulations the net results may be similar as there is little capability to enforce regulations, however well intentioned and suitable they might be.

The concept of self-regulation can work very well if the technology being introduced is unable to permanently damage the resource base or to deprive large numbers of other users access to water. If this logic is correct, then there is a strong case to support the present shallow tubewell development program, and to strongly discourage installation of

additional deep tubewells unless it can be clearly and definitively demonstrated that the site is totally unsuitable for shallow or manual tubewells. Indeed, evidence from parts of India that have very similar environmental and social conditions indicate that a policy of shallow tubewell saturation is likely to be the most successful. Far from creating waterlords, it actually inhibits their development because command areas are small, and many farmers can obtain water from more than one well. An interesting feature of this study was the relationship between wells and pumps: many more wells were sunk than pumps purchased, and non-pump owners would hire pumps on a regular basis either from their neighbors or from landless groups. This contrasts with Bangladesh where well and pump numbers are the same. As the cost of well drilling and installation is relatively cheap, this strategy could well be successful in Bangladesh.[4/]

This type of program contrasts with efforts to regulate development from above. Proposed regulations have to allow flexibility to account for local conditions for it is very difficult, if not impossible, to predict tubewell densities and spacings. It is far better to approach the problem on an empirical basis, by trying to monitor and identify problems as they begin to arise, and only bring regulatory efforts into play when they are needed. The danger of inappropriate or untimely regulation is that it may merely become a license to extract informal payments from potential installers of tubewells who wish to circumvent the regulations.

4/ Chambers, R. and D. Joshi (1983). Notes, Reflections and Proposals on Groundwater Development following a visit to Gouda District, Eastern U.P. Mimeo, Ford Foundation, Delhi.

3.1.2 Potential solutions

There are four main activities that would help to alleviate the current limitations of data availability:

- upgrading and strengthening of national groundwater and surface water inventories, aquifer characteristics, aquifer yields and development of probability levels of water availability from year to year (i.e. water supply forecasting).

- establishment of an inventory of all irrigation infrastructure that can be upgraded at regular intervals. This data base should group facilities both by administrative and hydrological units to facilitate the planning process.

- establishment of a nationally based monitoring and evaluation program that measures, on a sample basis, rates of water use, fluctuations of groundwater levels, surface water depletion, pump and engine performance, area irrigated, crops grown and estimates water use efficiencies. This program would require provision of mobile measuring units equipped to make good quality measurements at a set series of locations, preferably repeated at different times of the year.

- strengthening the capacity of the Thana Irrigation Teams (TIT) to make decisions concerning allocation of tubewells. These teams are to be established under currently proposed legislation, but it is not clear how they are to be trained to enable them

to carry out their intended tasks. The TIT members include technical officers and elected officials under the new Upazilla structure.

In all the above areas, it is obvious that there is no simple and quick solution. What is needed is the development of a long term and adjustable set of activities that can respond to changes in land and water resource pressures as and when the need arises. This demands patience from any donor who gets involved in an assistance program.

3.1.3 Possibilities for USAID involvement

The creation of the Water Master Planning Organization team earlier this year is designed to address at least the first two issues. Their role is to establish a data collection center and utilize the data in formulating water plans in the short and long run. In this respect there seems little direct role that USAID can play at the present time.

The third issue, creation of a monitoring program, is not specifically within the MPO program, although they would like to see such a program established. At present, much of the data is supposed to be collected by one of three main agencies: BWDB collects data on groundwater and surface water conditions, BADC is supposed to collect data on tubewell discharges and efficiencies and the Agricultural Census collects information of areas and yields (though not at the tubewell level). Quite apart from the difficulties of coordinating the activities of these agencies, there is a basic question as to the degree of impartiality of agencies collecting data that can be used to assess

their own performance. The creation of a compact monitoring unit with appropriate equipment to carry out a simplified version of the Diagnostic Analysis program is not a particularly complex task to organize and administer, yet it is one that could have tremendous impact on the degree and quality of information available for planners. Ultimately this role could pass to the Thana level itself, but there would have to be some considerable time delay before that can be achieved.

The training of TIT teams has not been addressed. Although Thana officers are being trained at the RDA, Bogra, with USAID assistance, the training focusses on Command Area Development (IMP) and not on the wider problem of resource use and planning. Many of the officers trained through IMP would also have to be trained in planning of water and land resource use, and it is no small task: even allowing that some thanas do not need training, a TIT comprises about six officers, or some 2500 potential trainees right away, plus a smaller ongoing program to replace those who retire or leave government service. Further, because thanas experience different water resource conditions, the training should reflect regional variation, but in light of previous comments, the degree to which training can be sensitive to regional variations is hard to assess because the data base is so poor at the present time.

Although the need for national level involvement in water management will be reiterated at a later stage, it is important to understand that any comprehensive or partially comprehensive water management program has to have a firm base in the policy arena. If this is lacking, then management efforts at local level or in relation to specific tasks are

always vulnerable to policy change. The creation of the Water Resources Council and the Central Coordination Committee for irrigation within the Ministry of Agriculture are positive moves but ones that require continuous follow-up. By feeding more and better quality information to these bodies it would be possible to have a long term and lasting impact on water management activities.

Any USAID involvement in such activities would have to be closely coordinated with the MPO/UNDP team, and there would be a possibility of joint collaboration if this was seen as desirable and feasible. A monitoring program would also require some degree of cooperation with both BWDB and BADC, although this could be done through the MPO program to a large extent. The technical assistance component of the monitoring program would include both the provision of equipment and probably a single expatriate advisor. There should not be a problem in finding local counterparts, who could be graduate engineers from BUET and BAU.

3.2 Development of pump and engine manufacturing capabilities

3.2.1 Problems identified

There are two major components here that require some attention: strengthening local manufacturing capability, and developing the most appropriate designs of pumps and engines for Bangladesh conditions.

Pump manufacture has been one of the more successful aspects of Bangladesh irrigation development. Virtually all shallow tubewell and low lift pumps are manufactured locally in a series of small workshops

and foundries. Construction of the pumps is done almost entirely with cast iron, a technology that is eminently suited for local conditions. As far as can be determined, quality control is adequate and there are few reports of pump failure. Further, the equipment lends itself to local repair should failure occur, but beyond the need to replace seals every so often, pumps are not subject to failure to the same extent as engines.

The same capability has not developed for deep tubewell pumps because these are far more complex. Although it is, in theory, possible to develop local manufacturing capability, two factors discourage such moves. Firstly, the market is not that big, for it is unlikely that in the long run there will vast numbers of turbine type pumps required, perhaps a few thousand at most. Secondly, by the time local capability is developed the next phase of deep tubewell development will be complete and will have relied on imported pumps. As at least some of the next phase of deep tubewell development relies on tied aid, requiring import of specified makes of pumps, local capacity will not be strengthened. Support for deep tubewell pumps is not viewed as desirable in terms of this project.

Of greater concern in the long run is the question of the matching of pumps to aquifers. The key component of the pump is the impeller (centrifugal pumps) or the turbine blades (turbine pumps). By slightly modifying the shape of impellers and turbines, pumps will perform significantly differently. The aim of impeller design is to try to make the pump efficient over the normal operating range, the range itself being

largely a function of groundwater table changes during the pumping season. In this respect, Bangladesh faces some difficult problems.

For most parts of the country it is likely that the groundwater level will fluctuate by about 20 feet from start to finish of the dry season. Design of impellers and turbines to pump over this range are different from those which pump under more constant conditions. In specifying pump designs BADC and BWDB merely specify a single operating point: this is expressed as a desired discharge to be achieved against a specific head and with a certain efficiency. A typical centrifugal pump specification is that it should discharge 0.5 cusecs at 50 foot head with 75% efficiency. Even if that specification is met, there is no effort to see what efficiencies are obtained as the pumping head changes. Manufacturers do not have to provide pump characteristic curves (graphic descriptions of expected pump performance) and there do not seem to be any efforts made to test sample pumps to see if they meet initial specifications. A lot of work needs to be done on modifying pump impeller designs and matching these to variations in groundwater conditions. Even if that were done, BWDB and BADC would have to change their procurement policies, which at the present time are not dissimilar to Pentagon procurement procedures: manufacturers do not have any accountability to users, and cost effectiveness appears largely absent due to a guaranteed market.

Engine manufacture is far less developed. The government has selected five manufacturers and given them licenses to build diesel engines in Bangladesh. However, some of these companies are also the

importing agents for the same makes and model of engines. The net result is that of the five manufacturers, only one (Deutz Bangladesh) has a significant manufacturing capability, with about 75% of value of engines being locally produced. A second company assembles Yanmar engines, adding some 7% of value to the finished motor from local production. The other three companies have not developed local capability.

The failure of this program is largely the effect of government policy that has, in the past, discouraged import of components and raw materials for manufacture because import tariffs were high in comparison to those of assembled equipment. But there is a more fundamental aspect, which is a reluctance by most manufacturers to invest capital and effort into an enterprise that is at the mercy of government policy changes. It is safer and easier to remain an importing agent than to become a manufacturer; it may also be more profitable. Deutz can manufacture an engine that is of similar cost to imported machinery, but they have a well run and disciplined organization. Further, their engines are suitable for a wide range of uses (marine engines, agricultural equipment) while their competitors engines are less flexible.

Although the World Bank has suggested a number of ways in which the government could, and should, stimulate local manufacturing capability, few positive moves have been made in this direction 5/. In some cases, donor assistance remains tied and the pace of shallow tubewell development is far faster than local manufacturing potential at least for the next few years. That there is a need for local capacity to manufacture engines is in no doubt, for the replacement of old engines will gradually become

5/ World Bank (1982) Review of Minor Irrigation Sector

a significant component of total production.

A related issue to this discussion is the appropriateness of the engines being imported or manufactured. In the long run Bangladesh has to develop self-reliance in engine manufacture and spare part production: the market will remain large and steady just to keep the sector running. However, many of the engines currently imported are not easy to repair. Lightweight alloy engines are not the most appropriate for Bangladesh: they need greater care in terms of daily operation and maintenance, and they are far harder to overhaul and repair. By contrast, cast iron engines, which have the disadvantage of being heavier from the perspective of portability, are durable, abusable and capable of being stripped down and overhauled many times. Henry Ford would not have been successful if he had started Model T production with a lightweight engine.

Because cast iron replacement parts are within the technology already extant in many towns (casting, welding and brazing business thrive) they enable the private sector to be responsive to local needs. The same is not true for the more sophisticated production techniques associated with alloy engines. Although there has been some recognition of these problems, there is reluctance by many to publicize this issue. One can only speculate that importing agents and government procurers are content with present agreements.

The electric motor manufacturing sector faces similar problems. GEC is the major manufacturer of electric motors in Bangladesh, but imports are still required. As rural electrification proceeds, there

will be an increasing demand for single phase, low horsepower electric motors for shallow tubewells and low lift pumps. A few have already been imported. These are much more suitable for local conditions than three-phase motors. Ironically, import of such motors is restricted because they have to be a complete motor and pump set, and this makes them more expensive than importing the motor and attaching the pump manufactured or assembled in Bangladesh. Also, complete sets are often harder to use for non-pumping purposes, and there is clearly utility to have motors that can be used for such activities as rice hulling and milling.

Local manufacture of electric motors, particularly small ones, is within the capability of several small companies as well as GEC, and this sector could benefit from assistance if the overall government policy favored local manufacture.

3.2.2 Potential Solutions

Two main activities are seen as the most useful at this stage. The first is to develop a capability to match pumps and engines with local environmental and operating conditions. Pump design is a straightforward technical task that is transferable from overseas, and there is a good opportunity to involve some local institutions in this field. The prime candidate is clearly BUET, although BWDB and BADC could also contribute. There is also scope for involvement by private sector manufacturers and voluntary organizations such as Asia Foundation or Mirpur Agricultural Workshop and Training School. Bangladesh could

benefit from a pump research institute that is charged with tasks such as testing of manufactured equipment, monitoring of field performance of pumps and development of pump design to meet local conditions.

The second activity involves encouraging the government to provide the appropriate policy environment for private manufacturing of engines and motors. There is clear evidence that the capacity exists in Bangladesh to produce good quality, durable engines such as those produced by Deutz. The World Bank took an initiative through the Minor Irrigation Sector Review to suggest ways of supporting local private sector production but they are in no position to follow through on these initiatives with their present project framework. They feel that unilateral donor action in the area of support for these manufacturing activities would be both appropriate and desirable.

It is not clear whether the licensed companies, all of whom represent major international business, would require capital assistance. What they do require is some assurance from the government that their investment is going to be worthwhile, that their production will not be undercut by subsidized imports, and that they will be allowed to be reasonably competitive. For its part, government will need assistance in developing more appropriate guidelines regarding makes and models of engines, quality of production and revised procurement policies.

3.2.3 Possibilities for USAID Involvement

It is clear that USAID can play a positive role in assisting the private sector manufacture of pumps and engines. The government shows willingness to support private sector development and there is strong support for an AID based project from the World Bank.

There appear to be a number of useful activities for USAID. Support for a research and development initiative that evaluates the suitability of different pumps, engines and motors is a major priority. Matching of pumps to groundwater and aquifer conditions has been cited as a deficiency in a number of reports but no action has yet developed. Support for BUET, BWDB and BADC in this field would be very valuable, preferably based in BUET.

Further evaluation of the suitability of different types of engines and their repairability is also a priority. A survey of existing performance of different engine and motor makes and models in terms of durability, ease of maintenance, repairability and ease of obtaining locally manufactured spare parts is required if policy towards local private sector development is to be rationalized.

In utilizing the results of both of these activities there would be both short term and long term benefits. By ensuring that design and manufacture of equipment is appropriate to local conditions there would be large savings on operational costs because pumping efficiencies would be higher and there would be fewer major breakdowns that currently limit the utilization factor of equipment.

Establishment of clearer goverment policy towards procurement is also important. Manufacturers of pumps, motors and engines are working under uncertain conditions, and USAID would be providing them a valuable service if policy were more clearly stated. One World Bank recommendation that merits particular attention is the development of more contact between policy makers and manufacturers to meet regularly to discuss matters of mutual interest and concern. Issues that could be included in these discussions include evaluation of availability of raw materials, problems of importation, establishment of appropriate levels of taxes and duties, estimation of demand and review of equipment performance.

If appropriate, USAID could consider credit for purchase of specific manufacturing equipment currently unavailable in Bangladesh to reduce reliance on imports of certain components for assembly. This would be consistent with World Bank recommendations that manufacturers subcontract for certain items rather than developing too much vertical integration into the sector.

3.3 Development of Services for Pumps and Engines

3.3.1 Problems Identified

As indicated in the previous section, the pump and engine sector is the heart of the irrigation program: if pumps and engines cannot be maintained and operated with some considerable degree of reliability, it is unlikely that there will be continued improvement in either agricultural production or productivity. There are a large number of detailed issues involved in providing support to the pump and engine sector and for purposes of clarity it is convenient to identify six groups of issues for discussion.

(a) Supply of Operating inputs: Operating inputs such as diesel, oil, lubricants and electricity have to be made available in order for the engines and motors to operate. There are scattered reports of non-availability of diesel and other supplies, but it appears that at the present time these shortages are not critical to pump sector irrigation performance. Although BADC is the main supplier of these inputs, there is sufficient private sector retailing to enable most farmers to buy what they need. As the number of engines increases it is likely that demand factors will ensure that supplies are adequate as long as imports are increased commensurately. Quantity is not the only consideration, however. There is also some concern of quality of diesel fuel by the time it reaches users, particularly in respect of contamination by water (accidentally or otherwise), and again there are reports of local shortages of appropriate grades of oils and lubricants. The requirements

of the various engines already installed vary, and for some engines it is hard to obtain the right grade at any time. This has a significant impact on engine life, particularly for lighter weight engines.

Electricity supply represents a special case, as the user is totally dependent on the PDB and PBS to supply electricity. Failure of power supplies is a common complaint, although again it is hard to evaluate the extent of the problem at the present time. It may be desirable to concentrate rural electrification in those areas where shallow tubewells and low lift pumps are in good supply, and ensure that the electricity can be delivered on a reliable basis. It is generally assumed that as generating capacity and transmission networks are improved there will be more reliability in electricity supply, and this should be encouraged because there is growing evidence that electric motors are more efficient and easier to operate and maintain than diesel engines.

(b) Production of spare parts: Currently production is constrained by a number of factors, including the wide range of pump and engine makes and models, difficulties in producing certain components, difficulties of producing alloy parts, competition from imported spare parts which receive subsidies, spot shortages of raw materials and coke for local manufacture, lack of knowledge of demand for spare parts, lack of workshop facilities away from major urban centers, public sector protection that discourages some private sector manufacturing, and a lack of coordination between manufacturers, sales agents and users.

Despite these factors, there is good evidence that where demand reaches certain levels, local manufacturing and distribution capability can develop rapidly. Bogra and Comilla are major centers for spare part production that have not received any outside support, yet can meet demand for most spare parts. This is certainly a further argument to support saturation with shallow tubewells and low lift pumps where appropriate. The real issue is how to promote such capability in areas where pump and engine densities are lower and where demand is less. Essentially there are two alternatives: promotion of local manufacturing in all urban areas, or development of a stronger and more responsive wholesaling network than presently exists. The record of BADC in maintaining adequate supplies of appropriate spare parts in its warehouses has not been impressive, both due to protection and lack of accountability. However, it is difficult to promote local manufacturing of spare parts if there is insufficient demand to justify it. A program that promotes manufacturing when demand is not known is a risky venture, particularly if there might be an alternative option in promoting distribution of spare parts made in a few centrally established regional centers.

(c) Sale and Service arrangements: this remains a serious concern. The policy for service is dependent on the nature of pump and engine sale or rental agreement. For rented equipment, the lessee is entitled to free visits of BADC and BWDB mechanics, but they have to purchase spare parts through the official wholesaling and retailing program. This system is open to considerable abuse, because the user is dependent

on the whim of the visiting mechanic and his honesty. BADC retains the right to refuse to service equipment which contains unofficial spares, even though the spares may not have been readily available through official channels. There is no accountability on behalf of official mechanics to keep the equipment operating, and corruption is widespread.

Equipment purchased by users includes an eighteen month period of visits by mechanics employed by the sales agent at no extra cost. The sales agent is required to maintain adequate stocks of appropriate spare parts. In reality neither of these happen: the user is obliged to obtain the services of paid mechanics (either those of the agent or independent mechanics) and sales agents rarely maintain any spare parts, advising users to purchase them on the open market because they are cheaper. This latter point is probably true in areas where demand is high enough to foster competition, but may not be so in areas where demand is still at a low level.

There is little doubt that it is extremely profitable to be appointed a sales agent through existing programs for shallow tube-wells and low lift pumps. The agent gets good commissions for sale, installation and service and has little risk because he invests none of his own capital. As there is no supervision of agents' activities, it is easy for him to cheat on installation and service agreements. That many agents do not charge users the full downpayment, paying it

instead "out of their commission" so as to increase sales, only goes to indicate the high degree of profitability. There is also no long term commitment, and it is probable that many agents will leave the sector as soon as a more profitable venture comes along.

The present policy also encourages another trend, which is service by make of engine, not by location of engine. This means that mechanics only fix their brand of engine, an inefficient operation if engine makes are all mixed up in the same area. More versatility in provision of service skills will be required, so that mechanics are trained to be able to fix a range of types. This may be a better policy than artificially restricting the range of model types of area, because such policies favor inefficient monopolies.

(d) Major and Minor engine and pump repairs and overhauls: the distinction between major and minor here really refers to whether the work can be done on site, or whether the equipment has to be removed to a workshop. This requires two cadres with different skills and functions, and at present there is no rational policy in this direction.

Field based mechanics only need to be able to undertake repairs and servicing of equipment that can be done with a simple set of tools. He should be able to carry with him a range of basic spare parts, in order to overcome the more common practise of making two visits: one to identify the problem, and other to return with the right parts.

Obviously with poor transportation available he cannot be expected to carry larger parts for a wide range of engines. These mechanics clearly have to be based at Thana or even Union level if the estimates of up to 40 pump sites per mechanic is right. Some thought has to be given to the questions of whether mechanics should be in competition with each other, or whether they should contract out services to a pump owner or group and assume some responsibility for ensuring that equipment is fixed speedily and effectively.

The evidence from Comilla and Bogra again indicates that where there is saturation or a high density of equipment, the private sector mechanics have taken over much of the service sector and do so reasonably efficiently. Where equipment is spaced far apart, and where communications are poor, the private sector does no better a job than public sector organizations. This raises the question of deep tubewell servicing, for spacing here is inevitably greater than for other types of pumps, so that private sector involvement is more difficult to promote. Travel costs will be higher and the income expectation will always be lower.

Training of field level mechanics is undertaken by a wide range of organizations, both public and private. Little coordination in their activities exists, but this is not of great importance. As long as the training is adequate, the source of mechanics is largely immaterial. It appears that PVO and NGO training programs are of slightly higher quality than official training institutes, and there is scope for expanding these activities. However, with several hundred

thanas involved it is difficult for these agencies to meet demand, and support for thana based training through thana workshops is essential. The World Bank has a program for this, and they expect to meet all of the demand.

Major overhauls of pumps and engines in workshops presents a rather different set of problems. Training of these mechanics has so far tended to be undertaken by manufacturers or agents, or through vocational training institutes. The trainees require better and more expensive equipment, and the training courses are generally of medium term (months) duration. While much of this training tends to be concentrated in the few large urban centers, much will have to be done through thana level workshops if demand is to be met.

Bangladesh is not short of people who have an aptitude for developing mechanical skills, and the market is large enough to support a large number of different training initiatives. There is considerable utility in supporting almost any training but there is definitely a place for some form of overall coordination of these training programs: the present trend towards in-house training by manufacturers and establishment of their own private sector service networks may come into conflict with other initiatives to strengthen thana level facilities.

(e) Training of operators for routine maintenance: the current training provided to pump and engine operators is clearly inadequate. There is a pressing need to ensure that operators learn much more about

routine tasks and what not to do if they wish engines to perform better. The scale of the problem is intimidating: if every operator and an assistant were to be given even basic training, some half a million people will be involved. The only way to do this is to develop a type of extension service that focusses on pump and engine operation. For a number of reasons, the existing water management programs largely ignore aspects of pump and engine maintenance, although it is not necessarily desirable that water management and maintenance extension be combined.

One thing that has been lacking is the preparation of simple and graphic training materials that can be distributed to encourage better routine maintenance. Beyond such items as wall charts and record keeping procedures, it would be valuable to have short video tapes capable of being shown on battery operated sets dealing with such aspects as dewatering fuel, proper and timely cleaning and changing of fuel, air and oil filters, and replacement of the most commonly needed components. Training that does occur at present is largely unimaginative and does not make sufficient allowance for educational standards of most operators and assistants.

(f) Pump and Engine Performance monitoring: In the same way as it is desirable to have monitoring of groundwater conditions, it is also useful to have some on-going program to monitor the pump and engine sector. While, in theory at least, BADC and BWDB have to do this so as to maintain proper stocks of spare parts, the rapid growth of private

sector sales and service could benefit from some form of program. There are really two components to a program of this nature.

Firstly, it is useful to keep a check on the suitability and durability of various engines and motors so that major difficulties can be identified fairly early, as has been the case for the Yanmar 75 engine. A regular check of farmer attitudes towards their equipment and the problems they encounter would be of considerable value.

Secondly, and particularly for wells and pumps, it is hard to know exactly what performance is being achieved. As the pump impeller slowly wears, pumping efficiency becomes lower. This is not necessarily noticeable for water is still being pumped, but at reduced volume and increased cost. There is little readily available information on the expected lifelength of pumps, and so it becomes difficult to estimate when users should think of purchasing replacement parts. Because of local problems of pumping sand, clogging of screens with inorganic and organic matter, deterioration of seals and valves and so on, reduced performance of wells and pumps will vary greatly in both magnitude and timing. This activity would be suitable for inclusion into any effort to monitor and evaluate the whole pump based irrigation sector, as described in section 3.1.

3.3.2 Potential solutions

There is no doubt that much needs to be done in the whole field of providing services for pumps and engines, and it is unlikely that it can be handled within the context of a single project or a

single organization. There is scope for both private and public sector involvement although the right mix will need to be determined.

The evidence from Bogra and Comilla indicates that when there is sufficient demand the private sector is capable of providing reasonable service at reasonable cost without significant intervention. With the current rate of tubewell installation it is likely that the private sector will continue to expand, particularly in those areas where tubewell densities are high. There is also some indication that public sector services improve when the competition from private sector mechanics and workshops becomes significant.

Naturally there are some questions as to the overall supply and quality of mechanics to service the rapidly expanding irrigation equipment sector. These needs are being met through a number of different programs organized by government and private organizations. For major overhauls mechanics are trained by individual manufacturers or agents and through a few PVO and NGO programs, notably Mirpur Agricultural Workshop and Training School and the Asia Foundation. District and field level mechanics are trained by ILO under World Bank programs, both for BADC and the private sector. The private mechanics are provided with tool boxes on credit. The World Bank is confident that as a result of these programs there will be sufficient mechanics trained to meet medium term requirements and would not be supportive of further training activities.

Support for spare part production is currently deficient. Donor agencies funding tubewell developments require a certain proportion of funds (normally 10%) for import of spare parts to support the installed equipment. However, this policy does not foster local private sector manufacture and there is scope for rationalization of spare part production and distribution. Like the fertilizer program this could be a major development for the private sector although there would be a wider range of products involved and a need to balance imports with domestic manufacturing capabilities.

More specifically, some program is required that will evaluate the desirability of manufacturing certain spare parts regionally and concentrating manufacture of more specialized parts in Dhaka and Chittagong. There is every reason to believe that local manufacture of almost all spare parts can eventually be achieved. However, for this to occur there should be some coordination of manufacturing and distribution and this merits attention in the context of a manufacturing support project.

In developing this coordination there has to be better feedback from the field as to local supply and demand for spare parts. The current situation works but only just, and it would be highly desirable to foster better communications between dealers and manufacturers. The formation of a field level monitoring program and the establishment of a joint consultative group between government and manufacturers would be positive moves in improving distribution of spare parts.

A final aspect of project support for spare part manufacture and distribution would be to address the questions of standardization and quality control. While standardization is attractive from the perspectives of simplifying import requirements, equipment servicing and maintaining appropriate spare part stocks, it may be detrimental if the standardized equipment is not the most appropriate for hydrogeologic conditions or repairability. One asset of domestic production of spare parts is that standardization is not so critical, for local manufacturers are more responsive to demand than agencies involved in large scale procurement. Obviously having a large number of manufacturers entails the risk of highly variable production quality but this can be overcome if manufacturers or wholesalers have the ability to undertake checks on products procured by them.

3.3.3 Possibilities for USAID involvement

In conjunction with support for manufacture of pumps, engines and motors there is considerable scope for USAID involvement. As well as promoting domestic manufacture of basic equipment there is a need for parallel support for spare part production and distribution. As much manufacturing relies on subcontractual arrangements, there should be attention paid to promoting spare part production by a series of smaller industries and workshops.

A first step is to develop better estimates of spare part requirements by equipment make and model and to use this information to develop an appropriate strategy for production or import of different

items. There should be no difficulty in fostering local production of spare parts if demand requirements and procurement procedures can be rationalized. Consultation between manufacturers and suppliers is an important component and USAID has an advantage over the World Bank in being able to communicate directly with private sector concerns. The same advantage holds true for distribution, sales and service agreements, and some local manufacturers are receptive to initiatives in this direction.

Because of existing programs, USAID has no reason to become involved in training programs at this stage. Although the World Bank sponsored programs may not fully meet requirements it would be very hard to justify any project involvement at this stage, and it would add extra obligations on the Mission in terms of supervision and collaboration with a number of different agencies. With current involvement in the Rural Electrification Project there is no need for additional USAID assistance in the area of supply of operating inputs.

3.4 Strengthening Water Management Services to Farmers

3.4.1 Problems Identified

All of the project consultants have identified a number of issues relating to the provision of services to farmers that aim at promoting improved water management at field level (field level here being taken as any water management activities that occur once water has been pumped to the ground surface). Rather than reiterate their findings and conclusions, it seems more appropriate to mention a few of the more important aspects of this very complex subject.

A basic criticism of most rural development projects that aim to assist farmers improve their farming performance is that there is generally an inadequate understanding of the factors that influence farmer behaviour. This is certainly true for water management, and particularly true in Bangladesh where the history of modern irrigation is very short. In the absence of good information, it is inevitable that outside intervention is based on a series of assumptions and generalizations about field conditions and the rationality of farmer actions. The few research studies that exist indicate that, given a partial knowledge of some of the technical, agricultural, economic and social conditions at field level, many farmer groups are probably doing a better job than they are normally given credit for. If this is so, then the utility of outside intervention has to be seriously questioned. Those of us who participated in the recent trip to Mymensingh and Tangail

might well concur with the school of thought that feels that farmers are doing a reasonable job despite the efforts of government to help them. Until there is a better information base from which to work, it may be better in many cases to leave such things well alone.

A second comment of most of the consultants was that the various training efforts that are currently underway have tended to reinforce the well established bureaucratic view that there is a single solution to overcoming field level problems. Almost without exception, all training programs concentrate on the technical aspects of water management, and promote a policy of "farmer motivation" to accept the package being offered. There is remarkably little sensitivity to regional variation in water management requirements, be they technical or non-technical in nature. The net result of this rather heavy handed, top-down approach is that farmer acceptance of the extension advice appears to be marginal.

Much of the focus of the direct assistance programs, where voluntary agencies (and to a lesser extent, government agencies) work closely with farmer groups has followed the same format: a package of activities is developed and the farmers "motivated" to accept them. This is not to say that all the effort is misdirected, and in some cases there have been significant improvements, but it does not always seem that the effects will be long lasting once the intervening agency pulls out. Very few groups out of all of the programs in Bangladesh have been deemed sufficiently self-reliant to "graduate". This may be more a reflection of the intervention process and the proposed package than an assessment of farmer willingness to change.

However, the basic flaw in all of these programs is that they assume that there is little or no interaction between factors external to the particular scheme, and the behaviour or performance of farmers within the scheme. The assistance packages being promoted take little account of the unreliability and uncertainty of basic operational inputs that farmers face on a day to day basis, and show little appreciation of risk management. In rereading the scope of work for the Water Management Systems Project, it appears that the primary purpose is to focus on trying to provide a more reliable and more certain environment for farmers, and it would be inappropriate to concentrate too much effort on the user of the services at the expense of focussing on the suppliers of those services.

3.4.2 Potential Solutions

Focussing on the service sector and letting farmers perform as they see fit is probably as good a solution as any. Despite every good intention to help farmers directly, they ultimately end up doing what they want, not what outsiders want them to do. This is not to say that extension advice and encouragement is inappropriate, but extension dictat probably is.

However, in order to obtain good extension and training services, they have to know what is going on at field level. Like far too many other programs, the water management arena in Bangladesh suffers greatly from a lack of coordination between the research, extension and training services. There is often little relevance in the research being done,

both because there is little incentive to do that type of work and because there is often little feedback from the field as to the nature of research problems that need to be addressed.

With extension, training and research being conducted by several independent agencies in different ministries, it is hard to expect much coordination. This is not helped by the multiplicity of different approaches being fostered by donor agencies, PVOs and NGOs either independently or through government agencies.

3.4.3 Possibilities for USAID involvement

Because the Water Management Systems project does not seem to be aimed directly at field level problems, but at higher levels in the systems, it does not seem appropriate to suggest any specific activities at the present time. It may be, that as more information becomes available and as the service sector is strengthened then the Project might have a role to play.

It is, however, encouraging that USAID is currently supporting a number of activities that could be very valuable. The Agricultural Research II program is aimed at finding out more about field level conditions and developing packages for extension and training programs that are suited to farmer needs and capabilities. The Diagnostic Analysis training program has the specific aim of increasing government officers' awareness of the complexity of water management at field level, and has the potential to come up with one of the better data bases on which

to base training and extension programs. The CARE program, although tending to promote a rather uniform package to all of its nearly two hundred deep tubewell groups, is systematically collecting valuable data that, when analyzed, should reveal a lot more about how farmers behave and the degree to which they will accept such packages. There is also USAID support for the FAO/UNDP training program at RDA, Bogra, which aims at providing thana level Subject Matter Officers some understanding of the problems they will face when dealing with water management. As purely editorial comment, it does appear that this last program is guilty of focussing too much on field level problems and not enough on the responsibilities of the very officers who are being trained, for it is precisely this cadre who are responsible for providing field level services to farmers.

If USAID can continue to support these programs, and perhaps guide them a little towards addressing the two major issues of increasing our knowledge of field conditions and strengthening the service sector, then there should be good prospects for long term improvement in field level water management. However, the current assessment of the project team is that government agencies have no capacity to absorb further initiatives in the supply of water management services to farmers, and an additional project addressing these issues is unlikely to be successful. It may also result in dilution of the impact of existing projects and this would be undesirable.

3.5 Strengthening Policy and Institutional Support

A common theme to the discussion so far as been the need to have clearly defined policy and appropriate institutional support to implement these policies. Without these conditions it is considerably harder to implement programs that focus on the development of managerial capability than implementation of programs that rely mainly on disbursement or provision of hardware.

It is quite apparent that within the water management sector there is still considerable debate as to the best policy or policies to promote, both within the government and by donor agencies. While there is a partial commitment to some aspects of privatization, there are also parallel moves to promote a greater degree of central control over sector development. Because of different approaches by donor agencies (some of whom promote different policies simultaneously) it is easy to sympathize with the government to some extent, but it is also true that vested interests within the government sector have some influence. This does not make the task of promoting a management intensive project any easier.

Part of the problem is undoubtedly a lack of good information available to senior level policy makers. Like the rest of us, they are to a large extent dependent on the same type of anecdotal information, and because of this it is only to be expected that there will be contradictory signals about what government is or is not likely to favor at any given time.

One effect of the lack of much information is that the few studies and reports available take on almost too much importance in terms of the breadth and depth of their contents. Groundwater policies are being shaped on the basis of two or three documents; knowledge of pump and engine performance is limited to two reports. It is more than obvious that any project that promotes the collection of more and better quality information is likely to be of incalculable value in helping senior officials formulate policy, and this would seem to be a major role for a USAID supported project at this stage in the development of the water management sector in Bangladesh.

The same is true for institutional support. Although there may be considerable utility in supporting a number of different institutions involved in various aspects of training, research or extension there also has to be a capability to develop some form of coordination. It is true that the creation of such bodies as the Water Resources Council, the Water Master Planning Organization and the Central Coordinating Committee for irrigation represent potentially positive moves towards policy coordination. But it is also true that these bodies need to develop linkages with more action oriented bodies, and foster a two way flow of information. A project that only interacts with the action oriented bodies is less likely to have as lasting impact as one which attempts to address institutional support and linkages between different groups within the policy making hierarchy.

4. RECOMMENDATIONS

In light of the information collected in connection with the Water Management Systems Project, the design team recommends the following activities for consideration by USAID.

1. Not to pursue further the component concerned with provision of water management services to farmers.

It is the opinion of the design team that existing donor-financed activities, in this area are providing sufficient support to the government at the present time. USAID already has a substantial commitment in this area through the Agricultural Research II Program, support for the CARE DTW Project and to the FAO/UNDP training program at RDA Bogra. Absorptive institutional capacity of Bangladesh appears to equal present water management services inputs.

There is little prospect that USAID can design and implement a satisfactory project in this area because there is not yet a demonstrated commitment on behalf of the government that they can absorb further support. While this commitment may materialize in time, it is felt that further activities are premature.

2. Not to pursue training of mechanics for maintaining irrigation equipment.

The World Bank mechanic training program has been designed to meet the full anticipated needs during the SFYP, in combination with private manufacturers training. Under these circumstances there seems little purpose in proposing a USAID sponsored training program.

3. <u>To support a program that concentrates on the local manufacture of pumps, engines and spare parts, their sale and distribution and the development of the required policy support for this program.</u>

The design team is firmly of the opinion that USAID should limit its activities to areas where there is a clearly defined role, and avoid becoming involved in an amorphous project that has diverse objectives. In terms of the original scope of work presented to the team, it is considered that the manufacturing sector is the only component that merits further attention.

In becoming involved in such a project, the design team feels strongly that it will require the commensurate strengthening of policy with respect to both water resource development and privatization of the manufacturing, sales and service sector. Policy areas that must be addressed are: the suitability of equipment for groundwater and aquifer conditions; the repairability of equipment; the degree of standardization of equipment; and contractual arrangements to be made with private sector enterprizes. Without clear policy support in each of these areas the team is dubious that long term strengthening of local private sector manufacturing capability will be accomplished. If government continues to support current import and procurement strategies that favor imports of machinery and spare parts of dubious suitability and repairability, there will be little incentive for private sector growth.

4. <u>The current design team project title and Scope of Work be amended to reflect this new direction</u>

The design team feels that the current title and Scope of Work of the project paper do not reflect the new direction of the previous recommendation. To this end the project team recommends revision of the Scope of Work to de-emphasize water management and emphasize interest in support for the irrigation equipment sector. A summary scope of work is presented in Attachment A.

Although the proposed Scope of Work extends the timeframe for project paper preparation, the design team believes that the interests of the Mission will be better served by focussing attention on this sector and spending additional time in preparation of a revised project. The proposals will better address the needs of the minor irrigation sector in Bangladesh which are not presently being supported and will result in a more implementable and appropriate project for the Mission.

IRRIGATION EQUIPMENT POLICY AND SUPPORT PROJECT

SUMMARY SCOPE OF WORK

The success of the pump irrigation sector in Bangladesh is dependent on the establishment of a viable domestic manufacturing, sales and service sector that can support long term reliability of equipment operation. Until reliable operation of equipment is achieved it is unreasonable to expect full utilization of equipment and this inevitably reduces the area of land that will be brought into foodgrain production. Despite the massive investment in pump irrigation little attention has been paid either to support of the irrigation equipment sector, or to the formulation of policies that will encourage appropriate private sector investment.

I. Study Purpose

The purpose of this study is to design a program of specific activities for AID support which, coupled with BDG and other donor resources, will strengthen the irrigation equipment sector in Bangladesh.

II. Approach to Study

The Scope of Work has three objectives: (1) to review and evaluate existing capability for domestic manufacture of irrigation equipment and spare parts; (2) identify policy strategies required to support manufacture, sales and service of equipment appropriate to

hydrogeologic conditions, operating conditions and repair facilities, and (3) design a program of specific activities that will promote private sector capability to manufacture and distribute irrigation equipment and spare parts.

III. Scope of Work

A. Review and Evaluation

The team will describe, review and evaluate the present situation in Bangladesh for manufacturing of irrigation equipment and spare parts, sales and service arrangements and support for repair and maintenance. The following aspects should be included in the discussion:

1. Compitation of an inventory of all manufacturers of pumps, engines and motors in Bangladesh and provide detailed information on facilities, manufacturing capacity production by make and model of equipment, subcontracting arrangements and prospects for future expansion.

2. Complication of an inventory of all manufacturers of spare parts and components for assembly of pumps, motors and engines and provide detailed information on facilities, production capacity, production achieved, contracting arrangements with equipment assemblers or spare parts distributors and prospects for future expansion.

3. Evaluate the appropriateness of current pump engine and motor imports and manufacture for hydrogeologic conditions in different parts of Bangladesh, and assess design requirements to maximize efficiency of irrigation equipment operation.

4. Evaluate the appropriateness of current irrigation equipment imports and manufacture for reliability of operation under normal conditions in Bangladesh and suitability for repair in local and district workshops. Particular attention should be paid to the materials used in the manufacture of irrigation equipment, their suitability for repeated major overhauls and the reproducibility of spare parts in Bangladesh.

5. Assess the relative benefits of electric versus diesel powered irrigation equipment and evaluate the impact of increased rural electrification on the demand for electric motors.

6. Describe existing arrangements for distribution, sales and service in both public and private sectors, licensing and franchizing agreements, procurement policies of government agencies and prospects for developing these arrangements throughout the country.

7. Describe existing pricing policies for irrigation equipment sales to farmers either individually or through group arrangements and evaluate the performance of sales programs.

8. Estimate future demand for irrigation equipment both for new installation and replacement of existing units over a 5-10 year period, including variation by type of equipment and durability of different makes and models.

9. Review existing government policies supporting or inhibiting domestic manufacture of irrigation equipment in both public and private sector, including import policy, taxation, financing, credit arrangements, agreements with donor agencies, investment approval procedures, licensing, regulation and other incentives and disincentives.

10. Review existing government and private sector institutions currently involved in the manufacture, distribution, sales and service of irrigation equipment and their interrelationships.

B. Development of Policy Strategies

The review team shall, in light of the review and evaluation findings, identify specific policy requirements for the

strengthening of private sector involvement in irrigation equipment manufacture, distribution sales and service arrangements. The areas to be covered should include, but not be limited to, the following:

1. Regulations controlling the design of irrigation equipment appropriate to hydrogeologic conditions.

2. Regulations controlling the construction materials used in manufacturing basic equipment to facilitate local production of spare parts and to maintain adequate quality control.

3. Desirability of measures designed to protect local manufacturers by controlling imports of assembled equipment and spare parts.

4. Relaxation of existing regulations regarding import of raw materials to be used by local manufacturers, tax benefits for stimulating domestic investment, and availability of foreign currency.

5. Relaxation or abolition of monopoly service agreements to government agencies responsible for equipment sales or leasing.

6. Feasibility of concentrating rural electrification projects in areas where potential for significant electrification of irrigation equipment exists.

C. Project Design

The review team will propose a specific program of activities which will result in the fulfillment of project objectives. The project should address both short and long term strategies for strengthening the irrigation equipment sector, and will include specific recommendations for a 5-10 year program.

In proposing specific strategies and activities, the project team should address the roles of existing government agencies and private sector organizations, and develop a plan of action to ensure coordination between public and private sectors. The recommendations should be described in sufficient detail to be included in an AID project paper, and should address, among others, the following topics:

1. Implementation Organizations,
2. Technical Assistance Requirements,
3. Commodity Inputs,
4. Cost Estimates,
5. Implementation Plan,
6. Feasibility Analyses, including technical soundness, financial and economic benefits and social soundness,
7. Evaluation Plans,
8. Environmental Examination.

D. Level of Effort

A three person team is proposed for the design of the Irrigation Equipment Policy and Support Project, consisting of:

1. An irrigation equipment specialist for six months to act as design team leader. The person selected should have a strong background in irrigation equipment selection, manufacture, repair and operations.

2. A business specialist for a period of three months to develop the private sector component and to foster linkages between public and private sectors.

3. An economist for a period of one month to support the financial and economic components of the project design.