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MARTIN MARIETTA

THE ECONOMIC AND SOCIAL IMPACT OF
RURAL ELECTRIFICATION IN BANGLADESH

Thomas A. Timberg
Robert R. Nathan Associates, Inc.
Washington, D.C. 20004

Prepared for the
Oak Ridge National Laboratory
Oak Ridge, Tennessee 37831

and

U.S. Agency for International Development
Washington, D.C. 20523

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ABSTRACT

This report assesses the economic and social impacts of Rural Electrification in Bangladesh. The economic and social effects will take several decades to work out and are especially difficult to measure in a country like Bangladesh. The sources of data are largely from secondary material--data with the Rural Electrification Board (REB), and studies of the impact of connected irrigation, electrification of cottage industries, and electrified rice mills. These secondary data sources can be further enhanced by primary data, e.g., interviews conducted with various beneficiaries. For this purpose, visits were made to nine PBS's and interviews conducted with a variety of clients.

Several important results emerge from this study.

- Subjectively, electrification is very popular with elders because of the energy cost savings it permitted; with the young because of the social possibilities it permits (late night study; TV; etc.).
- The process of allocating connections is popularly perceived as highly political despite the distribution coops (called Palli Bidut Samities or PBS's) well supported insistence that objective criteria are strictly applied.
- REB morale and performance are high as reflected in outputs like lowered system loss, increased bill collection, and low levels of theft of supplies.
- The PBS's are working cooperatives and highly participative, although the boards tend to be dependent in their decision making on the General Managers and REB.
- Considerable cost savings are achieved by most commercial end users with electricity over alternatives, primarily diesel, which encourage somewhat greater use of electricity in irrigation and mechanized agro-processing.
- Hours of shops, cottage industry, markets, study, etc., have lengthened due to the greater use of electric lighting and the heightened feeling of security in rural areas, bringing increased welfare and productivity.
- Electrification contributes to a feeling of integration of the electrified areas with the modern sector of the economy.
- Few entirely new industries and activities have been energized; however, these may appear when electrification is fully digested by society.

1. INTRODUCTION

The key point to understand in terms of the social and economic impact of Rural Electrification (RE) in Bangladesh is that it is primarily an institution building effort rather than simply investment in productive physical capital. The prime gains are in having a critical social function (electric power distribution) performed in a socially efficient manner which augments rather than detracts from other investment and growth in the economy.

The proposed RE structure is intended to:

- (1) be self sustaining and therefore no burden on the limited government budget;
- (2) responsive to its local clientele and thus provide service most appropriate to them;
- (3) constitute a model of an efficient participatory development institution which others can copy;
- (4) put pressure on other agencies to meet its standards--upstream by creating electrical transmission industries and cadres, downstream by improving electricity using industries in rural areas. It has already achieved considerable progress in these areas in indigenizing some of the power pole industry and in forcing down monopoly electric motor prices.

Generally, RE is intended to introduce a mechanism for social change--a mechanism which would have similar impacts to those in the U.S. and to a lesser extent in certain developing countries.

In addition, RE, considered simply as a productive investment seems to give adequate returns when viewed in benefit/cost terms--no matter

which one of a number of techniques is applied. (With returns ranging from 12 to 66% in various versions.)

The contrast provided by the Rural Electrification Board (REB) and the Bangladesh Power Development Board (BPDB), the alternative power distribution mechanism, is generally marked. The Energy and Mineral Resources Minister said (as reported in the newspaper) that the country had invested hundreds of millions of dollars in the BPDB since independence but it had failed to remove the power deficit and to check its system loss. REB morale and performance are high as reflected in outputs like lowered system loss, increased bill collection, and low levels of theft of supplies.

The cynics attribute this largely to the youth of the organization and the undoubted personal charisma of the Chairman, Brigadier Sabihuddin, and confidently predict organizational degeneration in time. But the organization has devoted considerable attention to developing working systems which ought to have been internalized, even if learned by rote as noted elsewhere in the companion report. I think we can agree that rote learning is better than no learning at all.

2. WEBERIAN RATIONALITY

"The personalization of contract is linked with patronage, dependence and sometimes with coercion as an outgrowth of the traditional moral economic order. This personalization of authority greatly damages the ability of the government to implement its development projects. It leads to frequent fluctuation of policy, reversal or countermanding of decisions and consequently demoralization of staff. The result is that in Bangladesh institutions are weak. The social infrastructure needed to propel the country to prosperity is not in place."

Clarence Maloney "Why do Bangladesh People Remain So Poor, Though They Work and Save? Some Reflections After Nine Years There" Conference on South Asia, Madison, Wisconsin, November 1985.

REB constitutes a rational bureaucratic intrusion into what is still functionally a largely patrimonial society. A story from the field trips in connection with this assessment illustrates the point. A vigorous Deputy Commissioner (DC), head of the government administration, used all of his influence to promote youth activities, especially of an intellectual-cultural sort. Himself a playwright, he assisted a variety of local clubs with libraries, publishing schemes, etc. One of the clubs he had been sponsoring fell behind in its electricity bill payments, and had its electricity disconnected, in what is a more or less routine fashion for PBS's. At this point precisely what happened will be meat for a generation of inquiries. According to the REB people, the DC summoned them to a public inquiry in which he announced to a large crowd that no disconnections would occur in his district without his authorization. Some local people detained the PBS finance manager and an unobtainable warrant was issued by the Judicial Magistrate, a subordinate of the DC, against the PBS General Manager. The PBS General Manager fled to a nearby army station and took refuge with a colonel, while the REB successfully used its influence to extricate and vindicate him.

Neglecting the details and formalities, the DC was adhering to a personal patrimonial model where the DC as the "Ma-Bap," mother and father of the district, was the court of appeal for all injustice and controlled all public functions, subject to appeal to his superiors. By contrast, the PBS is a rational bureaucratic model, in which the PBS's specialized function required that they collect their bills.

Max Weber proposed that society proceeded from the patrimonial to the bureaucratic rational state in which social functions were performed by specialized autonomous institutions. In the Middle Ages, all functions were performed by an undifferentiated royal household. In the modern period, specialist bureaucracy emerged. The various social functions were performed more expertly and efficiently. The increased rationality of the social setup permitted modern economic activity. Of course, such economic activity occurs today in patrimonial society, but its efficiency is reduced and its impact distorted.

The introduction of rational bureaucratic social mechanisms is not a value neutral phenomenon. Functions are performed impersonally. Electricity is delivered equally to noble and commoner, and with more difficulty to friend and foe. Social functions are predictable and proceed according to rule rather than whim.

Many people prefer patrimonial regimes with their one stop service and centralization of authority. But the central authority, especially if less than superhuman, finds it difficult to manage and understand all the facets of a large modern society. The conflict between bureaucratic and patrimonial systems is exacerbated by class and group differences

where bureaucratic and patrimonial systems may appear to serve conflicting interests.

3. METHOD

The impact of RE can thus be assessed both in terms of its broader social and institutional effect--which will take several decades to work itself out--or by the narrower approaches suggested by various Benefit/Cost Analyses. In the second case, the first source is secondary material--data with REB, and studies of the impact of the connected irrigation, electrification of cottage industries, and rice mills. These data can be further illustrated by primary data, e.g., interviews conducted with various beneficiaries. For this purpose, visits were made to nine PBS's and interviews conducted with a variety of clients.

4. CONCLUSIONS

Several results emerge:

- Subjectively, electrification is very popular with elders because of the energy cost savings it permitted; with the young because of the social possibilities it permits (late night study; TV; etc.).
- The process of allocating connections is popularly perceived as highly political despite the PBS's well supported insistence that objective criteria are strictly applied.
- The system efficiency of the REB-PBS system is very high, especially when compared with the previous BPDB delivery system in matters such as systems loss, bill collection, attention to customer complaints, planning, etc.
- The PBS's are working cooperatives and highly participative, although the boards tend to be dependent in their decision making on the General Managers and REB.
- Considerable cost savings are achieved by most commercial end users with electricity over alternatives, primarily diesel, which encourage somewhat greater use of electricity in irrigation and mechanized agro-processing.
- Hours of shops, cottage industry, markets, study, etc., have lengthened due to the greater use of electric lighting and the heightened feeling of security in rural areas, bringing increased welfare and productivity.
- Electrification contributes to a feeling of integration of the electrified areas with the modern sector of the economy.

Few entirely new industries and activities have been energized; however, these may appear when electrification is fully digested by society.

5. SELECTION OF SITE VISITS

The PBS's visited were: Dhaka I--the oldest and most successful in the country; Tangail I--an older PBS near Dhaka; Jessore I and II, which are further from Dhaka and major handloom areas in which the powerful Momin-nagar Weavers Co-op is active. Handloom weaving, employing more than 800,000 workers and accounting for over 80% of the cloth made in the country, is Bangladesh's leading industry. Natore I and II are in a rich agricultural area with extensive irrigation. Sirajganj and Pabna II are in one of the other major handloom areas in the country. Habiganj I is one area where a large number of tea gardens are located.

6. CRITERIA FOR COST BENEFIT ANALYSIS

In a perfectly functioning economist's world, consumers would be willing to buy power until the cost of the last unit they bought almost equalled its contribution to their revenue for productive uses or their pleasure (utility) for many domestic uses.

Revenue is a function of output, output (O) is a function of power input (P). The cost of power to a single consumer is a given C per unit, its price. The consumer, who in turn uses power to produce something, will add units of power until his additional revenue [$R = f(P)$] declines below that given cost [C]. He will be willing to pay for units as long as the cost of the last unit of power is less than what it will give him in production or utility.

Consequently, this customer's willingness to pay (WTP) is equivalent to the marginal contribution of power to production or his enjoyment.

"Economic resources are used more efficiently if the price which a consumer is willing to pay for an additional unit of electricity exceeds the opportunity costs of the extra resources required to produce that unit."^{*}

At the same time the utility, the producer of power, keeps producing power until its long run marginal cost--LRMC--(the additional cost of a unit of electric power including capital investment) equals the fixed price it gets.

All of these things occur because firms and consumers are presumed to maximize profits and utility. At equilibrium, the profit should be

^{*}Fed Flutman, "The Socio-Economic Impact of Rural Electrification in Developing Countries: A Review of the Evidence," World Employment Programme Research Working Paper, ILO, No. 1983, p. 19.

competed away (but this is excessively unrealistic). The system makes maximum efficient use of resources.

In the real world, even an approach to LRMC and WTP pricing should improve social efficiency. Also, in the real world, utility prices are regulated, set by fiat. Consumers, who use power to produce things, would often be willing to pay far more than what is charged for the last unit. Utilities often do not achieve the LRMC, make losses, curtail expansion, or become a drain on government budgets.

"Projects in public utilities, for example, are among those which presently present problems for economic analysis, even in the traditional sense. The main reason for this is that in many developing countries public utility services, such as power, telecommunications and potable water are rationed, the actual rates charged having little to do with market clearing."²

Since all this is so--several of the existing valuations of present proposed BD RE projects (most notably the IDA and USAID RE III projects) propose as their basic criteria WTP--and presume in IDA's case that consumers would at least pay for the energy costs they would save for "diverted" uses, formerly fueled by diesel. The AID evaluation assumes that consumers will be willing to pay for additional energy only what they will purchase at controlled rates for new "generated" uses. Clearly, actual willingness to pay is much higher than recorded in the latter category of generated uses (those which occur because electric power is now available), since the controlled rates are lower than the maximum the consumers would be willing to pay.

*Anandarup, Roy, Cost Benefit Analysis: Issues and Methodologies. Johns Hopkins Press, Baltimore, Md., 1984, p. 126.

In a clear formulation of the WTP criteria, Nitin Desai suggests that the actual WTP is between the upper limit of the energy cost savings and the lower limit posed by actual expense that consumers will incur, at the controlled rate. The precise WTP is determined by the elasticity of the consumers' demand for electricity; Desai generally finds this to be 0.5. In the case of Bangladesh, for the sorts of loads carried by REB, particularly because of repressed demand, this elasticity is quite low and can be disregarded. This point is already conceded for "diverted" uses. Even new "generated" uses which account, incidentally, for a small number of connections, and a smaller part of the load, are in very few cases enabled by lower energy costs. These new "generated" uses largely reflect ongoing government programs (to extend power pumps), which are insensitive to costs within a large range. These new "generated" uses also reflect locational decisions made by firms (for the 1000 or so new rice mills, 15-40 KW motors) as distinguished from a discrete decision to start an enterprise because of relative input prices.*

I would suggest that an alternative approach might be used. The extension of the RE network to meet certain energy needs in rural areas is an alternative, in almost every case, to meeting them with petrol fuels. Empirically, the bulk of irrigation users, and most domestic and commercial consumers, were already using petrol-based fuels. As I just indicated, in a large number of other cases new irrigation pumps were sited on various independent bases (government programs, etc.) and would have been undertaken with diesel had electricity not been available. In

*Nitin Desai, "Economic Analysis of Power Project," ADB Economic Staff Paper No. 24, ADB, Manila, 1985.

other cases, the same activities, such as some rice mills, would have been located in another place, but constructed nonetheless. Since energy costs are rarely more than 10% of rural industrial operation (usually 2-3%),* it is hardly surprising that they rarely determine overall profitability and thus the feasibility of enterprises. Consequently, it might be more sensible to evaluate all RE uses--"diverted" and "generated," in terms of potential energy cost savings. This would make clear that the policy choice is one to promote electricity over petrol products for the concerned use. Such an approach would not work in countries where other options (than diesel and electricity) are present. It is true that there are some cases where a use is only possible with electrification because the lower cost makes it economic. Where this is so, the cost savings might still well be a reasonable measure of the benefits. Only in the limited cases where the quality of electricity--especially electric light--being superior to kerosene is important are there potentially further benefits. The quality difference is especially relevant in social fields--permitting reading, studying, and greater security.

In addition to the cost savings there are many ways in which electric power, especially electric light, is preferable in quality to the alternative. Anyone who has had to read (or study) or write by hurricane lantern light will immediately recognize the greater ease afforded by electric light and lesser strain on eyes. Electric light also presents less of a fire hazard than kerosene. Electric motors are

*Rural Industries Study Project: Final Report, Bangladesh Institute of Development Studies, Dhaka, 1982 (RISP), pp. 132.

cheaper and require lesser amounts of repair, than diesel powered ones. In general, electric motors cost half as much and require little repair. Though a few users, such as a navigation center in Jessore complained about PBS current fluctuations--most found the power better than alternatives. The same Habiganj tea garden which reported little cost saving over autogeneration saw this quality difference as a key benefit.

One indication is the demand for connections by handloom units, which often do not run at night and to the extent that they do often used kerosene lanterns before. Only two units (in Tangail) reported increased hours worked since electricity, as compared to numerous owners interviewed in Jessore, Habiganj and even in Tangail who reported no such increase. Yet the units install connections--often 25 watt bulbs for security and sometimes alter their locations to be near roads and power. The matter is complicated because in Ullapara (Sirajganj) factory owners cannot get domestic connections--only commercial ones for fear they will use them for commercial purposes.

In what will follow I will examine both WTP and Energy Cost Savings approaches.

What is there:

As of June 1985, 119,000 of 154,000 connections were residential (including mosques and cottage industry units), 24,000 commercial (including some handloom units, schools and social institutions), 6,000 agricultural (pumps and wells) and 3,000 industrial (mostly rice mills). These units consumed 142,000 MWH during 1984-85 of which industrial users (mostly the larger units among them) accounted for one-half, agriculture for three-sixteenths, commerce one-sixteenth, and domestic users

including cottage industry, one-fourth. In both connections and current, non-domestic use represents a rising proportion of the total, reflecting a policy decision that the social benefits of such use is high, as well as the financial reality that non-domestic users pay higher rates.

The large industrial category is perhaps a misnomer since it includes large tea gardens in Sylhet (Habiganj and Moulvibazar), government installations, as well as factories (in general, units consuming more than 40 KV loads). Most PBS's have at least three to four such users. In Natore II, there were four such connections--a military cantonment, the police training academy, a Cadet college, as well as a sugar factory. In Natore I, there was a TV center, and the northern residence of Bangladesh's President, as well as a sugar mill and large rice mill. In Tangail I, and Dhaka I there were a number of factories, representing urban spillover from Dhaka.

Benefits:

The benefits from rural electrification can be considered under three main headings: those from activities that were formerly powered by BPDB connections ("transferred"), those from activities formerly powered by other commercial fuels like diesel ("diverted"), and those where power machinery has just been introduced, following electrification ("generated"). The BPDB transfers account for 10-20% of the total connections in the PBS's I visited. These transferred connections include a disproportionate number of heavy users. So they constitute more of the total power demand than their numbers would indicate. Even though a generalization is that most industrial users are new--25-30% were formerly served by BPDB, and others were diesel powered. New

industrial users are predominantly small rice mills. The benefits in the case of transferred uses are the greater efficiency of the REB over the BPDB operations, lower line loss, greater punctuality of collection of bills, etc. These were largely considered transfer payments in old fashioned cost benefit analysis--but not so in most contemporary analysis which recognizes the systemic necessity to make public enterprises self-financing, or the gains in efficiency from proper pricing.

"Diverted" users vary from category to category--there has been a presumption that most domestic and commercial connections formerly used some kerosene for lighting, and a large proportion of Deep Tube Wells (DTW), Shallow Tube Wells (STW), and Low Lift Pumps (LLP) ran on diesel.* The number of industrial units formerly using diesel is hard to determine but substantial.** The gains from operations that were previously powered by diesel are in total energy cost savings. Everyone seems to agree with this position, for different reasons, as I have already pointed out.

The valuation of production from new machinery, or of increased output from old machinery, is a point of controversy. Since the uses have occurred since electrification some observers credit the electrification with the entire addition to value added and welfare produced (as was the case in an earlier USAID draft or in a CIDA study). At the other extreme, the value is assessed on a willingness to pay

*The AID projection for RE III presumed that 40% of DTW, 10% of STW, and 75% of LLP will be "diverted," and those figures roughly correspond to present experience. This is confirmed in attached Table 1.

**One or two PBS's gave estimates in the 25-40% range for rice mills "diverted;" others did not have estimates readily available.

criteria, based on the charges which the machine owners will pay the power authorities on the grounds that it is at least worth that much to them.

If willingness to pay is the criteria, the figures would indicate what consumers would be willing to pay if they had to bear the full cost of electrification: if energy cost savings are used they represent the difference between the real costs of electric and diesel or kerosene energy. In the case of perfectly functioning markets, electricity would be priced at its marginal cost (MC) which is equal to the marginal revenue product (MR) in increased production. Consumers would be willing to pay that amount ($MR = MC = \text{price}$) and the two would be equivalent. In the real world, electricity prices are administered, often at subsidized levels, well below their marginal contribution to productivity. The electric charges (the price) thus are lower than electricity's value (its marginal revenue product).

On the other hand, observed increased production is due to a variety of factors of which the availability of electricity is only one. The Dhaka I PBS is the location of a large number of new factories--as are all areas adjoining Dhaka--reflecting factors such as the relative cost of land. The factories might well have located there even if no RE scheme was in place.

In other cases, such as the new textile mill in Habiganj, RE was critical. In Sirajganj, considerable new activity was apparent. Fifteen potential larger users, 40 KV loads, had "letter of assurances" of connections from REB. I do not know how general the pattern is. In

Sirajganj as well, a number of new ^{MACHINE}~~engineering~~ workshops were enabled by RE, as well as other new types of small industry (see Table 5).

7. ENERGY COST SAVINGS

The existing computations for energy cost savings (IDA, AID I, AID II) were all done for segments of the proposed RE III project to double the number of connections handled by REB from 1987 to 1992. The costs of such extension will be at least three to four times less per connection as projected than in RE I and II, and the net benefit proportionately higher, than past experience.

The computations for IDA are contained in a document I could not find. But they are presumably comparable to the Urner REB figures included in the draft Project Paper for RE III. These are based on REB work that seems somewhat optimistic. There are three benefit terms: avoided costs for diverted connections, PBS charges from all new connections, and net new profits from new production. (In the final USAID version this third category was dropped.)

On the cost side, domestic costs were reduced for distortions by 20% and labor costs by 25%. The Planning Commission of Bangladesh considers that the normal wage pays more than the real cost of labor to the economy. This seems appropriate, but transferred assets from BPDB were not considered. Best estimates are that the transferred assets are relatively insignificant.

The "diverted" use benefits were measured separately on domestic lighting, DTW, STW, and LLP. The costing for alternative fuels seems appropriate. The domestic lighting cost savings figures seem highly optimistic. If each rural household met even the "low" standard (for the poorer half of users) the amount of kerosene in the country would have to be multiplied by five. Fortunately, the electrified households are

generally the upper quintile of the income distribution and can be expected to have high energy usage. According to a monthly budget survey conducted in 1978-79, 23% of rural households had monthly expenditures of over Tk. 750. Their modal expenditure for fuel and lighting, including cooking (the bulk of the total), is Tk. 70-90 a month or Tk. 840-960 a year.* This contrasts to an average fuel cost of Tk. 2,395 a year projected by the RE III economic analysis for the "low" case, the poorer half of users. There has been some inflation since 1979, but nothing of quite the magnitude to overcome this difference. It seems sensible to reduce the benefits due to energy savings by domestic users by at least 75%, still ignoring the fact that power outages force people to sustain some kerosene costs even after getting electric connections. One tea plantation in Habiganj reported that power was out 18% of the time.** They and five other tea gardens retained and used their own generation capacity as a backup. Savings from lighting are thus overestimated as households will need to keep their kerosene lamps to give light during 6-9:30 load shedding which occurs nightly from 1-2 hours in many locations. Non-household users may simply shift their running hours, so no correction for this factor seems necessary. We should note that this adjustment to domestic user benefits makes the forecasted project return for RE III doubtful, unless other adjustments are made.

*Statistical Yearbook of Bangladesh, 12983-84, p. 768-69. Bangladesh Bureau of Statistics, Dhaka, 1985; Cross reference Annex F-3, p. 11 of RE III proposal).

**Habiganj was supposedly one of the PBS's to experience least power outage in the country.

The figures for costs for diesel tubewells (DTW, STW, LLP) seem moderate. Several respondents cited slightly higher costs (= benefits) under almost every category. The energy cost savings on these accounts are likely to be undercounted, but not by any great amount.

To the extent these energy saving costs, or acreages, are seen to be critical in assessing RE impact, it might be sensible for both the REB and USAID to commission small systematic studies of them. The PBS revenue projections (projected collections from consumers for "generated" uses) are reasonably accurate, though higher revenues may now be expected with increased rates. The increased agricultural product estimates from irrigation may be accurate, but I have yet to find any really good studies on return to irrigation in Bangladesh.

8. PRODUCTION BENEFITS

I will now proceed to consider at some length the benefits stemming from electricity to the economy in terms of (1) increased production due to irrigation; (2) increased production due to small scale industry; (3) production due to cottage industry; (4) increased employment; and (5) social benefits.

These production impacts are being considered despite the fact that they are not solely due to electrification, but are the products of a complex process of which electricity is a part. In the case of irrigation, production is a result of new technology, HYV seeds, fertilizer, etc. In the case of industry, largely agro-processing, it is a product of rising agricultural production.

It is estimated that 225,000 acres will be covered under RE I and II (1985) and that an additional 633,000 will be covered under RE III. This will still be less than 5% of all agricultural land and one-sixth of total irrigated acreage.* Of this 160,000 acres covered as of June 1985, 110,000 acres were not formerly irrigated. These newly irrigated acres are estimated to produce an additional 1.2 tons of rice or rice equivalent per acre as a result of irrigation.

Presently the average DTW irrigates 75 acres, STW 15, and LLP's 40, according to data supplied by REB. But REB thinks that acreage can be slightly expanded over time, and the estimates include that expansion. On the other hand, these REB figures seem high on the basis of random interviews.

*Other estimates seem to project one million acres by 1992.

If these estimates are accepted and 4448 new irrigation users come in RE III, distributed as they now are, the increased production would be 710,000 tons of paddy. The figure would be more than doubled if all connections were tubewells.

Roughly 2845 industrial connections will be energized under RE I & II, and 2120 will be energized under RE III. Over 75% of the units are probably rice mills, the majority of these new connections. Their modal profit is estimated as 40,000 taka, and thus at least 57 million taka of new profits a year are to be expected.

The bulk of the units are rice/flour/oil seed mills often in the same unit. Also a variety of other units are reported, such as light ~~engineering~~ ^{MACHINERY} units (one or two metal working lathes), sugar crushing units, powerloom units, and a polyethylene factory. The bulk of these units are new PBS connections and in many cases would have been impossible without RE.

Probably more than 2000 connections have gone to handloom units. If their product has increased by 10%, this would give an increased value added of 2,300 taka per loom (4.6 million taka a year) and a profit of Taka 470/per unit (about 1 million taka a year). Unfortunately, the amount of increase in production is probably lower, as indicated earlier.* Total increased production on these three heads (irrigation,

*See Handloom Census and RISP. The total value added of the average establishment is 23,208 and profits 4,693. (RISP, p. 166). One respondent reported a 40% increase in production (Tangail), but others reported much less.

mill/hullers and handlooms) alone would be about 5000 million taka a year (rice price \$210 = tk. 6930).*

*700,000 tons of rice times 7,000 taka a ton gives 4,900 million taka. There are 57 million additional in industrial profits on mills/hullers, and a million on handlooms. If we looked only at net production--about 4,000 taka an acre for rice--we would get 2,800 million taka on that account.

9. ENERGY SAVINGS

Roughly, if the energy savings from all irrigation is included it would raise the energy savings by one-third over the Urner estimate which only counted "diverted" uses and was used in some USAID documents. Total savings would be 57 million taka.* The energy savings for industrial units are harder to estimate. One-half to one-quarter of these are "transferred." This apparently applies both to the numerous rice mills and the small number of big power consumers who account for the bulk of the power. In the latter "large user" case, diesel motors are probably not the alternative, but rather BPDB connections. The bulk of the smaller industrial connections are rice mills as is shown in Table 4. The energy cost savings for such rice mills are probably typical of industrial connections. Consequently, if we look only at modal rice mills, the individual mills would save Tk. 30,000, and assuming 5000 such mills at the end of RE III, USAID component, the total savings would be 150 million taka a year.** If there are energy savings of 400 taka a year for each of 500,000 household connections this would give a 164 million taka saving a year. Thus making some modest estimates, energy cost savings of 370 million taka a year are achievable at the end of RE III, or over 10 million dollars a year. More generous but reasonable

*We must assume that the 4448 irrigation connections scheduled in RE III will be distributed among DTW, STW, and LLP in the same proportion as are the current irrigation connections. Of the 4448 connections, 712 would be DTW's, 3114 STW's, and 623 LLP's. Urner proposes that energy cost savings are 39,000 taka for each DTW, 9400 taka for each STW, and 600 taka for each LLP. Total annual benefits from RE III would be: $39,000 \times 712 = 28$ million taka; $9400 \times 3114 = 29$ million taka; LLP relatively little; Total = 57 million taka.

**These figures emerged in several interviews and are only indicative.

adjustments might give up to 20 million dollars a year. Another 10-20 million should be credited for existing RE I and II connections (20-40 millions of dollars a year). This is against over 400 million dollars in budgetary and donor support over the years 1977 to 1992.

Energy cost savings

Irrigation	57 million taka
Industry	150 million taka
Household	164 million taka

Thus it seems reasonable to assume that considerable energy cost savings are achieved, and that those are not so different than the benefits that would be calculated on a WTP basis by IDA and USAID (i.e., amount to a 12-27% internal rate of return). The investments will be made in a way that will support rather than undercut the country's dynamic development. The social and dynamic elements make the project desirable in this form, in which full costs will be charged to beneficiaries.

10. EMPLOYMENT

Irrigation, facilitated by RE, is known to lead to an increased demand for labor, for additional crops and for additional work on existing crops. No exact estimate of this effect is available for Bangladesh. It is reasonable to assume that much of the 25% of expected increase in the labor employment, 454 million new man days (1981-89), estimated to be created in agriculture will be attributed to irrigation. Newly irrigated land, has been shown in one study to employ 50% more workers than before (REB data). Allied jobs, perhaps of the same magnitude, will be created in agro-processing.*

As of June 1985, 110,000 new acres were covered by electrified irrigation according to REB estimate. If the same proportion applies to new connections, 592,000 acres will be newly irrigated by 1992. Presuming that the sole benefit is the addition of a HYV boro, winter rice crop, this should lead to roughly 51 million new man days of employment, or the equivalent of 160,000 new jobs.**

A secondary question is how much of the increase in irrigation is due to RE.

*"Bangladesh: Selected Issues in Rural Employment." South Asia Programs Department, IBRD Washington, D.C., March 11, 1983. Report No. 4292-BD, p. 157.

**Vol. III, Boro Paddy, Agro-economic Research, Agriculture & Forestry Research Div., Min. of Agriculture; Dhaka, B.D., Cost & Returns Survey for Bangladesh, 1981-82. Vol. I, Aus Paddy, for 1978-79 says that only 20% of Aus paddy is irrigated vs. almost 100% of boro HYV and adds about 15 days a year per acre. If we presume that all newly irrigated land also carries irrigated aus (whereas only a small fraction does) would add another 9 million man days.

Commercial connections have considerably extended the hours of trade and the volume of business of newly electrified shops, though few new employees are reported.

The primary category in small industrial connections is for small powered rice hullers, to which should probably be joined grain milling and spice grinding, which are all done with the same kind of motor. Milling was previously done by manual techniques in the case of rice, with a manually operated lever-like hammer, called a "dhenki." Other important small scale agri-processing operations, oil pressing and sugar crushing, have somewhat different economic and social implications and will be dealt with later.* There has been a rapid and accelerating increase in the proportion of rice handled by these hullers independent of the spread of RE. There has also been some increase in large automated rice mills but that does not concern us here. There has so far been little impact from mechanization on other post harvest activities. Efforts to do mechanical rice drying have largely failed. The mechanical hullers enjoy an enormous cost advantage, even when diesel powered, over "dhenkis." Electrified hullers make up less than one-fourth the number of diesel hullers.

However, "the popularity of the mill as an investment was much increased with the spread of cheap, subsidized electricity."** In one area in Tangail the number of mills increased from four (diesel) to 18

*"Bangladesh: Selected Issues in Rural Employment," South Asia Programs Department, IBRD Washington, D.C., March 11, 1983, Report No. 4292-BD, pp. 35-55.

**Ibid.

with the availability of electricity.* Profitability, however, may be reduced with increased energy cost, due to increases in PBS power rates.

Hullers are less efficient in recovery than "dhenkis," and "have resulted in a significant displacement of workers."** Recovery with hullers is 70% vs. 72% with "dhenkis." The "dhenki" rice has more nutritive value because it is less completely polished, but is also proportionally less marketable. In theory, hullers as now operated, permit less efficient recovery of waste products than "dhenkis."

In theory, each new huller might displace 142 to 330 women workers. An estimated 1.4 to 2 million women would be required to replace present powered hullers. One hundred to 140,000 such women are "replaced each year." "Dhenki" employment was a traditional resource of landless women. Some jobs are created by the hullers--men to operate them and women to do peripheral operations (winnowing parboiling, drying, etc.)-- but the number of jobs created is less than one-tenth that displaced.

Of course, since the rice crop is increasing, potential rather than actual jobs are displaced. Further, the "dhenki" jobs typically pay sub-subsistence wages which are only valued because the women involved have no alternative possibilities. The huller connected jobs are better paid.

Because of the cost advantage and connected profitability, the electricity induced increase in hullers only accelerates an inevitable process. The consensus seems to be to accept it rather than mount ineffective resistance. But the result is that the present employment

*Ibid, p. 41.

**Ibid.

impact of RE industrial connections is highly negative, especially for women. Positive thinking on counteracting this effect is required.

These negative employment implications of the rice hullers are dominated overall by the gains from irrigated agriculture. The same is true for the relative production from the two sources. Nonetheless, because of this negative impact on women AID should consider targeted programs of the sort mounted by BRAC and Gramin Bank, to let women exploit rather than be displaced by the new huller technology. A project might jointly be sponsored with REB to study and analyze the experience with the cooperative ownership of hullers, and the results publicized. Ken Marshall of Ford Foundation could give some guidance on how to proceed. ★

Other agro-processing uses such as sugar crushing may generate new employment, because they strengthen the position of the labor intensive gur and khandsari industries versus the large sugar mills. The GOB has been very uncertain of whether it will permit these gur and khandsari units to remain, or use the police to suppress them to protect its sunk investment in "white elephant" sugar mills. PBS's have consequently not been active in promoting crusher electrification. Unlike hullers, it is difficult to ascertain the number of sugar crushers connected. Six were reported in Natore I, one or two in Sirajganj and Pabna II.

Cottage industry units with high employment potential are typically listed and treated as domestic or occasionally commercial connections. In the former case, they benefit from favorable rates. Connections have been extensive for handlooms. Several PBS's (Tangail I, Sirajganj I,

Jessore I) claimed several hundred such connections. It was not clear that they or other cottage units benefitted from any specific preference.

The cottage units used their connections for lighting, in most uses substituting for hurricane lanterns, and achieved cost savings. Some extension of hours may also have occurred in some cases because of the inexpensiveness and better quality of electric light. One producer had extended his hours, and thus increased his sari production from ten to fourteen a day. These gains in production, and in work hours, were in no case connected with the hiring of new workers.

There do exist opportunities for new jobs and industries because of RE. Some lathe using industries, such as bobbin and spare part manufacturing for the handlooms, may now move closer to the looms. General ^{MACHINE} ~~engineering~~ shops to repair pumps are now more possible. Some attention should be given to identifying and facilitating these developments, even though they only represent the transfer of urban jobs into rural areas.

11. SOCIAL BENEFITS

In addition to the increases in production and employment, there are other benefits, loosely referred to as social benefits, which come from new rural electrification. These include a higher level of physical health and social consciousness, and manifest themselves in higher educational levels, increased practice of family planning, better health and an increased sense of personal efficacy and happiness. These in turn should translate into a happier, more democratic community. These desirable effects are produced through four mechanisms:

- (1) The increase of income permits higher nutritional levels, more consumption of energy for light and cooking, more purchase of health and educational services, newspapers, radios, etc. The increase in income includes two elements: that which emerges from the increased production enabled by electrification and that which comes because of access to cheaper electricity and savings in energy cost, which releases more income for other things.
- (2) The use of electricity by social institutions such as schools and hospitals permits them to extend their services. Electric light permits night school, the use of fans to increase comfort, electrical apparatus in laboratories, refrigerators to hold medicines, autoclaves to sterilize medical equipment, evening athletic and extra curricular activities. All of these have not yet occurred in electrified institutions but we may assume they will do so as time goes on.

- (3) The effects of participation in democratic rural electrification cooperatives include the resulting acculturation to democratic political participation.
- (4) The dynamic synergy effects caused by the general quickening of economic and social development have further impacts. This is the most difficult aspect to deal with although very apparent to those who observe the excitement new RE entails. Villages now have the facilities of cities. Doctors will make house calls, as reported in one locality. Everything that was possible in the city now seems possible in the village.

Because of the importance of the first mechanism many people feel that the social benefits are already largely accounted for by the increases in production and the savings in energy costs and any independent account of them would represent double counting.

12. SYSTEMIC EFFECTS

RE is expected to improve the overall functioning of society by increasing the level of participation and resources available as inputs and the efficiency with which such inputs are converted into outputs. The resource increase is treated earlier, as well as are some of the factors which will influence participation and efficiency.

It is expected that RE will affect the distribution of power within rural society. On the one hand, there is some apprehension that the productive effects will increase the power of the wealthy who control technologies favored by electricity, but the increased level of social consciousness should enhance the strength of the poor. The balance of these two effects is impossible to predict.

Whatever formal techniques one might use to assess the measurement of social benefits, higher levels of social welfare are marked in electrified rural areas than in their neighbors. A USAID sponsored study demonstrates a higher level of family planning and consciousness in these areas. And this correlation cannot be solely attributed to various indices of social progressiveness. Casual empiricism tells us this is true in other areas as well: education, health, etc. The problem is that the direction of causation is unclear, and the mechanisms for relating electrification and social advance less so. Progressive areas are, in fact, favored in receiving RE connections. The very priority scheme for selecting PBS's rightly includes some social advancement criteria.

However, the USAID study of family planning impacts advances a good a priori argument for identifying social benefits with rural

electrification.* In addition, surveys conducted by USAID and REB in connection with the 1983 Impact Evaluation Report, tell of increased time devoted to study by students, reading, etc., mostly enabled by the greater availability of electric power. Common opinion confirms this effect.** One school headmaster attributed some of the 100% improvement in his students scores over the last several years to the fact that they could now study in their electrically lit homes.*** And one of his students, from a newly electrified village, confirmed that he now studied until 10 or 11 in the evening as compared to (formerly) 8 or 9 o'clock.**** The Impact Evaluation Report showed increase in children's studying, reading, and time spent in recreation as a result of electricity reaching new villages. The effect seems to extend broadly

*Sarah F. Harbison and Warren C. Robinson, "Rural Electrification and Fertility Change," October 1984, USAID, Dhaka.

**1983 Impact Evaluation of Rural Electrification Program in Bangladesh, prepared by USAID with the assistance of the Evaluation Cell, PPD, REB, Dhaka, August 1983.

This was based on purposively, not randomly, selected groups of REB clients. 601 Households were covered, 399 electrified. They seem relatively wealthy for Bangladesh. Twenty-five percent (of households/respondents/heads of household?) were illiterate vs. roughly reverse for the country as a whole. Twenty-three percent had more than six acres of land vs. 4 to 8% for the country as a whole (Land Occupancy Survey, 1979, BBS). Almost all the surveyed households reported decreases in fuel cost, increases in working hours, amounts of children's study, family recreation, and overall security. Two-thirds reported an increase in income.

Two hundred and forty-five commercial and industrial users were covered, 175 electrified. Monthly income increased by an average of 33%, and 2/3 of the units reported increases in employment. The nonelectrified units employed proportionally more women. 126 pumps were covered. The electric pumps were half as expensive per acre as diesel.

***Mr. Borhanuddin, Principal, Dhamrai Government College.

****Mr. Sikdar, 10th class student of Village Kalia, Dhamrai.

across income classes and genders though it is accentuated for families where parents themselves have higher educational levels. The access to electricity within a village is, of course, correlated with economic wealth.

Among subjects on which we can speculate and small scale studies might be justified are: any difference in access to lighting and its benefits within the family between men and women and girl and boy students; effects from the use of fans on general health levels; negative effects on poorer children from unelectrified homes having to compete with those from electrified ones; and differential diffusion of televisions and radios in electrified and nonelectrified villages. A more systematic study is now scheduled looking at the changes in village level social data since 1981.

Further, electrification is quite a new phenomenon in rural Bangladesh, and a variety of social impacts, not all of them positive, can be expected to unfold over time. Evening time is available now, not only to extend work hours, but for organized social, cultural, political, and athletic activity, but few changes have yet been observed in these connections. The greater security provided by street lights, mentioned by all observers and in the impact studies (commissioned by the REB), should particularly accelerate participation in these activities.

There is no question that electricity has had significant social effects beyond those connected with increased income and energy cost savings, or that these largely belong in the realm of non-quantifiable benefits.

13. EVALUATION AND EVALUATION PLANS

The REB itself conducted a baseline study of eight areas to be served by PBS's in 1981, collecting a variety of objective data from a stratified sample of villages and village households.* It is intended to give a contract to Mr. Mahboob-ul-Hoque to resurvey these areas and chart any improvements over the period of the program. Since this evaluation if properly conducted might present prime material for a USAID outside evaluation, it would be desirable for all parties concerned if coordination is maintained on the terms and progress of the project.

This sort of evaluation is certainly standard for such projects, though its validity is limited by the other intervening variables which may act on the rural economy. One of the most doubtful negative summaries on REB's benefits endorses these sorts of studies as the base for the type of social cost benefit analysis it finds valid.**

I think that a cost benefit analysis has its place but is not sufficient for a project which is intended as an institution building one with long range dynamic effects.

The routine collection of data by the PBS's might also be adjusted to permit easier assessment of benefits. At intervals reports might be solicited on sub-categories of connections: (1) Handloom and cottage industrial units with rough size, number. and (for handlooms) type of looms; (2) Subcategories of social institutions such as schools, mosques,

*Rural Electrification in Bangladesh - A Baseline Study. Volume I: Summary Prepared by Quazi Mafizur Rahman, Institute of Statistical Research and Training, University of Dhaka, Dhaka, Bangladesh, March 1983.

**Flutman, pp. 29-30.

community centers; (3) REB connections as to whether they are "transferred," "diverted," or "generated."

Some survey work might be conducted to isolate some of the social benefits. Perhaps the examination results from college and high schools in the service area might be monitored. In the case of Matlab and Sirajganj--it might be possible to monitor some of the health data that will be collected by ICDDRB related projects.

The above along with this assessment would constitute the materials for a full scale impact evaluation--especially if proper coordination is secured with Mr. Mahboob-ul-Hoque. Such an impact evaluation would pursue three possible lines of approach.

(1) Using the Baseline and Impact Evaluation of Mr. Mahboob-ul-Hoque trace the differential impact of electrification.

(2) From REB data identify new connections as to whether they are "directed," or "generated"--and as to precisely what sort of unit they belong, and assess the likely impact of the unit using the connection. The raw material is present with REB and in some secondary material. This identification and assessment could be done either by an expatriate or a local academic. To the extent Cost-Benefit Analysis of productive benefits is desired in project justification, the Urner estimates, as modified in the USAID Dhaka Draft Project Paper seem good enough, but need to be adjusted for actual domestic fuel savings. It might be preferable, however, to compute overall energy cost savings.

(3) The collection of some physical health and educational data as suggested above.

All of these approaches should be integrated and combined perhaps with a detailed study of two sets of paired villages--electrified and non-electrified--one in a handloom area such as Sirajganj and one in a tubewell area such as Natore. These studies might be conducted by a contracted Bangladeshi, perhaps in combination with expatriate consultants.



14. IMPROVING IMPACT

In addition to recommending an assessment strategy it is possible to suggest several measures to enhance the social impact of the REB project.

- (1) Use development needs to be undertaken particularly for cottage industries and social uses. This requires some changes in reporting procedures to highlight these uses. It requires that some priorities be given to such uses in the granting of connections. Perhaps rather than the present subsidization of the relatively affluent rural domestic consumers, cross-subsidization should be concentrated on public uses such as schools, libraries, community study halls and social centers. These should be encouraged to use tubelights and high wattage lights. Some promotion might be done of refrigeration for medicine shops and rural health centers. Some of these public users should be protected from load-shedding. Some attention might be paid to the costs and maintenance of higher intensity lights and refrigeration. These uses are unfortunately peak hours uses, and perhaps should be the only connections protected at that time. A separate cell for use development might be set up, though intensive NRECA efforts to "develop" newer uses are widely recognized to have failed. I note with interest that REB is considering encouraging the PBS's to take a small share in funding of new industrial units in their areas--with the cooperation of the Bangladesh Farmer's Bank.
- (2) Productive loads, in general, are non-peak hour. These might be given rate preference over purely domestic connections as well as priority in securing connections they now have.

- (3) The development of productive uses of electricity will be especially advanced by coordinating RE with other rural development programs. In an AID study of RE in Costa Rica it was found "that impact is optimized in settings where expansion of infrastructure and social service are underway and where agricultural potential is great."

The other nation building organizations like one cooperative credit network, Bangladesh Rural Development Board (BRDB), Bangladesh Agricultural Development Corporation (BADC), and the Bangladesh Small and Cottage Industries Corporation (BSCIC) are represented on REB's board. Local relations are cooperative. BADC in Natore reported that the REB regularly and easily gave pump connections. But there is no evidence of coordination of the irrigation extension and line extension plans of the different organizations, or that BSCIC has identified cottage industry clusters who could benefit from lighting connections. The fault is not primarily REB's but needs to be remedied if the full productive benefits of RE are to be reaped.

- (4) The figures given by one Habiganj tea garden, that their energy costs only declined from 1.24 to 1.04 Tk. a kg. of tea suggest that autogeneration solutions may be appropriate in the tea estate areas. This is, of course, only one isolated data, and requires more detailed consideration.

The Habiganj PBS had given out several local subcontracts for spares to small workshops. This is a process that should be encouraged to increase project impact. Perhaps some explicit attention should be given, as earlier with USAID Dhaka and pumps, to developing small scale

local workshops--by identifying and publicizing parts which these small shops might supply, giving technical assistance in meeting quality standards, and providing simplified procedures by which the small shops could contract to supply such parts.

15. TOTAL IMPACT

As indicated initially the REB and PBS's have been able to deliver electricity in rural areas better than the alternatives.

- (1) Though real financial self-sufficiency has not and will not be achieved, they constitute a lesser burden on general revenues than the BPDB would have been.
- (2) They have introduced a relatively participative mode of rural service provision.
- (3) They have represented models of efficiency putting pressure on BPDB and electrical equipment manufacturers to meet their standards.
- (4) They have generated some productive benefits:
 - (a) in terms of real energy cost savings (though their size as is seen is a matter of controversy) and (b) in terms of dynamic development effects, although these are still in their early stages. Some increases in rural production, some increases in hours for cottage production, as well as a few new activities, can be noted. (The largest new use,--rice mills--has doubtful productive and employment impacts.)
- (5) They have generated some positive social effects, clearly marked in subjective rural attitudes.

Table 1. Number of tubewells
June 30, 1985

917	DTW
3875	STW
<u>778</u>	LLP
5570	

Source: REB

Table 2. Connections transferred from BPDB

	Transferred (approximately)	Total
Jessore I	2773 - of roughly	12,000
Jessore II	1200 (Noapara other - of same)	11,754
Pabna I		15,806
Tangail I	1200 (BPDB)	8,811
Habiganj	1300	9,712
Sirajganj	1500	10,826
Natore I	800	10,400
Natore II	76 of 372 miles of line	10,753

Source: Interviews at PBS

Table 3. Tubewells converted from diesel

PBS	Total Connections	Conversion from diesel	Percentage
1. Pabna II	175	29	17%
2. Natore	478	77	16%
3. Chandpur (Comilla II)	128	30	23%
4. Jessore II	447	227	51%
5. Natore I	DTW 82 STW 749 LLP ?	62 240 ?	
6. Moulvibazar	16	2	12%
7. Sirajganj	760	478	63%

Table 4. Data on industrial connections

<u>PBS</u>	<u>Ind. Connections</u> <u>6/30/85</u>	<u>Rice Mills (11/85) - Approx.</u>		<u>Dom. Conn.</u> <u>6/30/85</u>	<u>Comm.</u> <u>6/30/85</u>	<u>Handlooms</u> <u>11/85</u>	<u>Social (Mosque, School, etc.)</u>	
		<u>From BPDB</u>	<u>From diesel</u>					
Tangail I	199	230	60	?	6979	804	500	120
Jessore II	177	150		50-20	7791	2467	-	?
Jessore I	218	170	85	30	7243	2246	500	600
Dhaka I	445				13357	1083		
Habiganj	164	124			7415	1912	30 Expected	
Ullapara	247	160			7791	1823	1000+	200+
Pabna II	144 (11/85)	100			5848 (11/85)	1460 (11/85)	-	100-150
Natore I	179	160			8369	804	-	350
Natore II	229	200			8391	1556	30	?

Source: REB and PBS Interviews.

Table 5. Miscellaneous small scale industry in PBS

	Ullapara	Pabna II	Natore II	Jessore I	Jessore II	Habiganj
Sugar cane	-	3	5	-	-	-
Light eng.	15	15-20	8	15	-	-
Powerloom	20	1	-	-	60-70	-
Saw mill	11	10-15	10	-	-	-
Twisting	30	1	10	-	-	-
Ice factory	7	-	10	-	-	-
Wood processing	-	-	-	-	-	6
Light eng. workshop	-	-	-	-	-	20

Table 6. Big users

Pabna II

Bengal Solvent Oil Ltd.
 Naz Cold Storage
 Sirajganj Milk Vita
 Jamuna Oil Mill (new)
 Ullapara Cold Storage (new)

Habiganj

18 Tea Garden
 Habiganj Gas
 Textile Mills (new)
 1 Cold Storage

Natore

Rajshahi Cadet College
 Cantonment
 Sardah Police Trg.
 Sugar Mill

Tangail

Tangail Cotton Mills
 Islam Jute Mill
 Premier Textile
 Rice Biscuits
 Sunny Bread
 North Bengal Cycles
 Riaz Plastics
 Eastern Fabrics
 Anwar Textile

Jessore II

2 Textile Mills
 Many others

Dhaka I

1 Carpet Mill
 1 Jute
 1 Biscuit Factory
 2 Pharmaceuticals
 1 Cold Storage
 1 Printing
 1 Oil Mill, etc.

Source: PBS Interviews

APPENDIX A

PARTIAL LIST OF FACILITIES VISITED

DTW & STW - Sirajganj, Natore I, Vessore I, Tangail, Habiganj, almost none running

Handloom - Sirajganj (Ullapara and Shahzadhpur), Tangail, Jessore II.

Carpentry - Sirajganj, Habiganj

Light Metal Working - Habiganj (2 sites), Natore II

Sugar Cane Crushing - Natore I, Pabna II

Brass - Dhaka I

Rice Mills - Jessore II, Tangail, Dhaka I, Habiganj, Natore I (2 sites), Natore II

Health Center - Jessore II

Navig. Center - Jessore II

Pres. Palace - Natore I

Retail Shops and Tea Stalls - All

Orphanage - Habiganj

High School - Dhaka I

Ice Cream - Dhaka I

APPENDIX B

The statement of work raises questions about to what extent new crops and cropping seasons have been introduced as a result of powered pumps. The effects seem still to be working their way out as described by BADC officials often in the direction of somewhat lower cost input packages than suggested by extension agency. The bulk of irrigated area is being sown, for the first time to winter, "boro" rice, some to wheat, and an increasing proportion to grain, though these cropping patterns are established by a variety of factors of which RE is only one.