

**ASIAN DEVELOPMENT BANK**

**PPA:BAN 24102**

**PROJECT PERFORMANCE AUDIT REPORT**

**ON THE**

**NORTHEAST MINOR IRRIGATION PROJECT  
(Loan 1125-BAN[SF])**

**IN**

**BANGLADESH**

**April 2003**

## CURRENCY EQUIVALENTS

Currency Unit – taka (Tk)

	<b>At Appraisal</b> (September 1991)	<b>At Project Completion</b> (March 2000)	<b>At Operations Evaluation</b> (November 2002)
Tk1.00 =	\$0.027	\$0.020	\$0.017
\$1.00 =	Tk37.64	Tk50.95	Tk59.00

## ABBREVIATIONS

ADB	–	Asian Development Bank
DAE	–	Department of Agricultural Extension
EIRR	–	economic internal rate of return
LGED	–	Local Government Engineering Department
LLP	–	low lift pump
MFI	–	microfinance institution
MOA	–	Ministry of Agriculture
MTASDP	–	Medium Term Agricultural Sector Development Plan
NGO	–	nongovernment organization
OEM	–	Operations Evaluation Mission
PCR	–	project completion report
PCU	–	Project Coordination Unit
PIU	–	Project Implementation Unit
PMU	–	Project Management Unit
STW	–	shallow tubewell
TA	–	technical assistance
3FYP	–	Third Five-Year Plan
4FYP	–	Fourth Five-Year Plan

## NOTES

- (i) The fiscal year (FY) of the Government ends on 30 June.
- (ii) In this report, "\$" refers to US dollars.

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## BASIC DATA

### PROJECT PREPARATION/INSTITUTION BUILDING

TA No.	TA Name	Type	Person-Months	Amount	Approval Date
1610	Institutional Strengthening of the Department of Agriculture and Extension for Minor Irrigation Development	ADTA	24	\$388,000	21 Nov 1991

KEY PROJECT DATA (\$ million)	As per Loan Documents	Actual
Total Project Cost	93.10	24.46
Foreign Exchange Cost	55.40	7.87
Local Currency Cost	37.70	16.59
Loan Amount/Utilization <sup>1</sup>	73.00	22.59
Loan Amount/Cancellation <sup>2</sup>		54.80

KEY DATES	Expected	Actual
Appraisal		12 July–3 Aug 1991
Loan Negotiations		19-20 Oct 1991
Board Approval		21 Nov 1991
Loan Agreement		21 May 1992
Loan Effectiveness	19 Aug 1992	10 Dec 1992
Project Completion	31 Mar 1998	30 Jun 1999
Loan Closing	30 Sep 1998	26 Jun 2000
Months (Effectiveness to Completion)	67	79

INTERNAL RATE OF RETURN (%)	Appraisal	Completion	Audit
Economic Internal Rate of Return	36	15	17

**BORROWER** People's Republic of Bangladesh

**EXECUTING AGENCIES** Department of Agricultural Extension  
Local Government Engineering Department<sup>3</sup>  
Bangladesh Bank

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ADTA = advisory technical assistance, TA = technical assistance.

<sup>1</sup> Loan amount was equivalent to SDR53,602,000 at the time of approval, and to SDR15,594,026 at the time of loan closing.

<sup>2</sup> Equivalent to SDR38,007,974.

<sup>3</sup> Known as the Local Government Engineering Bureau at the time of appraisal.

**MISSION DATA**

<b>Type of Mission</b>	<b>No. of Missions</b>	<b>Person-Days</b>
Reconnaissance	1	12
Fact-Finding	3	109
Appraisal	1	122
Inception/Review <sup>4</sup>	1	25
Project Administration		
Review	5	157
Special Project Administration	2	44
Midterm Review	1	63
Project Completion	1	76
Operations Evaluation <sup>5</sup>	1	39

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<sup>4</sup> In conjunction with the review of TA 1610-BAN: Institutional Strengthening of the Department of Agriculture and Extension for Minor Irrigation Development, Loan 908-BAN(SF): Rural Infrastructure Development Project, and Loan 1215-BAN(SF): Second Rural Infrastructure Development Project.

<sup>5</sup> The Operations Evaluation Mission comprised T. Kondo, Senior Evaluation Specialist (Mission Leader); N. Brown (International Consultant); and N. Chakravorty (Domestic Consultant).

## EXECUTIVE SUMMARY

As a direct outcome of a review in the late 1980s of the drivers for increased agricultural production, the Government of Bangladesh adopted a sector development plan and associated strategy for the 1990s that incorporated a significant expansion in private sector investment in minor irrigation technologies, supported by a series of policy reforms to facilitate greater private sector participation in input supply to the sector. In addition, the Government focused on areas such as the northeast that, to date, had not experienced significant growth in minor irrigation but where the potential for this technology was promising. This Medium Term Agriculture Sector Development Plan was supported by a number of complementary projects and programs.

In 1990–1991, the Northeast Minor Irrigation Project (the Project) was formulated by the Asian Development Bank (ADB) directly from the proposal of the Government and as refined during four ADB missions prior to appraisal. The main purpose of the Project was to increase crop production and farm income through the expansion of minor irrigation facilities in four districts of Greater Sylhet and the adjacent districts of Netrakona and Kishoreganj. The project scope comprised (i) a credit facility to importers and private equipment dealers to finance the importation/purchase of locally assembled and manufactured shallow tubewells (STWs), low-lift pumps and power tillers for agriculture development in the project area; (ii) promotion of minor irrigation technology in the project area through groundwater exploration, installing demonstration tubewells, establishing demonstration farms, conducting farmer training, and using nongovernment organizations to facilitate access to credit; (iii) construction of critical bridges and culverts on rural roads in the project area; and (iv) project management support.

Given the immediate priorities for rural development in the northeast region, the Project's support to the demonstration of minor irrigation technologies and the improvement of rural infrastructure was relevant, but the major cost component—the trade credit facility—proved not to be attractive to importers and traders because of costly and complex compliance procedures, and the increasing availability of credit through existing channels. As a result, the trade credit component, representing 52% of project cost as appraised, was cancelled. Despite this significant change in scope from an overall cost perspective, the minor irrigation technology demonstration activities achieved their purpose, although the “flow-on” demonstration impacts, in terms of technology uptake by the private sector, proved significantly below expectations. Originally, it was anticipated that project activities would catalyze the installation of 20,000 STWs, but although the number of STWs grew from around 9,600 in 1992/93 to over 26,000 in 2000/01, only a small part of this growth can be attributed to the Project.

The Project was completed in June 1999, 15 months later than expected. This was a result of (i) front-end delays due to the Government's late compliance with conditions of loan effectiveness, (ii) slow project progress until the Ministry of Agriculture replaced the Department of Agricultural Extension (DAE) as the lead agency in September 1994, and (iii) additional work approved at the midpoint of project implementation. The actual project cost amounted to \$24.5 million, almost 74% below the appraisal estimate of \$93.1 million, largely because of the cancellation of the trade credit component and lower costs of incremental staff and office supplies.

Despite the congruence of the objectives of the Project with government programs and strategies at formulation, the significant reduction in its scope through cancellation of the trade credit component means that the Project is now assessed as being partly relevant. Similarly, given the reduced impact of project activities on the overall expansion of minor irrigation technologies throughout the area, the Project is assessed as less efficacious. A reevaluation of the economic impacts of the Project yields an economic internal rate of return of 17% that, together with a reasonable level of institutional performance by the executing agencies, once initial problems were

overcome, allows the Project to be assessed as efficient. The investments provided under the Project also appear to be likely sustainable. Private farmers are generally maintaining their STWs from which there are significant financial returns, and the continued road network maintenance programs of the Local Government Engineering Department are likely to keep the road structures built under the Project in good condition. Overall, the Project is rated partly successful.

The performance of the Project was adversely affected by insufficient attention to key issues in its design. In addition, if the Project is to have a pro-poor focus, then identification of the particular needs of this group, and the constraints they face, is essential, and is best achieved through beneficiary involvement during the design phase. At appraisal, operational details of the envisaged group-based farmer credit arrangements were not analyzed in detail and the institutional capacity of the agencies involved (including nongovernment organizations, microfinance institutions, and commercial banks) was not adequately assessed, with the result that credit constraints still adversely impact on the uptake of STW technology in the area, particularly by small farmers. Also, because the resourcing of DAE extension activities in the area is under considerable pressure, it is unlikely that the best use will be made of the opportunity that now exists to further extend the uptake of STW technologies in the project area.

While the Project was initially designed to strengthen DAE's institutional capacity, slow progress during the first 2 years of its implementation meant that DAE's responsibilities were transferred to the Ministry of Agriculture and a separate project management unit was established. While this action undoubtedly accelerated implementation, it did not strengthen the institutional capacity of DAE that is required to provide ongoing support to project activities. This adversely affects project sustainability.

There are two main lessons from the Project. First, there is no substitute for careful and rigorous project preparation to underpin investments in rural development. Such preparation must incorporate extensive involvement and input from all stakeholder groups (particularly from the project beneficiaries), as well as detailed assessments of institutional capacity. Second, continued monitoring and expansion of the groundwater testing program initiated under the Project will be essential if groundwater development by the private sector is to expand significantly in the project area. This relates not only to issues of availability, but also to water quality.

The single focus of the Project on expansion of irrigation through groundwater development, although common in the early 1990s, has now been replaced by the broader considerations of both ground and surface water development options, in order to promote the most cost effective, sustainable, and environmentally neutral alternative in specific local applications. The Government confirmed that continual monitoring of groundwater quality and quantity would be an integral part of their ongoing program to manage water resources in a sustainable manner.

Arsenic contamination of groundwater in the project area has been identified in varying degrees. Although STWs constructed under the Project are not commonly used for drinking purposes, an effort to mitigate arsenic contamination should be continued to minimize this health risk. ADB, which has technical assistance for arsenic mitigation in its 2003 program for Bangladesh, should monitor the status of the World Bank's Arsenic Mitigation – Water Supply Project to verify that testing of all arsenic-prone districts is completed by early 2003.





## **I. BACKGROUND**

### **A. Rationale**

1. To reverse the slowdown in the growth of agricultural production that had occurred during the middle part of the Third Five-Year Plan (3FYP, 1986–1990), the Government of Bangladesh (the Government) commissioned a sector review. On the basis of its results, the Government initiated a series of policy reforms and formulated a medium-term minor irrigation strategy to revitalize the sector under a Medium-Term Agriculture Sector Development Plan (MTASDP). This strategy was to be incorporated in the subsequent sectoral growth plan for agriculture in the Fourth Five-Year Plan (4FYP, 1990–1995) and was seen as a key component to achieving macroeconomic objectives during the 1990s. In addition, the Government decided to support specific projects that targeted relatively underdeveloped regions such as the Greater Sylhet district (where adoption of modern minor irrigation technology was lagging). Thus, in 1989 the Government requested Asian Development Bank (ADB) assistance to finance a project in the northeastern region of Bangladesh, which was relatively poorly served by minor irrigation (but where water resources were substantial).

### **B. Formulation**

2. The Project was not founded on detailed feasibility preparatory work, but was formulated directly from the proposal of the Government as refined during four ADB missions that were fielded in 1990–1991 prior to appraisal. The Northeast Minor Irrigation Project was developed within the framework of the Government's MTASDP to accelerate paddy and wheat production based on irrigated winter-season cropping under expanded coverage of minor irrigation, while recognizing the scope of other related assistance projects/programs to the sector.<sup>1</sup>

### **C. Purpose and Outputs**

3. The main purpose of the Project was to increase crop production and farm income in the project area through the expansion of minor irrigation facilities. Specifically, the Project aimed at (i) strengthening the private sector through increased involvement in minor irrigation and agricultural equipment trade; (ii) increasing cropping intensity, yields, farm income, and employment; (iii) improving road access; and (iv) enhancing the institutional capability of the Department of Agricultural Extension (DAE) through an attached advisory technical assistance (TA). The project area covered the four districts of Greater Sylhet (Habiganj, Moulvibazar, Sylhet, and Sunamganj) and the adjacent districts of Netrakona and Kishoreganj.

4. The Project had four components.

- (i) Part A (Trade Credit Facility for Minor Irrigation Equipment and Power Tillers): This component was to provide a credit facility to importers and private equipment dealers to finance the importation/purchase of locally assembled and manufactured shallow tubewells (STWs), low-lift pumps (LLPs), and power tillers for agriculture development in the project area.

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<sup>1</sup> Complementary assistance for minor irrigation was also provided by the World Bank under its 1991 Shallow Tubewells and Low Lift Pumps Project and its 1991 National Minor Irrigation Development Project in 1992, further assistance was provided by ADB under the Second Bhola Irrigation Project, approved in 1992 for \$39.8 million. Other related sector assistance was to be provided under the World Bank's 1991 Agricultural Support Services Project and the proposed Agricultural and Rural Credit Project to be jointly financed by ADB and the United States, although this latter project did not materialize (para. 33). Policy reform was supported under another ADB loan (for the Food Crops Development Program) and related technical assistance.

- (ii) Part B (Groundwater Exploration, Tubewell Installations, Demonstration Farms, and Trade Fairs): This component was to focus on groundwater exploration by drilling 1,000 test bores and installing 200 tubewells, establishing 200 demonstration farms, hosting two trade fairs in each of the six districts, and facilitation of farmer credit.
- (iii) Part C (Road Structures): This component was to provide for the construction of 6,000 meters of critical road crossings (bridges and culverts) on Type B feeder roads and rural roads in the project area.
- (iv) Part D (Project Management Support): This component was to focus on project management support, including the establishment of project coordinating units (PCUs), and project implementation units (PIUs).

5. The Project was accompanied by an advisory TA,<sup>2</sup> which aimed at providing institutional and management support and staff training to DAE.

6. During implementation, the Project experienced some changes in scope, i.e., the cancellation of the trade credit component, increased financing for minor irrigation technologies under Part B, and an increase in scope under the road structures component (Part C). Specifically, there was no demand for the Project's credit line so the trade credit was not utilized and was eventually cancelled. Under the tubewell installation subcomponent, an additional 300 STWs, 103 LLPs, and 100 treadle pumps were financed for demonstration activities, and an additional 50 demonstration farms were established. With regard to the road structures component, the following were added: (i) eight floating jetties (pontoons) to facilitate river crossings, (ii) three surface water control structures to help facilitate irrigation for a total potential command area of about 1,500 hectares (ha), and (iii) a further 1,800 meters (m) of bridges/culverts.

#### **D. Cost, Financing, and Executing Arrangements**

7. At appraisal, the total project cost was estimated at \$93.1 million, of which 55% was in foreign currency. ADB was to finance the entire foreign exchange cost and \$17.6 million in local currency costs. The remaining cost of \$20.1 million was to be borne by the Government, participating banks, and subborrowers. In addition, ADB was to finance \$388,000 of the accompanying advisory TA, the total cost of which was estimated at \$400,000.

8. DAE, as the lead executing agency, was responsible for Parts B and D. In addition, there were two other executing agencies: the Bangladesh Bank for Part A, and the Local Government Engineering Department (LGED)<sup>3</sup> for Part C.

#### **E. Completion and Self-Evaluation**

9. ADB's project completion report (PCR)<sup>4</sup> rated the Project as partly successful.<sup>5</sup> The physical targets of minor irrigation development were substantially underachieved, reaching only about 19,200 ha compared with the appraisal target of 140,000 ha. Also, the institutional enhancement objective, which was supposed to be achieved by the accompanying advisory TA, was not met. With the replacement of DAE with the Ministry of Agriculture (MOA) as the lead

<sup>2</sup> TA 1610-BAN: *Institutional Strengthening of the Department of Agriculture and Extension for Minor Irrigation Development*, for \$388,000, approved on 21 November 1991.

<sup>3</sup> Known as the Local Government Engineering Bureau at the time of appraisal.

<sup>4</sup> ADB. 2001. *Project Completion Report on the Northeast Minor Irrigation Project in Bangladesh*. Manila.

<sup>5</sup> Using the four-category rating scale of highly successful, successful, partly successful, and unsuccessful.

executing agency in 1994, the TA objective of strengthening DAE was no longer relevant and was not pursued further. While the flow-on impacts of the demonstration activities funded under the Project were not as great as expected, the incremental income of beneficiary households was 60% more than expected at appraisal. With regard to the improvement of road access, actual outputs were 38% more than appraisal targets. The economic internal rate of return (EIRR) at project completion was estimated at 15% against the appraisal estimate of 36%.

10. As can be seen from para. 9, the overall rating was consistent with the overall performance of the Project. However, the PCR assessed the Project as efficacious in spite of the lower achievement of outcomes than had been projected at appraisal.

## **F. Operations Evaluation**

11. This report presents the findings of an Operations Evaluation Mission (OEM) that visited Bangladesh in November 2002. It assesses the Project's relevance, effectiveness in achieving its objectives, efficiency, sustainability, and impacts. It is based on a review of the PCR, appraisal report, and material in ADB files, and on discussions with the executing agencies, representatives of other external sources of assistance, beneficiaries, and concerned ADB staff. Comments from concerned departments and offices in ADB and the executing agencies were taken into consideration in finalizing this report.

## **II. PLANNING AND IMPLEMENTATION PERFORMANCE**

### **A. Formulation and Design**

12. The Project as a whole was consistent with ADB's strategy as well as with the thrust of the Government's 4FYP,<sup>6</sup> which emphasized the need for expansion in irrigation coverage, largely through assisting the private sector in expanding surface and groundwater technologies.

13. The trade credit component (which accounted for almost 52% of total project cost as appraised) was designed to help overcome financing difficulties faced by importers and traders, but inadequate appreciation of the real credit constraints faced by this group, and the incorporation of complex and costly compliance procedures, resulted in there being no demand for the Project's credit line, and it was eventually cancelled. More adequate analysis of the inclusion of the trade credit component in the proposed Project should have been made. The unattractiveness of the credit component could be traced to a number of factors, including (i) a relatively short repayment period, (ii) cumbersome documentation requirements, (iii) higher equity<sup>7</sup> requirements compared with other sources of credit, (iv) a loan covenant requiring the borrower to have an office in the project area (since most experienced importers and larger traders came from Dhaka and/or Chittagong), and (v) increasing volumes of irrigation equipment and power tillers becoming available from local manufacturers. The fact that restrictions on currency convertibility, which were liberalized in 1994, together with increased foreign exchange

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<sup>6</sup> The aim of accelerated rice and wheat production during the 4FYP was to achieve grain self-sufficiency by the end of the plan period (1995).

<sup>7</sup> Importers/traders had to put up 20% of the cost of the imports to be financed. In effect, only 80% was eligible for financing, compared to the 100% financing provided by other credit sources.

reserves<sup>8</sup> and the slow initial uptake of the tubewell component, also meant that the previous constraints on the availability of foreign exchange were removed.<sup>9</sup>

14. At appraisal, operational details of the envisaged group-based farmer credit arrangements were not analyzed in detail and the institutional capacity of the agencies involved (including nongovernment organizations [NGOs], microfinance institutions [MFIs], and commercial banks) was not assessed. It was assumed that the NGOs could easily develop arrangements acceptable to farmers and banks during implementation. However, the difficulties in implementation were underestimated, and the proposed arrangements were never developed. The group-based credit arrangements to be facilitated by NGOs did not materialize, and credit constraints still adversely impact on the uptake of STW technology, particularly by small farmers.

## **B. Achievement of Outputs**

15. The largest component, i.e., trade credit, was eventually cancelled due to the absence of demand. Meanwhile, the physical output targets for minor irrigation development were substantially underachieved, reaching only 16,000 ha as compared with the appraisal target of 140,000 ha.<sup>10</sup>

16. Under Part B, 1,600 test boreholes had been drilled at project completion and maps had been produced. The groundwater table was monitored regularly under a simple but effective system. The evaluation showed generally homogeneous lithographical conditions in most of Kishoreganj and Netrakona districts, (a good potential for STW development), but very heterogeneous conditions in Greater Sylhet districts (with higher risks in drilling for STWs).<sup>11</sup> The Project installed 507 STWs (compared with 200 expected at appraisal), resulting largely from the incentive effect of a subsidy of about Tk5,000 per STW. Also, the Project (i) financed the setting up of 250 (as against 200) demonstration farms using STWs, and (ii) financed and organized 12 fairs (as expected at appraisal), which provided dealers and manufacturers the opportunity to exhibit and market minor irrigation and agricultural equipment, farm inputs, and agricultural produce.<sup>12</sup> The Project also financed publicity material, arranged demonstration activities, and organized training of farmers and project staff. NGOs were contracted but assisted only with the demonstration subprojects, so group-based credit mechanisms were not developed as had been expected.

17. A total of 8,300 m of small bridges and culverts was constructed under the Project by LGED,<sup>13</sup> together with the subcomponents added at the midterm review, i.e., 8 pontoons, and 4 (as against 3) water control structures.

18. The PCU and PIU established separate offices in Dhaka and the six project districts, with more staff than appraised mainly because of the increase in project scope.

<sup>8</sup> International reserves increased from \$880 million in June 1991 to over \$3,000 million by June 1995.

<sup>9</sup> For the same reasons, the World Bank's Shallow Tubewell and Low Lift Pump Irrigation Project also cancelled two thirds of its trade credit component in 1994.

<sup>10</sup> The Operations Evaluation Mission has assessed the impact to be less than that estimated by the PCR, mainly on the basis of the number of nonfunctioning STWs and reduced areas under the command of the water control structures (Appendix 3).

<sup>11</sup> The suitability for STW development varies from 80% to 87% in Kishoreganj and Netrakona districts to only 25% in Sylhet district.

<sup>12</sup> The Government estimated that 0.5 million people attended these fairs.

<sup>13</sup> Compared with 6,000 m estimated at appraisal and an additional 1,800 m added as a result of the midterm review.

19. Although the ADB-funded project activities were completed in June 1999, the Project Management Unit (PMU) of MOA continued for another 3 years undertaking similar types of activities but funded from the Government's Annual Development Plan at a cost of Tk69 million.<sup>14</sup> In particular, over this period they installed 429 demonstration tubewells, 1,561 demonstration treadle pumps, 211 demonstration artesian tubewells, and 12 water-retention structures, together with 173 ha of demonstration farm activities, and the installation of 4,730 m of low-cost irrigation channels. In addition, LGED continued with road improvement activities in the project area as part of their normal works, further extending the road pavement network on roads that had benefited from Project-financed structures.

### **C. Cost and Scheduling**

20. The actual total project cost amounted to \$24.5 million, almost 74% below the appraisal estimate. This could be largely attributed to the (i) cancellation of the trade credit component (which accounted for almost 73% of the total base cost at appraisal), (ii) lower costs of incremental staff and office supplies, and (iii) significantly reduced service charges (Appendix 1). Of the total estimated interest and service charges at appraisal, 79% was to be paid for by the participating banks<sup>15</sup> under the trade credit component that was eventually cancelled.

21. The reduction in costs was accompanied by increases in the costs related to (i) demonstration activities (31.2%), which could be traced to the higher than expected unit cost for tubewells; and (ii) the road structure component (40.1%), which in turn was a result of the increase in scope approved at midterm.

22. Actual loan disbursements amounted to \$22.6 million, financing around 92% of actual total project cost, with the Government financing the balance. As the trade credit component was cancelled, the share of the dealers and participating banks to total project cost as expected at appraisal did not materialize.

23. The Project was completed in June 1999, 1 year and 3 months later than expected. This was a result of (i) the front-end delays due to the Government's late compliance with conditions of loan effectiveness, (ii) slow project progress until MOA replaced DAE as the lead agency in September 1994, and (iii) additional work approved at midterm of project implementation.

### **D. Procurement**

24. Procurement of goods and services was undertaken in accordance with ADB guidelines. Delays were encountered in the procurement of goods due to DAE's lack of familiarity with ADB's procurement procedures and the delays in Government approval. Likewise, delays in contracting NGOs were experienced due to difficulties in developing acceptable selection criteria. After a 3-year delay, in September 1996, four NGOs were contracted and began facilitating the formation of farmer groups for the demonstration projects. However, the development of group-based credit arrangements for small STW farmers did not materialize.

<sup>14</sup> Known locally as the "Bridging Period" since it had been anticipated that other sources of aid would come forward to continue with a second phase of the Project.

<sup>15</sup> The Bangladesh Bank was to relend the proceeds of the loan to the participating banks, which in turn were to onlend these proceeds to eligible subborrowers.

## **E. Organization and Management**

25. Coordination of minor irrigation development with the credit and road structures component was considered critical to the success of the Project as a whole. DAE, being the agency responsible for minor irrigation development, was to take the lead role. However, DAE was not effective in performing this role largely due to the lack of authority of the coordinating director of the PCU. The delays in start-up activities by the PCU were such that ADB even considered suspension in 1994. Thus, in late 1994, a new higher-ranking coordinating director was assigned, reporting directly to the secretary of MOA, and implementation activities accelerated. This delay resulted in Part B being less integrated with the regular extension services. The objective of strengthening the capacity of DAE in the project area was no longer pursued, rendering the advisory TA ineffective.

26. At project completion, all but four covenants were complied with or no longer applicable due to the cancellation of the trade credit component (Appendix 2). At the time of the Operations Evaluation Mission (OEM), three covenants were partly complied with. They were related to the introduction of measures to mitigate the decline in water table levels or changes in the water quality in the project area, establishment of the Environment Cell, and engagement in an active policy dialogue on the reforms agreed upon under the ADB-financed Foodcrops Development Program.<sup>16</sup>

## **III. ACHIEVEMENT OF PROJECT PURPOSE**

### **A. Operational Performance**

#### **1. Part A: Trade Credit Facility**

27. The trade credit line of \$60.1 million<sup>17</sup> established under the Project for importers and traders was not utilized since established traders had no difficulties in accessing credit from existing sources (para. 13). The credit line was thus cancelled in two stages: initially \$25 million was cancelled in August 1994, and although efforts were made in 1995 to improve the acceptability of the credit line, it was still not utilized by traders and the remaining \$28 million was cancelled in December 1996. This cancellation did not appear to adversely affect the supply of irrigation equipment in the project area—indeed, if there was a credit constraint, it was not for traders but for farmers who wished to access short-term loans to establish tubewells and purchase associated equipment. In this context, the change in project scope to remove the trade credit component was justified.

#### **2. Part B: Groundwater Exploration, Tubewell Installations, Demonstration Farms, and Trade Fairs**

28. The operational performance with respect to Part B of the Project is assessed as moderate. In general, physical output targets were achieved or exceeded, but the impact on the marginal and small farmers is less than had been anticipated, largely through the selection process for the demonstration farms and STWs, and the fact that the project plans to facilitate group lending activities through NGOs did not materialize. The performance of each subcomponent is addressed in the following paragraphs.

<sup>16</sup> ADB. 1990. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of Bangladesh for the Foodcrops Development Program*. Manila.

<sup>17</sup> Including price contingencies amounting to \$11.8 million.

### **a. Groundwater Exploration**

29. While favorable aquifer conditions existed in two of the districts—Kishoreganj and Netrakona—hydro-geologic conditions were uncertain in the other four districts and this uncertainty constrained the expansion of STWs. The 1,600 test bores that were drilled and the resultant mapping provided information on groundwater availability that motivated farmers to invest in STW technology. In a few cases, these wells were unsuccessful in establishing adequate supply: in Sylhet district in particular, gas intrusion and/or stones have been a problem and a few wells have had to be abandoned. In certain locations in Habiganj district, groundwater extraction for irrigation has lowered the water table, adversely affecting the seasonal availability of drinking water at adjacent shallow wells. In these cases, deep-set STWs are being used for drinking water.

### **b. Installation of Demonstration Tubewells**

30. Under this component, 507 STWs, 103 LLPs, and 100 treadle pumps were installed for demonstration purposes, with shared financing between the Project and the beneficiaries. The demonstration impact of these new features has been less than anticipated at appraisal, with some 3–7 neighboring farmers adopting the technology or a level of just under 25% of what had been anticipated. While a lottery system had been proposed for selection of the demonstration tubewell sites (and beneficiaries), this lottery system was not systematically applied in practice due to lack of consensus. As a result, the 1998 project benefit monitoring and evaluation report suggests that larger farms may have received a disproportionate share of the financial benefit from this component: the weighted average farm size of those surveyed was 1.5 ha compared with an average size of landholding in the area of 0.9 ha.<sup>18</sup> The direct impact of the Project on low income and marginal farmers, and concomitantly on poverty, has therefore been reduced.

### **c. Demonstration Farms**

31. The Project established 250 demonstration farms to publicize STW irrigation technology, which were successful in technology transfer through field days attended by 23,000 farmers.<sup>19</sup> Additional training was provided at the Rural Development Academy, Bogra.<sup>20</sup> Again, the appraisal recommendation of a lottery system for site selection was not applied, with the demonstrations being principally concentrated on the land of lead farmers with larger landholdings. After the 3-year demonstration period, the units were transferred to the respective farmer groups for joint operation and maintenance, and it was expected that the shared maintenance program and the recommended cropping patterns would be subsequently adhered to. In practice, some demonstration farms have discontinued intensive, high-value crop production to concentrate on dry season rice rather than vegetables, and in a small number of cases (mainly in Sylhet where absentee landownership prevails), some of the demonstration units are no longer functioning. While the functioning demonstration units could continue to be used for demonstration purposes by DAE through field days, this does not appear to be common.<sup>21</sup>

<sup>18</sup> Interviews with beneficiaries by the OEM also confirm that it was easier for larger landowners to meet the cost-sharing arrangements; in particular, contributing Tk5,000 toward the STW drilling cost, and then subsequently funding the pump and motor.

<sup>19</sup> Source: Government PCR, p. 17.

<sup>20</sup> 1,109 farmers and 95 DAE staff attended various training courses at Bogra. Source: Government PCR, p. 17.

<sup>21</sup> DAE commented that this was due to lack of funding in their recurrent budget.



#### **d. Trade Fairs and Publicity Programs**

32. The 12 trade fairs organized under the Project were largely successful in achieving their initial purpose, by providing the opportunity for the trade to exhibit and demonstrate irrigation and agricultural equipment, but no trade fairs have been subsequently held. The three documentary films and other leaflets, posters, and promotional material are currently being held in the project offices, but do not appear to have been incorporated into normal DAE extension activities in these six districts. The OEM was advised that the two mobile training vans, which arrived only in the latter stages of the Project, are currently at MOA in Dhaka and are not being used for extension purposes; therefore, it is suggested that MOA transfer the vans to DAE.

#### **e. Facilitation of Farmer Credit**

33. This component of the Project had little of the impact that had been intended because of two significant factors. First, at the time the Project was being formulated, ADB had been coordinating with the United States Agency for International Development to cofinance the Agricultural and Rural Credit Project that was approved in December 1990.<sup>22</sup> It had been anticipated that this complementary facility would improve the credit delivery system for the sector as a whole, as well as assist farmers in the project area to access necessary credit requirements for minor irrigation development from commercial banks. However, because of the Government's 1992 repayment amnesty for agricultural loans, the Agricultural and Rural Credit Project was cancelled. But even if this loan had proceeded, it is doubtful whether it would have addressed the real credit constraint, in that the commercial banking system's required collateral for loans on minor irrigation equipment can generally only be met by larger landholders. The remaining 80% of farmers rely on MFIs and informal sources, and even MFI lending is not generally geared to lending for minor irrigation.

34. Second, the Project incorporated a specific provision to assist farmers accessing credit by utilizing the services of contracted NGOs to facilitate group-lending modalities from formal and informal sources. However, this activity was only implemented from 1996, and then the NGOs assisted in demonstration activities rather than in facilitating access to credit. The credit constraint faced by farmers, particularly small and marginal farmers, was therefore not really addressed by the Project and continues as a constraint to the uptake of minor irrigation in the project area. Facilitation of farmer credit had thus faced the mixed problem of targeting of credit and addressing the need for collateral.

### **3. Part C: Road Structures**

35. The Project constructed 1,409 small bridges and culverts,<sup>23</sup> directly improving market access for farmers, and to this extent achieved its project purpose. In addition, the eight floating pontoons facilitated cross-river access, and the three operating surface water control structures with a potential command area of some 1,500 ha will expand surface water irrigation for those farmer beneficiaries, provided the primary distribution channels are completed by the farmer organizations concerned, and that they adopt full responsibility for maintenance.<sup>24</sup> Currently, these organizations are largely ad hoc, and need support to develop as fully functioning water users associations that can (i) accept responsibility for maintenance of the control structure, and (ii) construct/maintain an appropriate water distribution system within the command area.

<sup>22</sup> ADB. 1990. *Report and Recommendation of the President to the Board of Directors on a Proposed Loan to the People's Republic of Bangladesh for the Agricultural and Rural Credit Project*. Manila.

<sup>23</sup> Involving a cumulative length of 8,300 m.

<sup>24</sup> Currently, the cultivable command area under each scheme is estimated to average 150 ha, for a total of 600 ha.

36. The road structures (bridges and culverts) are effectively part of the district road network that is being maintained by LGED. Their current condition is good, but road maintenance in Bangladesh is currently underfunded, and the long-term performance of these structures may be adversely affected should this underfunding continue over the medium term.

#### **4. Part D: Project Management Support**

37. Initially, the project design allocated overall coordination responsibility to DAE with a coordinating role for the director general of DAE in charge of a PCU. This PCU was also responsible for implementing Part B of the Project, with a PIU under a project director from LGED being responsible for implementing Part C. However, the DAE/PCU arrangements were ineffective, and for 2 years, the PCU was nonfunctional. Beginning in late 1994, therefore, a higher-ranked coordinating director was appointed to head the PCU, reporting directly to the secretary of MOA, and PCU activities accelerated, including the recruitment of staff, procurement of vehicles and equipment, and the coordination of training. However, as this change resulted in PCU staff operating independently of DAE, the opportunities for institutional strengthening that had been anticipated did not occur.

#### **5. Technical Assistance**

38. TA was provided under the Project to enhance DAE's changing role in support of the expansion of the private sector's role in the improvement of minor irrigation technology (footnote 2), with a provision of 24 person-months of consulting services over a 6-year period. The advisor was actually fielded for about 20 months, but following the change in implementation arrangements with a shift in responsibilities from DAE to MOA, the objectives of strengthening DAE under the Project became inappropriate. At the request of the Government, the consulting contract was shortened, and the unspent TA budget was cancelled. The TA was therefore largely unsuccessful.

### **B. Performance of the Operating Entity**

39. Individual farmers are responsible for the continued operation of tubewells installed under the Project on the demonstration farms, and to date maintenance appears to be satisfactory. Where tubewells are shared between farmers, maintenance costs are also shared, with no formal cost-recovery arrangements. When pump replacements are required, after roughly 6 years, farmers expect that they will share these costs, although in a few cases with absentee landowners, the units have not been replaced.<sup>25</sup> With respect to the road structures, LGED is responsible for regular maintenance, funded by the revenue budget of the Government. When floods damage culverts or structures, then repairs are undertaken by LGED,<sup>26</sup> although the overall fund allocation to road maintenance by the Government is less than required.

### **C. Economic Reevaluation**

40. At appraisal, the EIRR of the Project was assessed at 36%, with no separate calculations for the EIRR of the individual components. At the time of the PCR, the EIRR was reestimated at 15%, with the reduction being due to the lower than initially anticipated flow-on

<sup>25</sup> Overall, 85% of the STWs installed under the Project are assessed as operational.

<sup>26</sup> LGED informed the OEM that during the severe floods in 1998, none of the road structures installed under the Project was damaged.

effects of the technology demonstrations. The PCR attributed this largely to the failure of the credit component.

41. A reevaluation of the economic impacts of the Project indicates an EIRR of 17% (Appendix 3). This analysis incorporates two modifications to the basic assumptions incorporated at appraisal and in the PCR. First, previous assessments included the benefits generated by incremental production continuing in full over a 20-year period. Given that the effect of the Project was mainly to accelerate the rate of diffusion of irrigation technology into the northeastern region of the country, it is unlikely that the total amount of incremental production generated by project activities would have remained over the next 20 years when comparing what would have been likely to happen in the area without the Project.<sup>27</sup> Second, while initially the Project concept was to ensure close linkage between the agricultural and road improvement components (Parts B and C), this linkage was not realized. Also while irrigation development was concentrated in a few areas within each district, road improvement works were widely dispersed across the whole district. In this case, only a proportion of these road costs can be offset against the benefits generated by the increased agricultural production linked to project interventions.

#### **D. Sustainability**

42. The investments provided under the Project appear to be largely sustainable. The Bangladesh Water Development Board has the responsibility for continuing groundwater monitoring in the project area, utilizing its own network of piezometers,<sup>28</sup> although there is now the opportunity to extend this coverage by including the piezometers installed under the Project in this network. The 757 STWs, 103 LLPs, and 100 treadle pumps installed under the Project are being maintained by the individual farmers or farmer groups, and are generally operational, except in Sylhet where some 44 units are now not functioning and have not been repaired.<sup>29</sup> There is adequate capacity in the local servicing sector for tubewell/pump and motor maintenance. LGED is responsible for maintenance of the minor road improvement structures under its normal road maintenance program, but there are instances where heavy vehicle loadings are affecting the approaches to some bridges and culverts, particularly when heavy monsoon rains scour the approaches on earthen roads. The three operating surface water control structures<sup>30</sup> continue to be maintained by LGED, but this responsibility will be transferred to the relevant farmers' organizations when they are suitably strengthened. In addition, one of the eight floating jetties has now become redundant with the construction of a bridge in close proximity, and will be transferred to another site by LGED.

### **IV. ACHIEVEMENT OF OTHER DEVELOPMENT IMPACTS**

#### **A. Socioeconomic Impact**

43. The average farm size<sup>31</sup> in the project area is 0.86 ha, which is 26% higher than the national average of 0.68 ha. Just less than one third of holdings are small (<1 ha) compared with 41% nationally, and 27% are large (>3 ha) compared with 17% nationally. Farm holding numbers and farm size distributions are therefore skewed above the national averages.

<sup>27</sup> Diffusion of minor irrigation technology would still have occurred in the project area, albeit at a slower rate.

<sup>28</sup> An instrument for measuring pressure or compressibility.

<sup>29</sup> These are predominately on the properties of absentee landowners.

<sup>30</sup> One water control structure requires further earthworks to become fully operational. LGED assured the OEM that this would be undertaken promptly.

<sup>31</sup> In terms of operated area per holding. Data is based on the 1996 Census of Agriculture and Livestock.

Similarly, although a lower proportion of holdings in the project area have irrigation compared with the national data (56% compared with 64%), this irrigation tends to be relatively highly concentrated in the larger land holdings.<sup>32</sup> Given the nature of the project interventions, and the preferences given to “larger” landowners, it is expected that the majority of direct beneficiaries are farmers with over 1 ha. However, indirect beneficiaries (those who implemented the technology as a result of the demonstrations funded under the Project) may have included a number of smaller farms, with the result that the typical beneficiary model is assumed to have an “operated area” of 1 ha.

44. Following the assumptions made in the PCR, it has been assumed that each STW installed directly under the Project has resulted in the installation of an additional 5 STWs as a result of demonstration effects (Appendix 3).<sup>33</sup> Assuming that each STW commands an area of 4 ha, the area irrigated directly by project STWs is estimated at 2,574 ha, with a further 12,869 ha under the flow-on demonstration effect. Generally, the with-Project cropping system involves an increase in cropping intensity from 140% to 210%, with the increase reflecting production of boro (winter) crops such as paddy, tubers, and vegetables. Adopting the PCR farm models, household incomes (for a 1 ha unit) increase from Tk22,000 to Tk56,000 under the with-Project conditions, with the returns to family labor increasing from Tk113 to Tk346 per day.<sup>34</sup>

45. In aggregate, it is anticipated that the move to more intensive crops under the with-Project conditions will result in increased demand for on-farm labor, expected to increase by 1.3 million days annually.<sup>35</sup> In addition, the significant growth in the number of equipment suppliers and servicing outlets has led to increased number of skilled and semi-skilled persons employed in the project area. Besides this, the upgrading of rural infrastructure under the Project has resulted in improved access to markets, towns, and schools; reduced travel times and costs; and increased employment opportunities.<sup>36</sup> These improvements will benefit all rural households in the project area, including the landless.

46. Although collective ownership of shared irrigation equipment (such as STWs) has not been formalized in project areas, these groups are continuing to function well. This demonstrates a strong level of mutual trust and the ability to equitably share responsibilities and costs among the members of such groups. Poverty levels in the project areas are summarized in Appendix 4. The socioeconomic impacts of the Project on direct and indirect beneficiaries of STW technology, in terms of household income and employment, have been positive and the Project has contributed to significant improvements in road infrastructure and access throughout the six project districts.

## **B. Environmental Impact**

47. Potential problems with arsenic contamination of the groundwater in Bangladesh were first detected in 1993, and confirmed after 1995. Arsenic contamination in the groundwater of the project area has been identified with varying incidence across and within the six districts. A survey of the arsenic content of all project STWs was undertaken in 1996, with the arsenic content exceeding the drinking water threshold of 0.05 milligrams per liter in 19% and 12% of

<sup>32</sup> Thirty-five percent of land holdings with irrigation have an area in excess of 1 ha, compared with 23% nationally.

<sup>33</sup> Although 757 STWs were installed under the Project, it has been assumed that only 85% are currently operational and these form the basis for the indirect beneficiaries.

<sup>34</sup> In 2000 prices. ADB. 2001. *Project Completion Report on the Northeast Minor Irrigation Project*. Report IN.258-01. Manila.

<sup>35</sup> Even allowing for the labor substitution effects of power tillers.

<sup>36</sup> Some farm laborers have switched to rickshaw drivers.

STWs in Sylhet and Moulvibazar, respectively.<sup>37</sup> More recently, although the nationwide testing program conducted between 1996 and 2000 has identified the largest concentration of arsenic contamination in the groundwater in the central part of the country, the Greater Sylhet area is also identified as having a number of *upazilas* (subdivision of a district) with contamination of varying degrees. Although STWs are not commonly used as the source for drinking water in the project area,<sup>38</sup> they may be used as supplemental sources, inadvertently exposing households to this health risk. In addition, the extent to which irrigation with arsenic-contaminated water influences crop productivity and the extent to which grains and leafy vegetables take up arsenic are not well understood.<sup>39</sup>

48. There are a number of ongoing arsenic-mitigation programs in Bangladesh, including the World Bank's Arsenic Mitigation Water Supply Project. This initiative involves screening in all 268 arsenic-prone upazilas, and the implementation of mitigation measures where drinking-water contamination is identified. As of October 2002, this program had covered three upazilas in the project area, with the remaining upazilas due to be tested in Phase III that should be completed by early 2003. It is expected that, where necessary, appropriate mitigation measures will be in place by mid-2003 within the project area. Research on the wider issue relating to the indirect effects of using arsenic-contaminated irrigation water should be available in 2003 and based on these results, appropriate mitigation measures, if necessary, should be derived.

### **C. Impact on Institutions and Policy**

49. The Project's contribution to institutional capacity building has been moderate. A large number of the 286 informal beneficiary groups formed around the STW demonstration units remain functional, and the potential exists to continue to use these units as the platform for future extension of STW technologies in the project area.

50. However, the reformulation of the implementation arrangements in 1994, although accelerating implementation, has not resulted in strengthening the core institutional capabilities of DAE at the field level to the extent envisaged at appraisal, and has not developed the expected institutional linkages between MOA, DAE, NGOs, and MFIs.

51. While the Project has had no direct impact on policy reform in the agricultural or water resources sectors, project activities did benefit from ongoing reforms supported by complementary ADB projects, in particular, the tariff reforms relating to the import of minor irrigation equipment and the facilitation of greater private sector participation in the minor irrigation sector assisted by the Foodcrops Development Program (footnote 16).<sup>40</sup>

## **V. OVERALL ASSESSMENT**

### **A Relevance**

52. The Project was formulated with the objective of increasing crop production and farm income in the northeastern region by stimulating the uptake of minor irrigation by the private

<sup>37</sup> ADB. 2001. *Project Completion Report on the Northeast Minor Irrigation Project*. Manila. The PCR by the Government sources this same data to the 1999 national survey, 3 years later, which appears more likely. STWs in which the arsenic content exceeded the threshold were marked as unusable for drinking water.

<sup>38</sup> Manually operated hand pumps located near houses or within communities are more common.

<sup>39</sup> Research on this is ongoing, both by the Australian Commonwealth Scientific and Industrial Research Organization and by the Bangladesh office of the International Maize and Wheat Improvement Center.

<sup>40</sup> The World Bank's National Minor Irrigation Development Project and the Shallow Tubewells and Low Lift Pumps Project also assisted these reforms.

sector in the area through diffusion of technology that, although having potential for minor irrigation, had experienced relatively slow growth. This objective was consistent with the thrust of the Government's 4FYP (1990–1995),<sup>41</sup> and also matched ADB's strategy at that time. The Fifth FYP (1997–2002) continued with this emphasis, although concentrating more on the direct linkage between rural development (including expanded irrigation coverage) and poverty reduction, an emphasis that matched ADB's poverty focus. A National Agriculture Policy and a National Water Policy were approved by the Government in 1999, and a National Water Management Plan<sup>42</sup> now provides a focus on surface water development, but with groundwater development where surface water is unavailable or too expensive to exploit. The current operational strategy of ADB includes the aim of sound water resources management based on ADB's 2000 Water Policy. More detailed project preparation may have identified potential problems with the manner in which the trade credit component was formulated and, through increased stakeholder participation in formulation, been able to target project interventions to increase the resultant poverty impact.<sup>43</sup> Overall, the Project is assessed as partly relevant, mainly reflecting the significant reduction in scope that resulted from the cancellation of the trade credit component.

## **B. Efficacy**

53. The principal objective of the Project was to increase crop production and farm incomes in the project area through expansion of minor irrigation facilities. These outcomes have been largely achieved, but not to the extent envisaged. Originally, it was anticipated that over 7 years (1991-1997) the Project would be the catalyst for an expansion in irrigated area of over 80,000 ha resulting from the installation of 20,200 STWs stimulated by project activities. In practice, the number of STWs grew from around 9,600 in 1992/93 to over 26,000 in 2000/01, with the main increases being in Habiganj, Kishoreganj, and Netrakona. Not all of this growth can be attributed to project interventions, however. In the light of this fact, the Project is rated less efficacious, reflecting the limited extent to which the physical development targets assumed at appraisal have been achieved.

## **C. Efficiency**

54. The EIRR of the Project is assessed at 17% (Appendix 3), indicating an efficient application of investment capital. Cost effectiveness standards for irrigation development are difficult to apply to this Project, given that over three quarters of the base cost as implemented was applied to road improvement components. With respect to the efficiency of institutional processes, ADB's internal processing of the Project, including midterm review, was reasonably efficient. Supervision and coordination of project implementation by the lead agency, DAE, was initially not satisfactory. However, with the changes introduced in 1994, implementation greatly improved and internal processes improved markedly. Works were being well executed in an efficient manner and meeting the required quality standards. On balance, the Project is rated efficient.

<sup>41</sup> Although the 4FYP was launched in July 1990, the draft underwent several revisions before being finally approved in June 1995.

<sup>42</sup> To be approved within 2003. One of the main aims of the plan is to ensure food self-sufficiency through increased crop production. It defines a coordinated strategy for improved performance of the water sector involving stakeholder participation in processes. ADB contributed to the finalization of the Government's water management plan, which is consistent with ADB's 2000 Water Policy.

<sup>43</sup> Particularly with respect to addressing the credit constraint faced by project beneficiaries who wished to invest in STW/LLP technology.

## **D. Sustainability**

55. The demonstration tubewells established under the Project are still operational, and can continue to provide a platform for diffusion of minor irrigation technologies across the six districts if utilized effectively by DAE. The majority is being maintained by the beneficiary farmers, and has been a stimulus to private sector expansion in minor irrigation throughout the project area.<sup>44</sup> Similarly, the road bridges/culverts established under the Project have now largely been incorporated in an upgraded, sealed road network within the project districts, and through the continued maintenance programs of LGED, are likely to be maintained provided adequate resources are allocated for this purpose.

56. Current government policy, as under the National Water Policy and the National Water Management Plan, is likely to support a continued sector policy framework that is supportive to the replication of project initiatives into the future, and further expansion of the technology across the six districts, but focused on those areas where surface water development options are limited or relatively too expensive. It is also likely that those beneficiaries of the technology who are owner-operators<sup>45</sup> will continue to maintain their STWs, given the relatively significant increase in farm income associated with adopting this technology. Overall, project interventions are therefore seen to be likely sustainable.

## **E. Institutional Development and Other Impacts**

57. While the Project has successfully demonstrated that informal beneficiary farmer groups can successfully develop and operate STW technologies, the Project has not resulted in strengthening the core institutional capacity of DAE at the field level, nor in developing linkages between farmer groups, MFIs, and commercial banks in order to improve access to credit for the installation of minor irrigation technology. The impacts of the Project on farm incomes and rural employment have been positive, but significantly less than the levels anticipated at appraisal. Overall, the Project had moderate institutional and other development impacts.

## **F. Overall Project Rating**

58. The overall project rating is partly successful,<sup>46</sup> reflecting a weighted average of the assessments described in paras. 52–57.

## **G. Performance of the Borrower and the Asian Development Bank**

59. The ADB appraisal was not founded on detailed project preparatory assessments, a fact that may have contributed to the shortcomings in project design. ADB could have been efficiently involved in the project design, to clarify the major cause of the issue instead of directly adopting the proposal prepared by the Government. Following loan effectiveness, ADB fielded nine review missions<sup>47</sup> for the Project, which were adequate, but the timing of the inception mission, at 6 months after loan effectiveness, was too late. Subsequent supervision to overcome start-up difficulties was intense, and ADB's overall performance was only partly satisfactory.

<sup>44</sup> Although mechanical services for maintenance are now largely concentrated in the largest towns in each district, it is expected that they will expand across the districts as the demand for their services escalates.

<sup>45</sup> As distinct from absentee landowners.

<sup>46</sup> Based on the four-category rating system (highly successful, successful, partly successful, and unsuccessful).

<sup>47</sup> Including 1 inception-cum-review mission, 5 review missions, 2 special project administration mission, and 1 mid-term review mission.

60. Taking account of the limited role of the Bangladesh Bank and the participating banks in the trade credit component, their performance is judged to be satisfactory. Initial supervision and coordination of the Project by DAE was not satisfactory (although this may have been partially due to a design problem),<sup>48</sup> but performance improved significantly in 1994 when institutional arrangements for implementation were changed and the coordinating director reported to MOA instead of DAE. The commitment to the project objectives by the Government, as exemplified by the extension of project-related activities under government financing for a further 3 years after the project account was closed (para. 19), also supports an overall assessment ranking on the Borrower's performance as satisfactory.

## VI. ISSUES, LESSONS, AND FOLLOW-UP ACTIONS

### A Key Issues for the Future

61. **Design.** The performance of the Project was adversely affected by insufficient attention to key issues in project design. There is a wide range of socioeconomic and cultural drivers for rural development, and a critical understanding of them and their inter-relationships is critical in formulating successful and sustainable rural development projects.<sup>49</sup> In addition, small farmers are very risk averse, and they need high-quality information on the aquifer conditions and the probability of striking a high-yielding aquifer before committing to the expense of drilling. The involvement of NGOs, and their institutional capability, also needs very careful examination in project preparation if they are to be involved successfully, particularly in facilitating access to credit. In addition, if the Project is to have a pro-poor focus, then identification of the particular needs of this group, and the constraints they face, is essential, and is best covered through beneficiary involvement during the design phase.<sup>50</sup> Continued assessments of institutional capacity of implementing agencies would be critical if implementation arrangements are to be both effective and efficient for the Project's sound operation. Particular effort should have been made to address the main constraints in the sector before designing and formulating the Project.

62. **Technology Diffusion Constraints.** The sustainability of the Project depends on a number of key factors. While it is likely that the majority of the project beneficiaries will continue operating their STWs, the extent to which this technology will transfer to additional farmers depends, to a large extent, on the demonstration and extension support activities ongoing under DAE to build up the institutional capability of farmers to adopt and utilize minor irrigation investment options. However, the resourcing of DAE and extension activities in the area is under considerable pressure, and it is unlikely that the best use will be made of the opportunity that now exists to further extend the uptake of STW technologies across the farms in the project area. Diffusion rates are thus likely to fall unless further resourcing in demonstration and aquifer testing is forthcoming. Uptake by small and marginal farmers is likely to be further constrained by the lack of available credit unless carefully targeted credit modalities suited to groundwater irrigation are developed and promoted among the target groups.

<sup>48</sup> A detailed assessment during the design phase of the institutional capacity of DAE to undertake project management activities may have averted some of these implementation problems.

<sup>49</sup> For example, absentee landholders differ from owner-operators in their approach to adopting new technologies, and this difference was not taken into account in this Project.

<sup>50</sup> For surface water development projects, as with the water control structures, commitments from the beneficiaries and farmer group formation prior to construction are also seen as the key to successful implementation.



63. **Institutional Strengthening.** While the Project was initially designed to strengthen the institutional capacity of DAE, slow progress during the first 2 years of the Project meant that activities were transferred to MOA and a separate PMU structure developed. While this action has undoubtedly accelerated the achievement of project targets, it has not strengthened the institutional capacity of the agency that is required to provide ongoing support to project activities after completion of the Project. This shortcoming adversely affects project sustainability, and is at the long-term cost to the sustainability of project activities in the agriculture sector. It would be useful to stress the importance of the proper coordination role between MOA and DAE for the agriculture development activities.

64. **Project Benefit Monitoring Activities.** It would have been helpful if the Project's benefit monitoring assessments had collected more impact data relevant to individual components, particularly the impacts of minor road infrastructure improvement. This activity accounted for around 76% of the actual base cost of the Project, and while improvements in the road network indirectly affect farmgate costs and prices, a more direct assessment of the impact of the Project on vehicular and passenger movements and costs, and the extent of generated traffic, would have been useful in assessing overall project impacts.

## **B. Lessons Identified**

65. **Detailed Project Preparation.** There is no substitute for careful and rigorous project preparation to underpin investments in rural development. Such preparation must incorporate extensive involvement and input from all stakeholder groups (particularly from the project beneficiaries), as well as detailed assessments of institutional capacity and capability. In particular, such an exercise would have identified the potential demand for micro-credit from small and medium farmers as a serious constraint on uptake, and formulated a component to address this issue.<sup>51</sup> Adopting an investment proposal prepared by the Government needs to be examined very carefully to avoid the cancellation of such a substantial component.

66. **Need for Post-Project Monitoring.** Continued monitoring and expansion of the groundwater testing program initiated under the Project will be essential if groundwater development by the private sector is to expand significantly in the project area. This relates not only to issues of availability, but also to water quality.

67. **Extension of Project Impacts.** The "bridging" program undertaken by the Government after the ADB project account was closed (para. 19) has clearly demonstrated the impact of ongoing demonstration activities as a key ingredient to the further transfer of groundwater technologies into the project area. This bridging has significantly increased the impact of the Project by maintaining the momentum for minor irrigation development activities.

## **C. Follow-Up Actions**

68. **Farmer Organizations.** By the end of 2003, farmer organizations should have been strengthened and trained in managing water distribution within the command areas of the surface water control structures constructed under the Project. The role of DAE could be reviewed during the implementation of the ongoing project. These activities can be incorporated

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<sup>51</sup> While a trade credit component was provided under the Project, farmers credit of \$45 million to finance 20,000 STWs, 7,500 LLPs, and 15,000 power tillers was also needed.

within the scope of activities financed under ADB's Second Small-Scale Water Resources Development Sector Project,<sup>52</sup> being implemented by LGED.

69. **Technology Demonstrations.** To continue the demonstration momentum for appropriate technologies to utilize groundwater initiated under the Project and further expanded under the "Bridging Program," by the end of 2003, DAE should undertake 30 demonstrations (five per district), using the demonstration units developed under the Project.

70. **Resource Monitoring.** The Bangladesh Water Development Board has 163 piezometers in the project area that are read weekly, and seven groundwater sampling stations that are read annually for water quality. Given the heterogeneous nature of the groundwater aquifer in four of the six project districts, the Bangladesh Water Development Board should continue with periodic readings of the piezometers established under the Project, and transfer this information to DAE's Water Management Wing and to the Water Resources Planning Organization by the end of 2003 so that farmers' organizations can use the groundwater tables in the project areas.

71. **Arsenic Monitoring.** ADB's Bangladesh Resident Mission should monitor the status of the World Bank's Arsenic Mitigation Water Supply Project to verify that the testing of all arsenic-prone upazilas in the project area has been completed by early 2003, and appropriate mitigation measures implemented (para. 48). The ADB Arsenic Mitigation TA, proposed for 2003<sup>53</sup> should include assessing and implementing appropriate demand-driven responses to issues of arsenic contamination in project areas.

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<sup>52</sup> ADB. 2001. *Report and Recommendation of the President to the Board of Directors for a Proposed Loan to the People's Republic of Bangladesh for the Second Small-Scale Water Resources Development Sector Project*. Manila. The project aims at sustainable resource management utilizing surface water resources, and covers also the area concerned with this Project.

<sup>53</sup> Advanced from 2004 to 2003 during the ADB Country Program Confirmation Mission in November 2002.

**APPRAISAL AND ACTUAL PROJECT COSTS**  
(\$ '000)

Component	Appraisal Estimate			Actual			Actual as a % of Appraisal Estimate		
	Foreign	Local	Total	Foreign	Local	Total	Foreign	Local	Total
A. Trade Credit Facility for Irrigation Equipment and Power Tillers	41,474	6,808	48,282	0	0	0	a	a	a
B. Demonstration Activities	187	1,523	1,710	259	1,985	2,244	139	130	131
1 Groundwater Exploration and Tubewell Installation	0	225	225	51	1,088	1,139	b	484	506
2 Demonstration Farms	187	1,044	1,231	208	509	717	111	49	58
3 Trade Fairs	0	255	255	0	388	388	0	152	152
C. Road Structures	2,483	9,931	12,414	6,378	11,011	17,389	257	111	140
D. Project Management	350	3,805	4,155	507	2,860	3,367	145	75	81
1 Consulting Services Support	0	640	640	0	585	585	0	91	91
2 Vehicles and Equipment	233	361	594	224	272	496	96	75	84
3 Vehicle Maintenance and Office Supplies	118	958	1,076	283	514	797	240	54	74
4 Incremental Staff	0	1,846	1,846	0	1,489	1,489	0	81	81
<b>Base Cost</b>	<b>44,494</b>	<b>22,067</b>	<b>66,561</b>	<b>7,144</b>	<b>15,856</b>	<b>23,000</b>	<b>16</b>	<b>72</b>	<b>35</b>
Contingencies	8,996	8,492	17,488	0	0	0	0	0	0
Service Charges	1,891	7,179	9,070	325	0	325	17	0	4
Support for the Flood Damage Rehabilitation Project	0	0	0	397	737	1,134	c	c	c
<b>Total Project Cost</b>	<b>55,381</b>	<b>37,738</b>	<b>93,119</b>	<b>7,866</b>	<b>16,593</b>	<b>24,459</b>	<b>14</b>	<b>44</b>	<b>26</b>

<sup>a</sup> This component was cancelled.

<sup>b</sup> There was no provision for this at the time of appraisal.

<sup>c</sup> Following the devastating flood of 1998, \$1.1 million was reallocated to support Loan 1666-BAN(SF): Flood Damage Rehabilitation Project (approved on 18 December 1998, for \$104 million).

**COMPLIANCE WITH LOAN COVENANTS<sup>a</sup>**

<b>Loan Covenant</b>	<b>Status of Compliance</b>	
	<b>Project Completion Report</b>	<b>Project Performance Audit Report</b>
<b>Plan for Environmental Monitoring and Collection of Groundwater Data</b>		
The Borrower shall ensure that the Department of Agricultural Extension (DAE), through the Project Coordination Unit (PCU), prepares within 12 months of the Effective Date a plan, acceptable to the Asian Development Bank (ADB), for environmental monitoring under the Project. The Borrower shall also ensure that DAE, through the PCU, coordinates with the Borrower's Department of Public Health Engineering in order to introduce adequate mitigation measure in the event of any decline in the water table levels or any detrimental change in the water quality in the project area during and after project implementation. (Schedule 6, para. 10[a])	Partly complied with. Groundwater tables were measured and water quality was monitored. No mitigating measures were introduced.	Partly complied with. There were no mitigating measures introduced.
The Borrower shall further ensure that DAE, through the PCU, coordinates the collection of groundwater data from selected tubewells installed under the Project and that the information collected is provided in an appropriate database to the Environment Cell to be established in the Ministry of Agriculture under the International Development Association-financed National Minor Irrigation Development Project (Credit Number 2246-BD). (Schedule 6, para. 10[b])	Partly complied with. Groundwater data was collected but Environment Cell was not established.	Partly complied with. The Environment Cell was not established.
<b>Continued Implementation of Reforms in the Agriculture Sector and Policy Dialogue</b>		
The Borrower shall continue to implement expeditiously the policy and institutional reforms in the agriculture sector agreed upon under the ADB-financed Foodcrops Development Program (Loan 1045-BAN(SF)). The Borrower shall also implement the reforms agreed under the ADB-financed Agriculture and Rural Credit Project [Loan 1071-BAN(SF)]. The Borrower shall strengthen such reforms to ensure the sustained development of the agriculture sector.	Partly complied with. The policy and institutional reforms under Loan 1045 were largely implemented; however, Loan 1071 was cancelled.	Since Loan 1071 was eventually cancelled, the covenant related to this loan is no longer applicable.
The Borrower and ADB shall, under the Project, continue to engage in an active policy dialogue on such reforms focusing, in particular, on sector development issues, policy initiatives, institutional strengthening, and investment measures to ensure a conducive environment for the successful implementation of the Project.	Partly complied with. Project-relevant aspects were discussed during loan reviews.	Partly complied with.

<sup>a</sup> Include covenants that were partly complied with at the time of project completion.

## ECONOMIC REEVALUATION

### A. Introduction

1. The economic viability of the Project was reassessed broadly applying the same approach and methodology as used in the project completion report (PCR). The basic methodology for the economic analysis follows the approach given in the Asian Development Bank's *Guidelines for the Economic Analysis of Projects* and the recommendations given in the *Guidelines for the Preparation of Project Performance Audit Reports*.

2. As appraised, the Project had the objective of increasing agricultural production, employment, and income through the expansion of minor irrigation. Project-initiated activities were expected to result in the installation of 20,200 shallow tubewells (STWs) serving 80,800 hectares (ha) and 7,501 low lift pumps (LLPs) serving an additional 60,000 ha. There would be an associated demand for an estimated 15,000 power tillers to be imported under the Project. The Project would also finance the construction of 6,000 meters (m) of bridges and culverts to upgrade the road network in the area. The impact of the expansion in the coverage of minor irrigation was expected to increase paddy production by around 336,000 tons (t) annually, generate incremental labor demand of 14 million person-days annually, and double the annual income of small farmers. It was expected that the impact of the Project on the rural poor would be substantial, mainly through the increased demand for agricultural labor. The expected economic internal rate of return (EIRR) of the Project was 36%.

3. In the event, the impact of the Project was significantly less than had been expected, mainly due to over-estimation of the diffusion effects of the STW demonstration activities on the uptake of the technology by other farmers in the six project districts. The result of this difference was to reduce the EIRR.

### B. Methodology and Assumptions

#### 1. With and Without Project

4. STW and LLP irrigation technology had been experiencing rapid growth in Bangladesh during the 1980s—from 93,100 STW units in 1982–1983 to 309,300 in 1991–1992, and from 35,500 to 50,300 units for LLPs over the same period. This reflects annual growth rates of 14.3% and 4%, respectively. Despite this national growth, regional disparities existed, particularly in the six districts of the northeast where there were only some 9,630 STWs and 8,619 LLPs of which the majority (over 95%) were in Netrakona and Kishoreganj districts. The project objective was to accelerate the uptake of STW and LLP technology in the six northeastern districts, so in re-evaluating the economic returns generated by the project investment, two considerations arise. First, what impact has the Project had on accelerating the uptake of this technology in the project area? Second, over what period could it reasonably be expected that this impact (in terms of incremental production) would continue given that, in the absence of the Project, this technology would still have gradually diffused across the project area because of the demonstration effects of the technology from adjacent areas of the country? Indeed, expansion in minor irrigation technology driven by private sector investment continued in Bangladesh throughout the 1990s, with the latest census concluding that there were some 786,000 operational STW units and 73,600 operational LLP units in 2000–2001. This reflects national annual growth rates of just under 11% for STWs and 4.3% for LLPs during the period when the Project was under implementation.

5. Under the Project, 757 STWs,<sup>1</sup> 103 LLPs, and 100 treadle pumps were installed for demonstration purposes in the six project districts during 1992–1999.<sup>2</sup> Eighty-seven percent of these units were installed over the last 3 years of the Project, i.e., between 1996 and 1999. Aggregate data on the number of STWs, force mode tubewells,<sup>3</sup> and LLPs by project district between 1992 and 2001 from the National Minor Irrigation Census is given in Table A3.1.<sup>4</sup> STW growth was significant during the 1990s, with total numbers in the six project districts increasing from 9,630 in 1992–1993 to 26,232 in 2000–2001, but this growth has not been even across the area; indeed, some 89% of this expansion has been in just two districts—Netrakona and Kishoreganj—where there was an initial high concentration of STWs, and where lithographical conditions for STW expansion have been relatively homogeneous. In the other four project districts, expansion has been relatively small, with the exception of Habiganj, where STWs increased from 298 to 1,482 over the period. In Moulvibazar, Sylhet, and Sunamganj the total increase is some 719 units, compared with 240 units installed under the Project.

6. While the appraisal report predicted that project activities would result in private sector investment in an additional 20,000 STW and 7,500 LLP units, this has not occurred and the flow-on effects have been considerably reduced. The PCR concluded that each unit installed under the Project indirectly resulted in the installation of an additional five comparable units, and this ratio seems to be reasonably consistent with the district-level data and field survey interviews of beneficiaries. However, it is apparent that in some areas, particularly in Sylhet, a number of the tubewells established with project assistance have been abandoned,<sup>5</sup> with an assessment that overall some 85% of those installed under the Project are still operational. Adopting an 85% operational figure, and a technology transfer rate from the operational demonstration wells of 1:5, implies that of the uptake of STW technology across the six districts during the 1992–2001 period, 4% was directly attributable to the Project, and another 19% was indirectly attributable to the Project (Table A3.2).

7. The second methodological consideration is to assess how long the incremental production generated by the Project would continue into the future. Both previous assessments included the benefits generated by incremental production directly attributable to project activities continuing in full over a 20-year period. Given that the effect of the Project was mainly to accelerate the rate of diffusion of irrigation technology into the northeastern region of the country, it is unlikely that the total amount of incremental production generated by project activities would remain over the next 20 years when comparing what would have been likely to happen in the area without the Project. It is anticipated that the uptake of minor irrigation technology would still have occurred in the area, albeit at a slower rate than with the Project, but it would be expected that over time the incremental production benefits that can be directly ascribed to project interventions would gradually decrease in a comparison between with and without Project scenarios. Assessment of the direct effect of the Project in accelerating technology transfusion into the area is very subjective, but a range of expert opinion suggests that the Project's activities have advanced agricultural production levels in the area by 7–10 years on what they would have been without project intervention.

<sup>1</sup> Includes the STW installations on the 250 demonstration farms.

<sup>2</sup> The contribution of the LLPs and treadle pumps to the economic returns generated under the Project is not evaluated separately.

<sup>3</sup> Includes deep tubewells.

<sup>4</sup> It should be noted that there is considerable variance on the number of operational tubewells as reported by the National Minor Irrigation Census and as given to the Operations Evaluation Mission by field staff. Given that the only consistent time series information collected is by the census, this data set is adopted in this analysis.

<sup>5</sup> Field level data from Sylhet, for example, indicates that of 131 STWs installed under the Project, only 87 (66%) are currently operational. In contrast, in Sunamganj, some 97% are currently operational.

8. The base case for economic analysis therefore assumes a gradual decay in incremental benefits generated by the Project starting 7 years after each annual block of incremental irrigated area becomes commissioned. Total incremental production gains are assumed to have been dissipated 14 years after these areas are commissioned, with a bell-shaped decay curve in years 7–13.

## **2. Benefits of the Road Infrastructure Improvement Component**

9. While initially the project concept was to ensure a close linkage between the agricultural development and road improvement components of the Project (road structures would be upgraded in those areas where there was significant expansion in groundwater exploitation), this linkage did not take place, and as a result irrigation development was concentrated in a few areas within each district, while road improvement works were widely dispersed across the whole district. For example, a study of maps at the district level depicting the road infrastructure activities of the Project, overlaid with the location of STW development, suggests that in Habiganj district the STW developments were concentrated in about half the district compared with road improvement works being scattered over the whole area. Similarly in Moulvibazar, STW development was only really appropriate in one thana (subdistrict) because of groundwater conditions, and yet the road improvement works extended across all six thanas in the district. In these cases, the economic analysis cannot offset all the costs of the road improvement component against increased agricultural production from groundwater development due to the Project as was assumed in the appraisal and the PCR—in fact, only a proportion of these road costs can be offset against these specific benefits.

10. Another consideration is that, while the Project provided 1,409 small bridges and culverts on rural roads in the district, contemporaneously many of these roads were being sealed and upgraded under other projects funded by the Government, sometimes with external assistance. For example in Sylhet, on the 19 roads where 77 structures were constructed under the Project, sealing expanded from 47 kilometers (km) before the Project (24% of total length) to 155 km (77%) currently. Further sealing is ongoing. In these circumstances it is difficult to separately allocate any resultant benefits from an upgraded rural infrastructure network to the construction of structures and the sealing of the network.

11. A major factor in examining the economics of this Project is therefore the inter-relationship between the agricultural and road structure improvement components and the extent to which road infrastructure works funded by the Project directly impacted on the cost/return structure faced by those farmers participating directly or indirectly in the expansion of STW technology also being supported under the Project. In this case, it has been assumed for the purposes of the economic analysis that half of the costs of the road infrastructure component should be offset against the benefits from incremental production generated directly or indirectly from project activities, on the basis that the area of influence of both components is not the same, and some of the cost/return benefits should be attributed to the other aspects of the network upgrade program (such as the sealing).

## **3. Prices, Conversion Factors, and Residual Values**

12. The economic prices assumed in the analysis follow the approach used in the PCR with minor modifications, summarized as follows:

- (i) Domestic price numeraire is used. Value is expressed in constant 2000 prices.
- (ii) Project costs have been adjusted to this numeraire using the Manufactures Unit Value Index as the foreign price index for foreign costs, and the gross domestic product deflator as the local price index for domestic costs.
- (iii) An exchange rate of Tk52.60 per \$1.00 has been used for conversion of the foreign dollar cost stream.
- (iv) A conversion factor of 0.88 has been used to adjust farm family and unskilled labor prices to economic values.
- (v) A zero residual value is assumed for project equipment and vehicles. The economic life of irrigation equipment (pumps and motors) is assumed to be 6 years.

13. An export parity price has been used for urea, and import parity prices have been assumed for paddy and the two main nutrient sources for fertilizer: triple superphosphate and muriate of potash. All other outputs and inputs are valued at their domestic market prices. A summary is provided in Table A3.3.

#### **4. Economic Life**

14. Although the economic life of the Project's interventions could be assumed to be 20 years, the net incremental agricultural production generated by the Project<sup>6</sup> reduces to zero in Year 19 of the analysis period (Table A3.4). This period is then taken as the time scale over which the EIRR is assessed.

### **C. Estimates of Economic Costs and Benefits**

#### **1. Project Costs**

15. Project costs reflect those adopted in the PCR, with no allowance for any costs incurred after the project account was closed (i.e. excluding the bridging period, 1999–2000 to 2001–2002). Yearwise cost distribution is shown in Table A3.4. Minor irrigation equipment (pumps and motors) is assumed to have an economic life of 6–8 years with a replacement cost of Tk20,000 in 2000 prices. An allowance of 3% of capital costs, which would reflect the actual current maintenance budget, is assumed necessary to maintain road infrastructure assets over the economic life of the Project.

#### **2. Project Benefits**

16. For evaluating the economic value of the incremental agricultural production attributable to project activities, this analysis adopts the following assumptions:

- (i) 85% of demonstration tubewells constructed under the Project are operational;
- (ii) 2,574 ha is irrigated by Project-financed tubewells;<sup>7</sup>

<sup>6</sup> i.e. in a comparison of with and without project scenarios.

<sup>7</sup> Assumes 4 ha per STW.



- (iii) 600 ha is irrigated by Project-financed water control structures;<sup>8</sup>
- (iv) 12,869 ha is irrigated as the indirect “flow-on” effect of project demonstration activities;
- (v) intensification of production under tubewells has resulted in winter (boro) paddy, and the production of winter green vegetables and tubers; and
- (vi) those farmers “indirectly” benefiting from project activities have mainly increased the production of boro paddy.

17. Summaries of the impact of the Project on crop yields and cropping patterns are given in Tables A3.5 and A3.6.

18. With respect to assessing the benefits of the road infrastructure component, it would have been helpful if the project benefit monitoring assessments had collected more impact data relevant to this activity, which accounted for around 76% of the base cost of the actual Project. While improvements in the road network indirectly affect farmgate costs and prices, a more direct assessment of the impact of the Project on vehicular and passenger movements and costs, and the extent of generated traffic, would have been useful in assessing overall project impacts.<sup>9</sup>

19. One of the two project benefit monitoring surveys<sup>10</sup> did collect some qualitative information on the impact of the bridges and culverts constructed under the Project, which included:

- (i) increased traffic volumes,
- (ii) reduction in travel times,
- (iii) improved drainage and reduced flooding,
- (iv) improved access to markets,
- (v) improved access to schools, and
- (vi) increased employment opportunities in that some farm laborers switched to rickshaw drivers.

20. However, no quantitative data are available to evaluate the economic impact of these changes, and while some of these benefits would be attributable directly to the roads structures constructed under the Project, some would also be due to the road sealing program that was ongoing at the same time. The approach that is followed therefore matches that of the appraisal and PCR, which both linked the road infrastructure improvement to the benefits being realized from the increased agricultural production generated by project activities. The only change adopted is as described in para. 11 above, in that only half of the road structure costs are offset against these particular benefits.

<sup>8</sup> Assumes 150 ha for each water control structure.

<sup>9</sup> One recent study has assessed the impact of upgrading Feeder Roads Type B, concluding that volumes of motorized and nonmotorized traffic increase significantly, goods traffic and passenger traffic numbers more than double, and unit costs of freight and passenger travel decrease. Bakht, Z. 2000. “Poverty Impact of Rural Roads and Market Improvement and Maintenance Project of Bangladesh”, Paper presented at the World Bank South Asia Poverty Monitoring and Evaluation Workshop, India Habitat Center, New Delhi. Bangladesh Institute of Development Studies. Dhaka.

<sup>10</sup> Kranti Associates Ltd. 1998. *Mid Term Review of Project Benefit Monitoring and Evaluation of North East Minor Irrigation Project*. Report to the Project of the Ministry of Agriculture. Dhaka.

#### **D. Economic Internal Rates of Return**

21. The EIRR that is re-estimated for the Project is 17%, compared with the 36% estimated at appraisal, and 15% estimated by the PCR.

22. The relatively high rates of return from the Project are not unexpected, given that the financial returns generated from private sector investment in STW technology have been assessed to be high, the variance between economic and financial costs in 2000 prices is not dramatic, and the non-STW component of Project's costs related only to the infrastructure and administration costs;<sup>11</sup> for example, the PCR estimated the financial internal rate of return for individual farmers who were direct or indirect beneficiaries in excess of 50%, which seems in line with the 52% estimated ex-post for diesel STWs in the World Bank's review of the performance of its National Minor Irrigation Development Project,<sup>12</sup> and the 40% and 61% financial returns estimated for STWs and LLPs respectively in the review of the Shallow Tubewell and Low Lift Pump Irrigation Project.<sup>13</sup> These high returns are no doubt the rationale behind the rapid expansion of STW technology across Bangladesh by private farmers (para. 4).

#### **E. Sensitivity Analysis**

23. The sensitivity of this result to the number of indirect beneficiaries has also been assessed—in the case where the flow-on demonstration impacts at a ratio of 1:3, as against the base case of 1:5, the EIRR falls to 10%. The actual demonstration effects of the Project, in terms of the rate at which the demonstration technologies are taken up by the other farmers in the project area, is therefore a key factor in the overall EIRR. In terms of the sensitivity of the re-estimated EIRR to prices, if grain commodity prices fall by 10%, the EIRR falls from 17% (base case), to 13%.

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<sup>11</sup> And that only 50% of road structure costs are offset against incremental agricultural production due to the Project.

<sup>12</sup> World Bank. 1998. National Minor Irrigation Development Project. ICR. Report No. 18035. Rural Development Sector Unit, South Asia Region.

<sup>13</sup> World Bank. 1996. Shallow Tubewell and Low Lift Pump Irrigation Project. ICR. Report No. 15492. Country Department I. South Asia Region.

Table A3.1: Number of Operational Tubewells by Project District and Year

District	1992–1993			1994–1995			1995–1996			1996–1997		
	STW	FMTW	LLP	STW	FMTW	LLP	STW	FMTW	LLP	STW	FMTW	LLP
Habiganj	298	143	1,801	411	155	2,043	564	120	2,120	716	92	2,472
Moulvibazar	5	8	273	6	2	389	11	3	530	36	3	647
Sunamganj	89	15	1,523	97	18	1,730	244	5	2,124	332	8	2,548
Sylhet	12	28	1,076	1	25	1,232	7	28	1,199	49	15	1,295
Netrakona	4,593	528	1,694	7,401	534	2,341	9,192	535	2,288	10,652	473	2,290
Kishoreganj	4,633	688	2,252	6,045	623	2,085	6,346	575	1,961	7,199	475	1,937
<b>Project Total</b>	<b>9,630</b>	<b>1,410</b>	<b>8,619</b>	<b>13,961</b>	<b>1,357</b>	<b>9,820</b>	<b>16,364</b>	<b>1,266</b>	<b>10,222</b>	<b>18,984</b>	<b>1,066</b>	<b>11,189</b>

District	1997–1998			1998–1999			1999–2000			2000–2001		
	STW	FMTW	LLP	STW	FMTW	LLP	STW	FMTW	LLP	STW	FMTW	LLP
Habiganj	870	94	2,740	1,221	104	2,831	1,362	86	2,746	1,482	87	2,948
Moulvibazar	46	3	677	62	4	783	89	0	798	77	0	885
Sunamganj	421	5	2,727	503	7	3,004	606	7	3,256	709	6	3,433
Sylhet	62	10	1,268	72	12	1,410	71	7	1,257	39	3	449
Netrakona	10,926	471	2,296	13,199	462	2,341	13,405	423	2,190	14,563	365	2,446
Kishoreganj	7,835	465	1,926	9,089	513	1,961	9,018	475	1,945	9,362	458	1,943
<b>Project Total</b>	<b>20,160</b>	<b>1,048</b>	<b>11,634</b>	<b>24,146</b>	<b>1,102</b>	<b>12,330</b>	<b>24,551</b>	<b>998</b>	<b>12,192</b>	<b>26,232</b>	<b>919</b>	<b>12,104</b>

FMTW = force mode tubewells , LLP = low lift pumps, STW = shallow tubewell.

Notes: Data are operating units. Tubewells are counted as pumpsets, not wells. On average, there are 1.04 wells per pumpset. No Census in 1993–1994.

Source: National Minor Irrigation Census of the National Minor Irrigation Development Project. Department of Agriculture and Extension, Ministry of Agriculture. June 2002.

**Table A3.2: Scheme Numbers and Irrigated Areas Used in Project Reevaluation**

Item	Unit	Year of Project						
		1	2	3	4	5	6	7
<b>Scheme Numbers:</b>								
Project Wells/Pumps	No./yr		85	190	250	232		
Water Control Structures	No./yr					1	1	2
Indirect Beneficiary STWs	No./yr			31	808	1,063	986	
<b>Irrigated Areas:<sup>a</sup></b>								
Project Wells/Pumps	ha/yr		289	646	850	789		
Water Control Structures	ha/yr					150	150	300
Indirect Beneficiary STWs	ha/yr			1,445	3,230	4,250	3,944	
<b>Total for Year</b>			<b>289</b>	<b>2,091</b>	<b>4,080</b>	<b>5,189</b>	<b>7,094</b>	<b>300</b>
<b>Cumulative Total</b>	<b>ha</b>		<b>289</b>	<b>2,380</b>	<b>6,460</b>	<b>11,649</b>	<b>15,743</b>	<b>16,043</b>

ha = hectare, No. = number, STW = shallow tubewell, yr = year.

<sup>a</sup> Four ha per pump in Project and indirect schemes and 150 ha per water control structure. Areas served by water control structures are included in the direct benefit category in the economic reevaluation. It is assumed that 85% of the tubewells installed under the Project are operational, and form the basis for the indirect beneficiary tubewell numbers and areas at a ratio of 1:5.

Source: Project records and project completion report and Operations Evaluation Mission estimates.

**Table A3.3: Input and Output Prices per Unit**  
(in taka)

Item	Unit	Financial	Economic
<b>A. Outputs</b>			
1. <b>Paddy</b>			
2. Aus LV B	kg	6.98	6.96
3. Aus LV	kg	6.88	6.96
4. Aus HYV	kg	6.79	6.79
5. Aman LV	kg	7.44	6.96
Amman HYV	kg	7.18	6.79
Boro LV	kg	6.98	6.96
Boro HYV	kg	7.12	6.79
Straw	kg	0.60	0.67
6. <b>Wheat</b>			
Ravi Wheat	kg	7.41	7.78
7. <b>Noncereals</b>			
Potato	kg	7.15	7.87
Oilseeds	kg	15.50	17.05
Pulses	kg	25.00	27.50
Vegetables	kg	8.21	9.03
Spices	kg	32.00	35.20
<b>B. Inputs</b>			
1. <b>Draft Power</b>			
Family	per day	95.00	85.50
Hired	per day	95.00	85.50
2. <b>Fertilizer</b>			
Urea	kg	6.25	6.47
TSP	kg	11.00	13.30
SSP	kg	8.00	10.20
MOP	kg	9.25	11.83
Manure	kg	0.40	0.44
3. <b>Investment</b>			
Share of Pump/Well	ha	10,000.00	11,100.00
4. <b>Seed</b>			
Paddy (Local)	kg	16.00	17.79
Paddy (HYV)	kg	20.00	22.20
Wheat	kg	15.00	16.65
Potato	kg	12.00	13.32
Spices	kg	50.00	55.50
Oilseeds	kg	20.00	22.20
Pulses	kg	30.00	33.30
Vegetables	kg	1,000.00	1,110.00
5. <b>Plant Protection</b>			
Granular	kg	100.00	110.00
Powder	kg	150.00	165.00
Liquid	kg	200.00	220.00
6. <b>Irrigation</b>			
Irrigation-Aus	ha	2,000.00	2,220.00
Amman	ha	1,500.00	1,665.00
Boro	ha	1,800.00	1,998.00
Wheat	ha	900.00	999.00
Tubers	ha	1,200.00	1,332.00
Spices	ha	1,150.00	1,276.50
Other <sup>a</sup>	ha	2,000.00	2,220.00
7. <b>Other</b>			
Hired Labour	per day	70.00	61.60
Power Tiller	hr	100.00	111.00
Sundry <sup>b</sup>	lump sum	1,000.00	1,110.00
8. <b>Labor</b>			
Family	per day	70.00	61.60

ha = hectare, HYV = high-yielding variety, kg = kilogram, LV = local variety, LVB = local variety boro, MOP = potassium chloride, SSP = sulphur superphosphate, TSP = triple superphosphate.

<sup>a</sup> Includes oilseeds and vegetables.

<sup>b</sup> Bags, etc.

Source: Project Impact Evaluation Study and project completion report and Operations Evaluation Mission estimates.

**Table A3.4: Economic Internal Rate of Return**  
(in million taka at constant 2000 values)

Item	Year of Project																			
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
<b>II. Economic Benefits</b>																				
Drop Margins-																				
Direct Beneficiaries <sup>a</sup>	—	0.91	1.12	7.11	20.22	44.47	68.25	96.55	108.38	113.82	117.50	117.50	117.50	117.50	117.50	117.50	117.50	117.50	117.50	117.50
Indirect Beneficiaries <sup>a</sup>	—	—	(18.55)	(30.59)	(11.55)	48.26	173.68	230.36	270.71	291.22	291.22	291.22	291.22	291.22	291.22	291.22	291.22	291.22	291.22	291.22
<b>Subtotal (A)</b>		0.91	(17.43)	(23.48)	8.67	92.74	241.93	323.91	379.09	405.04	408.72	408.72	408.72	408.72	408.72	408.72	408.72	408.72	408.72	408.72
Decay Series Adjustment <sup>b</sup>									0.0	0.01	0.04	0.11	0.25	0.45	0.66	0.84	0.94	0.98	1.00	1.00
<b>Subtotal (B)</b>		0.91	(17.43)	(23.48)	8.67	92.74	241.93	323.91	378.74	401.31	392.95	363.09	306.41	226.58	138.82	66.50	24.93	6.36	0.38	
<b>III. Economic Costs</b>																				
Project Costs <sup>c</sup>	17.36	314.38	556.28	211.32	198.93	108.70	25.94													
Adjusted Costs <sup>d</sup>	16.98	178.56	323.00	138.98	144.99	68.88	25.70													
Equipment Replacement <sup>e</sup>								45.00						90.00						
Bridge/Culvert Maintenance <sup>f</sup>						16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07
<b>Subtotal (C)</b>	16.98	178.56	323.00	138.98	144.99	84.95	41.78	61.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07	16.07
<b>Net Benefits</b>	<b>(16.98)</b>	<b>(177.65)</b>	<b>(340.42)</b>	<b>(162.46)</b>	<b>(136.32)</b>	<b>7.79</b>	<b>200.15</b>	<b>262.84</b>	<b>362.67</b>	<b>385.24</b>	<b>376.88</b>	<b>347.01</b>	<b>290.33</b>	<b>120.51</b>	<b>122.74</b>	<b>50.43</b>	<b>8.86</b>	<b>(9.71)</b>	<b>(15.69)</b>	<b>(16.07)</b>
IRR		17%																		
PV @ 12%		192																		

- = not available, EIRR = economic internal rate of return, NPV = net present value.  
 Based on farm models developed for both beneficiary groups using FARMOD.  
 Adjustment to project benefits as shallow tubewell technology diffusion occurs in the area in the without-Project scenario.  
 Total project costs in economic prices.  
 Treats half of road infrastructure costs as directly attributing to incremental agricultural production.  
 Primarily engines and pumps. Six to 8 year life assumed with cost of Tk20,000 per installation, net of residual value.  
 Three percent of investment cost covering both regular and periodic maintenance.  
 Source: Project completion report and Operations Evaluation Mission estimates.

**Table A3.5: Crop Yields**

<b>Crop</b>	<b>Unit</b>	<b>Present</b>	<b>Future With Project</b>
<b>A. Cereals</b>			
1. Aus Local	t/ha	1.63	2.50
2. Aus HYV	t/ha	2.72	4.50
3. Amman HYV	t/ha	3.00	4.50
a. Boro Local	t/ha	2.21	3.50
b. Boro HYV	t/ha	3.60	4.20
c. Wheat	t/ha		1.84
<b>B. Others</b>			
1. Potato	t/ha		13.90
2. Oilseeds	t/ha	0.64	2.50
3. Pulses	t/ha	0.67	
4. Vegetables	t/ha	6.90	9.30
5. Spices	t/ha		2.90

HYV = high-yielding variety, t/ha = ton per hectare.

Source: Project Impact Evaluation Study and Operations Evaluation Mission estimates.

**Table A3.6: Cropping Patterns With and Without the Project**  
(for a crop year beginning in April and ending the following March)

Item	Unit	Direct Beneficiary Model			Indirect Beneficiary Model		
		Present	Future Without	Future With	Present	Future Without	Future With
		1	4	4	1	4	4
<b>Cropping Intensity</b>	Percent	140	142	216	140	142	210
<b>Cropping Pattern under:</b>							
<b>A. Existing Technology</b>							
Aus HYV T'plant	ha	0.10	0.40	—	0.10	0.40	—
Amman LV T'plant	ha	0.90	0.30	—	0.90	0.30	—
Amman HYV T'plant	ha	—	0.22	—	—	0.22	—
Boro HYV T'plant	ha	—	0.18	—	—	0.18	—
Potato	ha	—	0.23	—	—	0.23	—
Spices	ha	—	0.01	—	—	0.01	—
Oilseeds	ha	0.01	—	—	0.10	—	—
Pulses	ha	0.05	—	—	0.05	—	—
Vegetables	ha	—	0.06	—	—	0.06	—
<b>Subtotal (A)</b>	<b>ha</b>	<b>1.40</b>	<b>1.42</b>	<b>—</b>	<b>1.40</b>	<b>1.42</b>	<b>—</b>
<b>B. New Technology</b>							
Aus HYV T'plant	ha	—	—	0.49	—	—	0.49
Amman LV T'plant	ha	—	—	0.41	—	—	0.41
Amman HYV T'plant	ha	—	—	0.41	—	—	0.41
Boro LV T'plant	ha	—	—	0.13	—	—	0.13
Boro HYV T'plant	ha	—	—	0.14	—	—	0.35
Wheat	ha	—	—	0.02	—	—	0.02
Potato	ha	—	—	0.16	—	—	0.02
Spices	ha	—	—	0.06	—	—	0.06
Oilseeds	ha	—	—	0.02	—	—	0.20
Pulses	ha	—	—	—	—	—	—
Vegetables	ha	—	—	0.15	—	—	0.02
<b>Subtotal (B)</b>		<b>—</b>	<b>—</b>	<b>2.16</b>	<b>—</b>	<b>—</b>	<b>2.10</b>
<b>Total Cropped Area</b>		<b>1.40</b>	<b>1.42</b>	<b>2.16</b>	<b>1.40</b>	<b>1.42</b>	<b>2.10</b>

— not available, ha = hectare, HYV = high-yielding variety, LV = local variety, LVT = local variety transplant.  
Source: Project Impact Evaluation Study and Operations Evaluation Mission estimates.



## SOCIOECONOMIC IMPACTS

### A. Socioeconomic Profile of the Project Population

1. The six northeastern districts under the Project (Sylhet, Moulvibazar, Sunamganj, Habiganj in the greater Sylhet region, and Kishoreganj and Netrakona in greater Mymensingh) have a population of about 11 million, according to the Bangladesh Bureau of Statistics, 2000. The density of rural population is around 600 per square kilometer. The average intensity of cropping for the year 1999-2000 was 146% and 166% for overall Sylhet and Mymensingh districts, respectively, which is lower than average intensity (175%) of the country. Small farm families, particularly, of the four districts (Sunamganj, Habiganj, Kishoreganj, and Netrakona) are more keen to develop agriculture through practices of modern and commercial crop varieties that require irrigation. Those of the remaining two districts have a tenancy pattern with more absentee farmers than the other four districts have. About 85% of the project households depend on agriculture for food and livelihood. As for the poverty situation, the headcount index (percentage of population living in households with a consumption per capita that is below the poverty line, i.e., 2,112 calories per person per day) and the human poverty index (percentage of people deprived of health, knowledge, and overall economic provisioning) are at varying levels, as shown in Table A4.1. The headcount index is highest in the Sylhet and Netrakona districts, while the human poverty index is highest in Sunamganj. The other three districts under the Project are rated almost the same under both the indicators.

**Table A4.1: Poverty Indexes for the Project Districts**

<b>Name of Project District</b>	<b>Value of Head Count Index</b>	<b>Value of Human Poverty Index</b>
Sylhet	45 – 50	35 – 40
Sunamganj	40 – 45	40 – 45
Moulvibazar	30 – 35	35 – 40
Habiganj	40 – 45	35 – 40
Kishoreganj	40 – 45	35 – 40
Netrakona	45 – 50	35 – 40
<b>Bangladesh</b>	<b>40 – 45</b>	<b>35 – 40</b>

Source: Bangladesh Poverty Analysis: Trends, Policies and Institutions, Binayek Sen, February, 2000.

### B. Impact on Socioeconomic Aspects

2. The Project has helped large, medium, and small farmers to unite for a common interest: minor irrigation with shallow tubewells (STWs) or water retention structures. Relatively well-off farmers have contributed the larger part of the Tk5,000 cost for drilling the wells and holders of relatively small plots contributed a smaller part. This informal sharing of initial cost has been a good practice that would not have occurred without the Project. Informal dissemination of knowledge and skills around new production and irrigation technology through farmers' kinship networks has been another good practice due to the Project.

### C. Impact on Agricultural Production

3. The Project has enhanced the yield levels of winter crops that have been receiving irrigation water from STWs and water retention structures. The increase in yields of major crops are shown in Table A4.2.

**Table A4.2: Yields of Major Crops**

<b>Major Winter Crops Fed by Shallow Tubewells</b>	<b>Yield Before Project (t/ha)</b>	<b>Yield After Project (t/ha)</b>
Local Variety Boro Paddy	2.2	3.5
High-Yielding Boro Paddy	3.6	4.2
Wheat	1.2	1.8
Potato	12.5	13.9
Spices	2.0	2.9
Vegetables	6.9	9.3

t/ha = ton per hectare.

Source: Project Completion Report, November 2001 and Operations Evaluation Mission, 2002.

4. The increase in yields has helped improve crop production for the farm families. Production of high-value vegetables has raised the income of farm families above what would have been possible through traditional paddy production.

#### **D. Impact on Production, Income, and Poverty**

5. The Project could not address poverty directly, as the micro-credit initiative originally designed for supporting the poor farmers in procuring the STW and other high-yielding variety input packages did not materialize. But the Project has indirectly improved the production environment and farmers' capacity to cultivate high-yielding boro paddy and high-value crops in winter.

6. The average size of landholding in the project area is 0.86 hectare (ha). It appeared during interviews with farmers in Sylhet, Habiganj, and Moulvibazar areas that one STW-group (having 4 ha command area, on average) consists of 5–10 farm-families. So, small farmers are included in such groups to be benefited by irrigated agriculture. Net financial farm revenue from the winter crops, including rice (for which STWs are mostly used) is around Tk17,000 per ha. Field interviews by the Operations Evaluation Mission (OEM) with farmers in Moulvibazar (Kamalganj village) show that production of vegetables (particularly cabbage, tomato, sweet pumpkin, and cauliflower) yield twice the income of rice production. The Project's impact on the intensity of cropping is positive. While the district average is 146% and 166% for Sylhet and Mymensingh (for 1999–2000), the project area's average is 210%. The estimates of the project completion report (2001) and the Impact Evaluation Study (which are confirmed by the OEM) show that returns to family resources are higher (Tk34,000 per 1 ha per annum) in 2001 than that estimated during appraisal (converted into 2000 taka values). With an incremental requirement of 20 human labor-hours per ha for boro production<sup>1</sup> in the project area (benefited area for project-financed STWs is 3,931 ha of which 80% is under boro rice), the contribution of the Project to increasing the income of the poor laborers is approximately Tk4.5 million. (The wage rate is Tk70 per day per laborer). Total incremental labor-days is 62,000 due to the Project. As a result of demonstration, farmer-financed STWs also have a positive impact on this wage income of the poor households. An additional 37,416 ha provides an additional employment opportunity for about 750,000 person-days during rabi season only. So, besides providing access to additional food production, the project-induced increase in labor demand for high-yielding crops has deep implications for poverty reduction locally.

<sup>1</sup> Table 5.7, Evaluation Study Report, Implementation, Monitoring and Evaluation Division, 2001.

7. Regular monitoring of the poverty situation of the poor farmers in the STW groups would help in assessing the poverty reduction impact of the Project. In terms of calorie intake, the headcount index is expected to come down gradually.

#### **E. Enhanced Market Accessibility**

8. Improved market access for farmers and project district residents in general has been a direct impact of the Project. Construction of 1,409 bridges and culverts and eight pontoons at different river-crossing locations has provided market access for farmers, particularly those producing high-value crops. Bulk transportation of surplus production to distant markets for a fair price is facilitated by the new infrastructure. Moreover, the information network to help the disadvantaged groups (such as day laborers and destitute women) avail themselves of higher wages and employment opportunities at even distant locations has improved through such road access.

#### **F. Demonstration Effect**

9. Under the Project, 250 demonstration farms were established. The immediate effect of practical demonstrations of the new technology, test-borings, and field days attended by as many as 4,000 farmers was good. The size of most of the demonstration farms was about 4 ha, while farmers involved in each such farm were 7–20 in number. The Project provided input support for only 1 ha of each demonstration farm. Additional training was provided in Bogra. Farmers were particularly motivated by the idea of producing high-value crops instead of rice only. The trend is still positive, because the Government took interest in continuing the services by retaining Department of Agricultural Extension personnel under an arrangement known as the “bridging period,” which ended in June, 2002. The positive socioeconomic impacts of these activities have to be taken forward so that the momentum of improvements for small farmers through the Project is not lost.

#### **G. Equity and Sustainability of Water Use**

10. Groundwater from the STWs of the Project is being utilized equitably by the farmers. Equitability is ensured by the demand-driven receipt of water from a particular STW by using the engine procured privately by the concerned individual farmers. The surface water from the water retention structures of the Project is received by gravity through collectively dug narrow channels along the beneficiaries' plots of land. Differences in the availability of water between head, middle, and tail of the channel may remain at this stage. Appropriate water users' associations have to be formed to ensure equitable access. Sustainability will depend upon proper operation and maintenance of the infrastructure for which adequate funding and technical know-how must be ensured. The OEM observed that the mechanics for repair of STWs are not easily available in the vicinity.